Project:	*Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment*
Project ID:	*240009*
Date:	*17th September 2024*
To:	*Warren Smith Consulting Engineers*
Subject:	***Australian Turf Club Non-Race Day Events SSDA – Stage 2 Flood Risk Assessment***
Version:	*Version 4 (Final – Issued for SSDA)*
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1. Introduction

This flood risk assessment has been prepared by GRC Hydro Pty Ltd (GRC Hydro) to accompany a detailed State Significant Development Application (SSDA) for the Australian Turf Club Limited (the applicant) at the Royal Randwick Racecourse (the site). The site is legally described as Lot 2009 in Deposited Plan 1169042 and the purpose of this SSDA is for the use of sections of the site to accommodate a number of non-race day events.

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the project (SSD-63536466) on the 14/11/2023. The focus of the flood risk assessment is on the flooding aspects of the issued SEARs, including the flood risk assessment and for input into the Draft Emergency Evacuation Plan.

This Stage 2 report presents the full flood risk assessment based on the Flood Risk Management Manual (DPE 2023) and guidelines from the Flood Risk Management Toolkit (DPE 2023) to accompany the SSDA. The report layout is as follows:

- Section 1: Introduction of the site, the proposal and overview of flood behaviour.
- Section 2: Development of the 2D flood model for assessing the existing flood behaviour.
- Section 3: Presentation of results for the existing flood behaviour, including inundation depths, peak flood levels, velocities, hazard categories and flood function for a wide range of flood events up to and including the PMF. Mapped results are presented in Figure Set A in Volume 2 of this report.
- Section 4: Development of a scenario representing a 'worst-case' non-raceday event and the resultant impacts on the existing flood behaviour. Mapped results are presented in Figure Set B in Volume 2 of this report.
- Section 5: A detailed flood risk assessment based on the results from Sections 3 and 4, which includes discussion on evacuation potential and emergency management. A draft emergency management plan is presented in Volume 3 of this report.
- Section 6: Details the SSDA full compliance with the issued SEARs.

1.1 The Site

The site is located at Royal Randwick Racecourse, which is legally described as Lot 2009 in Deposited Plan 1169042. The site has an area of 79.93 hectares and is identified in Image 1.

The site is located approximately 6 km south-east of the Sydney Central Business District (CBD) and is located within the Randwick local government area (LGA).

The site is broadly located between Anzac Parade and Alison Road in Randwick. Specifically, the site is bound by Alison Road to the north, Wansey Road to the east, High Street and part of Anzac Parade to the south, and the rear of residential dwellings fronting Doncaster Avenue along the western site

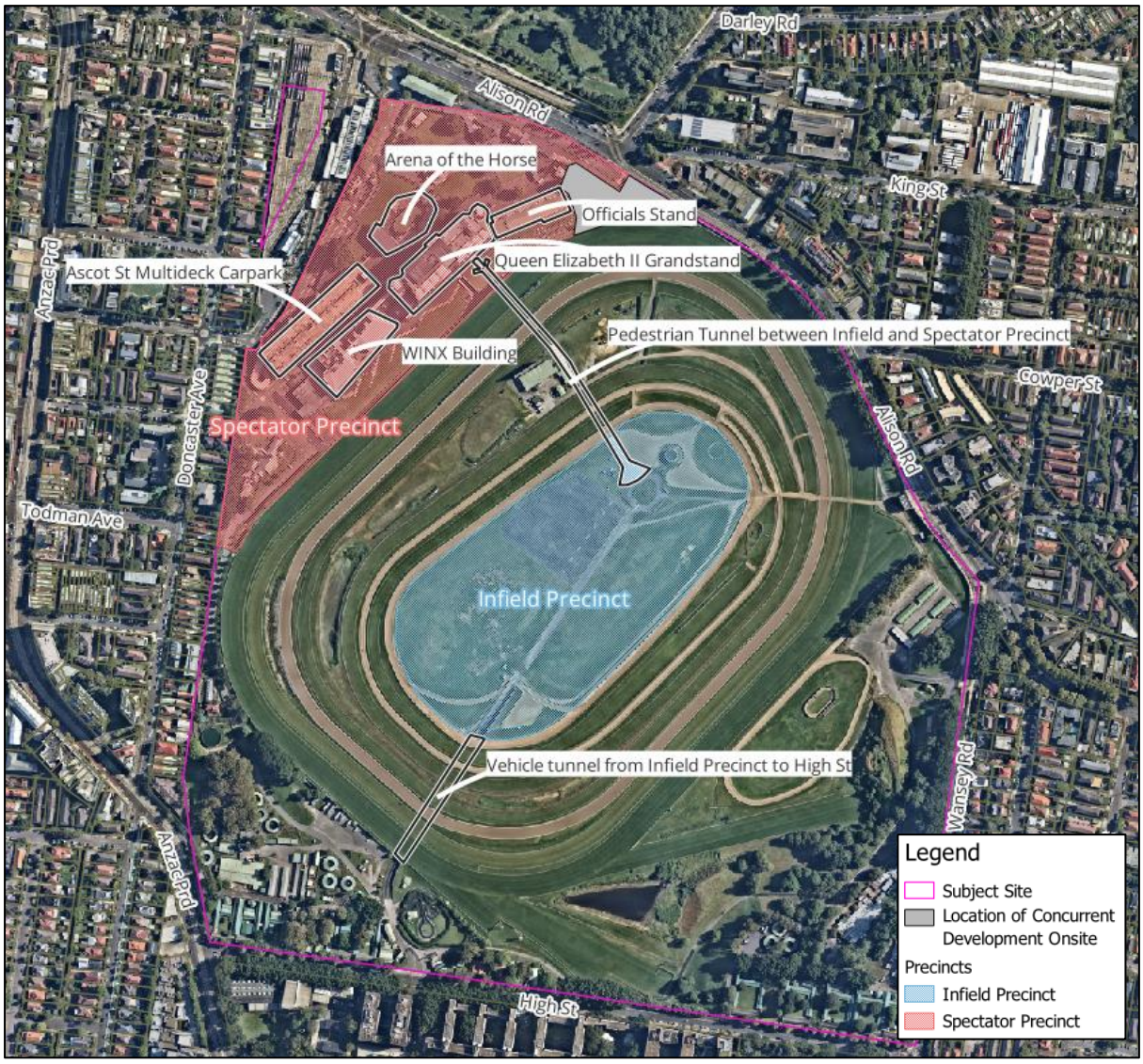
boundary. A portion of land occupied by Transport for NSW (TfNSW) for the CBD and South-East Light Rail (light rail) stabling and maintenance yard adjoins the site to the north-west.

Two areas within the site are relevant to this project. The Spectator Precinct accommodates Royal Randwick's spectator, entertainment and convention facilities, and comprises a concentration of buildings/structures. The Infield Precinct comprises of a parking area and several fenced turfed areas.

Underground connections are located all over the site including a pedestrian tunnel connecting the Spectator and Infield Precincts, a vehicle tunnel from the Infield Precinct connecting to High Street in the south and several tunnels within the Spectator precinct connecting the multideck carpark, horse arena and providing access under the Queen Elizabeth II Grandstand to the racetrack.

Concurrent works are occurring onsite in SSD-38019507 in the area east of the Spectator Precinct as indicated on Image 1. This development is not part of the Spectator Precinct or this SSDA application. Further detail provided in Section 1.4.

Image 1: Subject Site



1.2 The Proposal

This application seeks approval for the use of land and buildings within the Spectator Precinct and the Infield Precinct of the Royal Randwick Racecourse for various non-race day events.

The accommodation of non-race day events on the site is consistent with the historical use of the site as a *recreation facility (major)* and the broader event character of the site. The site has accommodated a number of non-race day events under previous approvals, and this application seeks to continue the ongoing use of the site for this purpose.

Table 1: Proposed scope

Parameter	Proposal
Location	Events will be held in the Spectator Precinct (all events)
Number of events	10 per annum
Patronage	5,000 – 15,000
Hours of operation	Event hours: • Monday – Thursday: 10am – 8pm • Friday, Saturday, Sunday or public holiday: 10am – 10:30pm Bump in and bump out may occur between 6am – 1am the following day for a maximum of 10 days prior to and following the event. Works will only be undertaken outside of these hours if required in an emergency to avoid the loss of life, damage to property, prevent traffic conflicts and / or prevent environmental harm.
Type of events	Non-race day events may include a range of community events, private and corporate events/functions, festivals, cultural / art events, markets, and consumer roadshows.
Event duration	The duration of events will be between 1 – 2 days (consecutive days). No event will continue for more than a consecutive 2-day period (excluding bump-in and bump-out procedures).

1.2.1 Event Location

Events will be accommodated within the land and buildings of the Spectator Precinct (all events). The nominated event locations are illustrated in the Site Activation Plans prepared by MI Consultants.

The detailed layout and site design within these precincts will vary depending upon the type of event and the individual event operator.

Events will not be permitted within the Stables Precinct on the south-eastern corner of the site adjacent to High Street and Wansey Road. However, pedestrian and vehicular access routes to activated areas may be provided through this precinct from High Street.

1.2.2 Temporary Structures

The proposal involves the erection of ancillary temporary structures including stages, marquees, screens, amenities, and lighting to support the non-race day events. The proposed temporary structures will be:

- erected in the days preceding the events and dismantled and removed from the site within 10 days following the event,
- positioned on a level stable surface and sufficiently weighted to ensure stability at all times of use,
- monitored throughout the duration of the event to ensure any potential safety concerns (such as during adverse weather conditions) are mitigated by the applicant,

- erected in accordance with the relevant provision of the Building Code of Australia (BCA) and Australian Standards to ensure the structures can adequately support the proposed loads,
- managed to ensure the number and width of exits and maximum number of people permitted in the temporary structures is in accordance with the provisions of the BCA,
- wholly located within either the Spectator Precinct or the Infield Precinct, and
- carried out to ensure that there is no damage to the site, including existing structures and landscaping elements.

A potential layout of temporary structures to support a non-race day event on the site is illustrated in the Technical Layout Plan prepared by MI Event Consultants. This is for information purposes only and represents a 'worst case' scenario. The specific layout and type of temporary structures will be determined by the event type and operator.

Temporary structures that could be erected on the site to support a non-race day event includes:

- Stages located in the Spectator Precinct, in addition to the main spectator zone adjacent to the QE II Stand and Winx Stand.
- Food, bar, amenities and supporting merchandise and administration stalls within the Spectator Precinct.
- Artist back of house in the Spectator Precinct.
- Staff, security and safety marshalling areas within the Spectator Precinct.

1.2.3 Site Access and Parking

Existing drop-off facilities will be utilised for events, in accordance with a standard race-day operation. This includes:

- Taxi Rank via Ascot Street, Gate 18
- Public Bus layby via Alison Road
- Shuttle drop-off via Alison Road, Gate 1
- Limousine, and large shuttle/coach drop off
- A managed pedestrian exit will be provided from Gate 18 (Ascot Street) after 8pm

On-site parking will be available within the multi-deck car park and the infield car park. Patrons will be encouraged to utilise public transport and active transport for access to and from events.

1.2.4 Event Management

A draft Operational Management Plan (OMP) has been prepared to outline the intended management and operation of the non-race day events on the site. The draft OMP will be supplemented by the following:

- Traffic Management Plan,
- Waste Management Plan,
- Noise Management Plan,
- Alcohol Management Plan,
- Security Management Plan,
- Consultation Plan, and
- Draft Emergency Evacuation Plan.

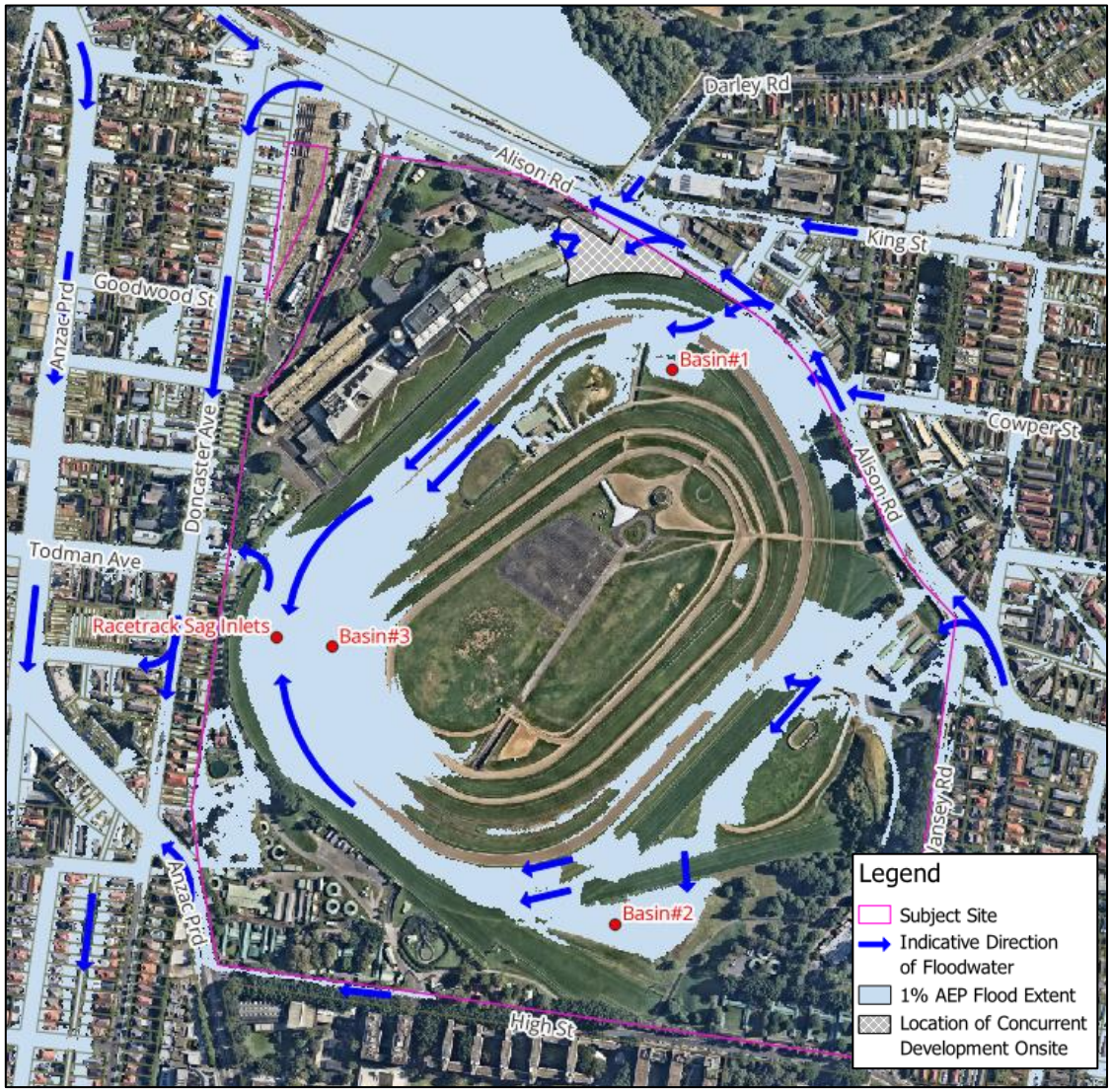
These management plans have been appended to the Environmental Impact Statement (EIS).

1.3 Flood Behaviour

The site is located outside of any mainstream creeks or channels with flood behaviour characterised by overland flow incoming from the east. As shown in Image 2, Alison Rd conveys floodwater from the east, with some floodwater spilling into the racetrack and the eastern corner of the Spectator precinct. Channels located between the racetracks convey floodwater to the south-western extent of the racetrack which acts as a floodwater storage area. Three basins are also located on the site providing additional floodwater storage.

Outflow from the site occurs through the sag inlets located in the racetrack, which discharge into Council stormwater assets to the west in Anzac Prd. In rare flood events there can be overland flow into Doncaster Ave and Anzac Prd from the racetrack when the storage capacity of the site is exceeded. The northmost tip of the Spectator Precinct experiences some overland flow from Alison Rd in very rare events.

Image 2: Overview of existing flow paths

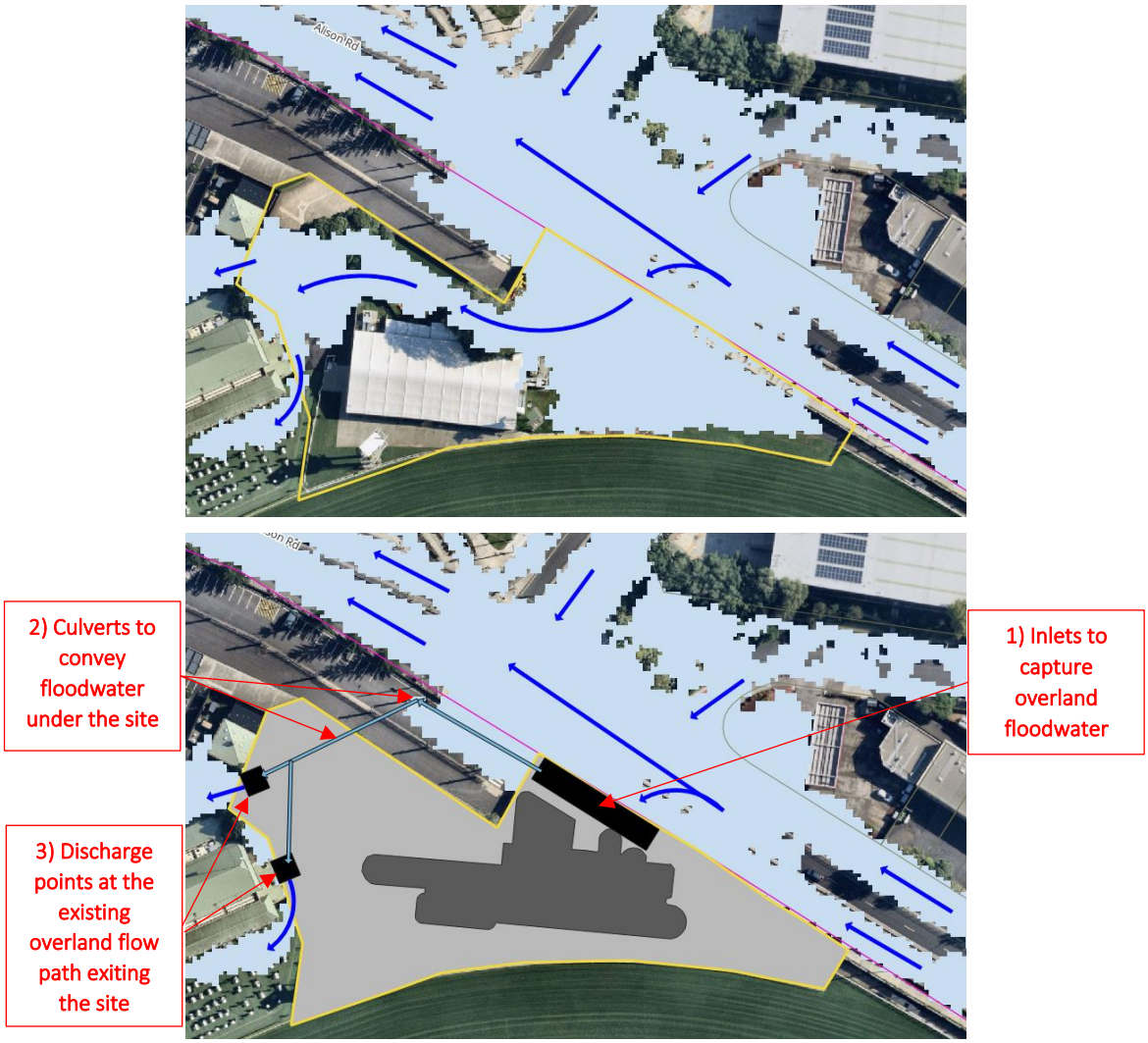


1.4 Concurrent Development

Concurrent works for a hotel development are occurring onsite in the area indicated in Image 1 and Image 2. The concurrent development is for SSD-38019507 which involves replacing the existing marquee with a multi-storey hotel. As the proposed hotel blocks the overland flow that currently occurs through the concurrent works site, a stormwater network is proposed as part of the concurrent development to convey floodwater under the building. The concept is shown in Image 3. The concurrent development aims to match the existing overland flowpath site discharge so as to not change flood conditions outside of the development area.

The concurrent works are still under development and not available for this flood risk assessment. However, as the concurrent works propose to maintain the existing discharge locations it is expected to have minimal impact on the outcomes of this flood risk assessment, but it could create minor changes to the flooding results entering the Spectator Precinct and site from this location. This has been indicated when it occurs, and further discussion of any risks due to this assumption are discussed in Section 5.

Image 3: Concept for concurrent site development SSD-28019507 with Pre-development flowpaths (top) and Post-development flowpaths (bottom)



1.5 Consultation Outcomes

The NSW SES were consulted for feedback on the outcomes of the draft flood risk assessment and draft emergency management plan. They offered advice which was received on the 27th May 2024, as per below:

NSW SES:

1. Reiterate that severe weather and flood warnings are to be checked prior to the start of each workday and staff and visitors advised not to attend the site in the event of current warnings.
2. Reiterate that flooding emergency plans should be regularly exercised, similar to building fire evacuation drills. The NSW SES also recommends updating the FERP at regular intervals and whenever additional flood information is available or highlighted during the drills or flood events.
3. Recommend that any proposed refuge location is above the height of the PMF, and aligns with the Red Cross Preferred Sheltering Practices for Emergency Sheltering in Australia, including water supply, waste management, sanitation, food, and shelter and space management.
4. Recommend, where possible, consulting with Transport for NSW on the impacts of flooding on people evacuating the site during or after a flood event.

Items 1 and 2 have been incorporated into the draft emergency management plan in Volume 3. Item 3 has been addressed and discussed in the risk assessment in Section 5 and Item 4 is a recommended outcome from this report and included in the conclusion.

1.6 Reference Documents and Information

In the course of undertaking this flood risk assessment, GRC Hydro has relied upon the following documentation and materials:

- SSDA Documents
  - *Temporary Structures Plan, MIGP 2024*
    Royal Randwick / Spectator Precinct – Temporary Structures Plan / 5,000-15,000 Capacity, MI Global Partners, Site Plan 2, 10th June 2024;
- Council Flooding Information
  - *FPRMS&P, WMAWater 2019*
    Kensington – Centennial Park Floodplain Risk Management Study and Plan, WMAWater, 2019;
  - *FS, WMAWater 2013*
    Kensington – Centennial Park Flood Study, WMAWater, 2013;
  - *Council TUFLOW model*
    TUFLOW models provided to GRC Hydro by Randwick City Council from the FPRMS&P, WMAWater 2019 and FS, WMAWater 2013 (received Mar, 2024);
- Council Planning Documents
  - *DCP 2013*
    Randwick Comprehensive Development Control Plan 2013, Royal Randwick Racecourse, Water Management B8, Section 5 – Flooding;
  - *LEP 2012*
    Randwick Local Environmental Plan 2012 (2013 EPI 36), Part 5, Section 5.21 – Flood Planning;

- NSW State Government Flood Guidelines
    - *NSW Flood Manual, DPE 2023*
      NSW Flood Risk Management Manual, Department of Planning and Environment, NSW Government, 2023;
    - *LU01, DPE 2023*
      Flood impact and risk assessment - Flood risk management guideline LU01, Department of Planning and Environment, NSW Government, 2023;
    - *EM01, DPE 2023*
      Support for Emergency Management Planning - Flood risk management guideline EM01, Department of Planning and Environment, NSW Government, 2023; and
    - *FB01, DPE 2023*
      Understanding and managing flood risk - Flood risk management guideline FB01, Department of Planning and Environment, NSW Government, 2023.

2. Flood Modelling Approach

The TUFLOW 2D flood model from the Randwick City Council's (Council) FPRMS&P (WMAWater 2019) forms the basis for this assessment. This model was provided by Council to GRC Hydro in March 2024 and is henceforth referred to as the 'Council TUFLOW Model'. It is estimated the Council TUFLOW model represents catchment conditions as they were in the year 2013 but with light rail from 2019.

Notably there is recent catchment information and new developments missing from the Council TUFLOW Model pertinent to representing current catchment conditions for the site including:

- Updated LiDAR terrain elevations (2020)
- The completion of the WINX Stand in the Spectator Precinct (2021/2022)
- The Ascot Street Multideck Carpark (2017/2018)
- TAFE NSW Randwick construction (2020)
- Tram Sheds off Alison Rd (2019)
- The Council TUFLOW model does not include stormwater assets or the underground connections within the site.

To accurately represent current catchment conditions, the Council TUFLOW Model was updated to an 'Existing Conditions' TUFLOW Model which includes the missing items above.

2.1 Existing Conditions TUFLOW Model

The TUFLOW model was refined for the local area of the site to produce a revised Existing Conditions model which better represents current catchment conditions. Details of the amendments made to the Council TUFLOW model to produce the Existing Conditions TUFLOW model are shown in Image 4 and described below:

- TUFLOW version '2016-03-AE' was used with implementation of the 'Classic' solver. The Council TUFLOW model utilises the '2016-03-AC' TUFLOW version with 'Classic' solver. The version update reflects bug fixes between AC and AE versions.
- The model topography of the site was updated to use 2020 LiDAR downloaded from the 'Elevation and Depth – Foundation Spatial Data' (ELVIS) website on the 12th March 2024 and added to the Council TUFLOW model for the site area. This captures terrain updates from the developments, has sufficiently high resolution to include the drainage channels within the site and captures the basin topography.
- Building extents were updated to reflect current catchment conditions based on available aerial imagery. Building extents are coded out by using a '2d_bc' layer with the code flag, which fully removes the building from conveying overland flow and is consistent with the approach used in the Council TUFLOW Model.
- Underground connections were included for:
    - The pedestrian tunnel connecting the Infield and Spectator Precincts;
    - The horse tunnel under the Queen Elizabeth II Grandstand providing access between the Theatre of the Horse and the racetrack;
    - The tunnel between the Ascot Street Multi-Deck Carpark and the Theatre of the Horse; and
    - The vehicle tunnel from the Infield Precinct to High Street.

  These connections were based off the survey plans (Rygate, Oct 2021)[1] received through correspondence with Warren Smith Consulting Engineers (WSCE) on 20th Feb 2024, and the use of site photos. These were implemented in the 1D domain as a '1d_nwk' rectangular culvert.

[1] 'Plan, Showing Compilation of Survey Plans, Lot 2003 DP1169042, Lot 1642 DP752011, Lot 1588 DP(7949-2030), Randwick Racecourse' (Rygate, Oct 2021)

- The stormwater was implemented based off the survey plans (Rygate, Oct 2021) received through correspondence with WSCE on 20th Feb 2024. Conduit attributes, pit blockage factors and model implementation are consistent with the approach used in the Council TUFLOW Model.
    - Conduits with headwall structures rather than a pit inlet were updated to use blockage factors consistent with the ARR2019 within the site only. Where this would result in a lower blockage factor than methods used in the Council TUFLOW Model, blockage was updated to use the Council TUFLOW model value. No changes were made to structures outside of the site. The resultant blockage factors are given in Table 2.

Table 2: ARR2019 culvert blockage factors for Existing Conditions

Structure Diameter (m)	Sag or On-grade	1% AEP debris potential	Calculated Blockage Factor (%)		
			>5% AEP	5% AEP to 0.5% AEP	<0.5% AEP
0.375	On-grade	Low	25	25	50
	Sag	Low	50	50	50
0.750	On-grade	Low	25	25	50
	Sag	Low	50	50	50

- Fences along the northern and north-eastern boundaries of the site were updated to reflect changes since the completion of the light rail. This involved extending the '2d_lfcsh' layer from the Council TUFLOW model to cover the full north to north-eastern extent of the site and replacing sections which were represented as complete flood obstructions but are now open fencing.
- The model has a single inflow location for the racetrack which represents the subcatchment covering the whole racetrack. This was updated from applying this flow to the vehicle tunnel entrance in the Infield Precinct, to applying flow at the racetrack sag inlets. This change more accurately represents the flow of floodwater on the racetrack being conveyed by the channels to the sag inlets, which is the dominant flood behaviour for the subcatchment.

All other items were retained as per the Council TUFLOW Model including:

- The 2-metre model grid resolution and 2D model extent were retained.
- Surface roughness values for the Manning's 'n'.
- Initial and continual losses applied to the model.
- Rainfall inflows use the Council TUFLOW model rainfall, which is derived from a DRAINS model based on Australian Rainfall and Runoff (ARR) Guidelines 2016.
    - ARR2016 had subsequent updates in ARR2019, however a cross check between IFD data retrieved March 2024 and the IFD tables in Appendix B of the FPRMS&P (WMAwater 2019) show a perfect match with cell coordinates 33.8875 (S), 151.2375 (E) suggesting the ARR2016 and ARR2019 rainfall is unchanged for the model area.
- Critical durations were retained, using the events, durations, and temporal patterns in Table 3.

Table 3: Critical durations

Event	Storm 1		Storm 2	
	Duration	Temporal Pattern	Duration	Temporal Pattern
10% AEP	1 hr	TP10 - 4567	NA	NA
1% AEP	1 hr	TP08 - 4559	12 hr	TP08 - 4785
0.5% AEP	1 hr	TP08 - 4559	12 hr	TP08 - 4785
0.2% AEP	1 hr	TP08 - 4559	12 hr	TP08 - 4785
PMF	1 hr	GSAM	NA	NA

- Blockage factors, with a 20% blockage of on-grade stormwater inlets and a 50% blockage of sag inlets.
- Stormwater drainage assets outside of the site.

Image 4: Updates to create the 'Existing Conditions' TUFLOW model.



2.1.1: Probable Maximum Flood (PMF) Updates

Certain model inputs needed for the PMF event weren't available in the handover provided by Council to GRC Hydro. These were files used to provide stability in the 2D flood model for the PMF event and for the application of rainfall to the catchment.

Based on the list of files from the TUFLOW control files, the missing inputs included:

- '2d_mat' files for updating material layers to provide stability in the PMF event.
- Several '1d_bc' and '2d_sa' layers that apply the DRAINS rainfall to the 1D and 2D domains.
- The 'bc_database' used to connect the provided DRAINS rainfall files to the TUFLOW model.

Since the files were missing, Council provided the TUFLOW model from the older FS (WMAwater 2013) to GRC Hydro in March 2024. GRC Hydro have adapted the flood study files to replace the missing files from the handover. These were implemented in the Existing Conditions TUFLOW model for the PMF event.

Comparison between the Council TUFLOW Model PMF results and the Existing Conditions TUFLOW Model PMF results suggest a close match with these changes. As such, the Existing Conditions TUFLOW Model was considered sufficiently accurate to inform flood behaviour for the PMF event in this flood risk assessment.

3. Existing Conditions TUFLOW Flood Model Results

The Existing Conditions TUFLOW model was run for the events and durations in Table 3. The model results for Existing Conditions are presented for inundation depths and floodwater levels, velocities, flows, hazards and flood function.

For the 1% AEP, 0.5% AEP and 0.2% AEP events, the 1hr and 12hr results have been combined by using the highest flood parameter to create the result. i.e. the 1% AEP depth results presented in this report is a single result generated from the higher of the 1hr and 12hr peak flood depths model outputs for each 2D model cell area.

3.1 Peak Depths and Levels (Existing Conditions)

The flood depths and levels are mapped in the following figures attached in Volume 2:

- Figure A01: Existing Conditions 10% AEP Depths and Levels
- Figure A02: Existing Conditions 1% AEP Depths and Levels
- Figure A03: Existing Conditions 0.5% AEP Depths and Levels
- Figure A04: Existing Conditions 0.2% AEP Depths and Levels
- Figure A05: Existing Conditions PMF Depths and Levels

Tabulated water levels at key locations both at and within the vicinity of the site are presented in Table 4 for all events. Locations of the recording locations are shown in Image 5.

Table 4: Water levels at key locations under Existing Conditions.

ID	Description	Water Level (mAHD)				
		10% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
	Onsite					
SITE1	Basin #1	29.46	30.35	30.53	30.64	31.08
SITE2	Basin #2	30.28	31.29	31.29	31.29	30.75
SITE3	Basin #3	28.39	29.25	29.35	29.40	29.85
SITE4	Racetrack Sag Inlets	27.75	29.25	29.35	29.40	29.85
SITE5[#]	East of the Officials Stand	31.14	31.27	31.29	31.35	31.75
SITE6[#]	North of the Officials Stand	31.03	31.21	31.27	31.35	31.75
SITE7	South of the Queen Elizabeth II Building	-	-	-	30.24	30.38
SITE8	Vehicle Tunnel to Infield Precinct	-	-	-	-	29.83
SITE9	Pedestrian Tunnel between Infield and Spectator Precincts	-	25.52	25.65	26.37	30.56
	Points of Entry to the Site					
POE1	Junction of Ascot St and Alison Rd	29.56	29.86	29.90	29.96	31.27
POE2	Wansey Rd, north of RRR Gate 10	43.85	43.98	44.01	44.06	44.37
POE3[#]	Junction of Alison Rd and Darley Rd	31.53	31.59	31.60	31.63	31.99
POE4	Junction of Ascot St and Doncaster Ave	27.39	27.83	27.87	27.94	29.21
	Offsite					
OFF1	Junction of Anzac Prd and Darling St	24.78	25.12	25.18	25.26	26.89
OFF2	Junction of Doncaster Ave and Todman Ave	26.84	27.07	27.10	27.14	27.98
OFF3	Junction of Doncaster Ave and Anzac Prd	23.71	24.34	24.42	24.52	26.83
OFF4	Anzac Prd near Day Ave	26.43	26.61	26.64	26.68	27.16
OFF5	Anzac Prd near Harbourne Ln	25.87	25.99	26.03	26.10	26.62
OFF6	Junction of Arthur St and Wansey Ln	60.10	60.14	60.14	60.15	60.25
	Catchment Points of Egress					
CAT1	Anzac Prd near junction with Alison Rd	30.01	30.35	30.42	30.52	31.60
CAT2	Alison Rd near junction with Anzac Prd	30.16	30.59	30.64	30.71	31.69
CAT3	Junction of Gardeners Rd and Houston Rd	-	22.78	22.79	22.80	22.87
CAT4	Junction of Todman Avenue and Kensington Rd	25.44	25.68	25.71	25.77	26.71

[#] The concurrent development could change flood results at this recording location

Image 5: Key locations for recording peak floodwater levels.



3.2 Peak Flood Velocity and Flow (Existing Conditions)

The flood velocities are mapped in the following figures attached in Volume 2:

- Figure A06: Existing Conditions 10% AEP Velocities
- Figure A07: Existing Conditions 1% AEP Velocities
- Figure A08: Existing Conditions 0.5% AEP Velocities
- Figure A09: Existing Conditions 0.2% AEP Velocities
- Figure A10: Existing Conditions PMF Velocities

In addition, flow hydrographs into and out of the site are presented in the following figures attached in Volume 2, with the recording locations in Image 6:

- Figure A11: Existing Conditions 10% AEP Flow Hydrographs
- Figure A12: Existing Conditions 1% AEP Flow Hydrographs
- Figure A13: Existing Conditions PMF Flow Hydrographs

Tabulated peak flows at key locations are presented in Table 5 for all events. Locations of the recording locations are the same as presented in the figures and shown in Image 6.

Table 5: Peak flows at key locations under Existing Conditions.

ID	Description	Peak Flow (m^3/s)				
		10% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
	Overland Flow					
FLOW1	Inflow off of Alison Rd into the Site	0.91	2.17	2.54	3.35	35.51
FLOW2	Inflow off of Wansey Rd into the Site	<0.01	0.22	0.35	0.57	12.61
FLOW3[#]	Inflow into the Spectator Precinct	0.10	0.71	0.86	1.07	5.45
FLOW4	Outflow from the Site into Doncaster Ave	-	0.07	0.73	1.57	27.52
FLOW5	Outflow from the racetrack into Anzac Prd and High St	-	-	0.46	1.55	44.31
FLOW6	Alison Rd downstream of the Site	2.45	3.75	4.15	4.82	63.68
FLOW7	Day Ave downstream of the Site	11.67	30.74	33.26	36.15	88.33
	Stormwater Outlet Flow					
FLOW8	Site stormwater outlet draining into Council stormwater assets	0.55	0.62	0.63	0.63	0.63
[#] The concurrent development could change flood results at this recording location						

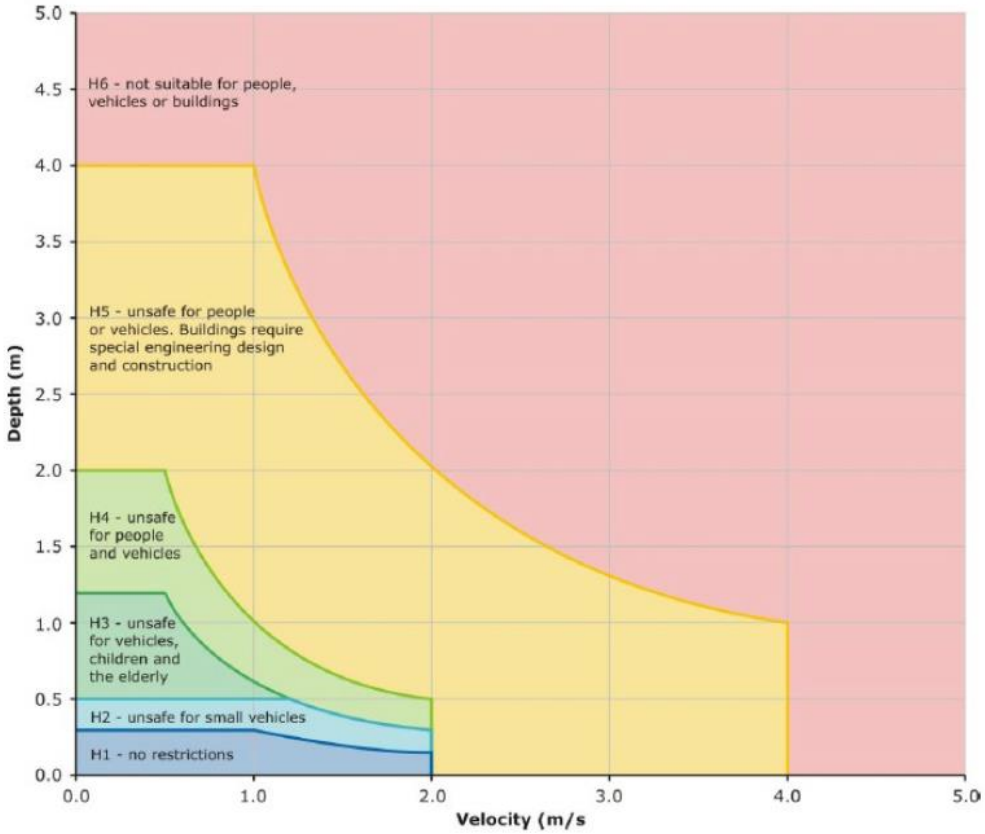
Image 6: Key locations for recording peak floodwater flow.



3.3 Peak Flood Hazard Categories (Existing Conditions)

Flood hazard values were derived using the methodology outlined in ARR2019 which considers flow hydraulic characteristics of velocity and depth as presented in Image 7, to determine flood hazard for various floodplain uses.

Image 7: ARR2019 flood hazard – depth and velocity characteristics



The flood hazard for the site under the existing conditions are mapped in the following figures attached in Volume 2:

- Figure A14: Existing Conditions 10% AEP Hazards
- Figure A15: Existing Conditions 1% AEP Hazards
- Figure A16: Existing Conditions 0.5% AEP Hazards
- Figure A17: Existing Conditions 0.2% AEP Hazards
- Figure A18: Existing Conditions PMF Hazards

3.4 Peak Flood Function (Existing Conditions)

The FPRMS&P (WMAwater 2019) and the FS (WMAwater 2013) defined the flood function (also known as the hydraulic categorisation) according to the following:

- Flood Fringe (base layer):
  - PMF extent for peak depth greater than 0.15m.
- Flood Storage (takes precedence over Flood Fringe when overlapping)
  - 1% AEP extent for peak depth greater than 0.15m.
- Floodway (takes precedence over Flood Fringe and Flood Storage when overlapping)
  - Extent of 1% AEP peak velocity depth product when greater than $0.3m^2/s$; or
  - Extent of 1% AEP peak velocity when greater than 0.5m/s.

This has been replicated using the updated TUFLOW model and mapped in:

- Figure A19 – Existing Condition – flood function

which is attached in Volume 2.

3.5 Overview of Flood Behaviour (Existing Conditions)

The 10% AEP represents flood behaviour for a frequent flood event. There is a small area of flooding north of the Official Stand with depths < 250mm which represents flooding of 2% of the overall Spectator Precinct. The Infield Precinct is flood free, with the remainder of the racetrack inundated but not exceeding the storage capacity of the sag inlet area enough to cause overland flow out of the site. Hazard is quite benign with H1 for most of the site except in the flood storage areas and some racetrack channels.

The 1% AEP is the main design flood, commonly used across most flood risk considerations and impact assessments. Inundation of the Spectator Precinct is more extensive in the 1% AEP, with 5% of the area flooded including north and east of the Officials Stand and the site overland flowpath from the racetrack sag pit storage being exceeded. The racetrack area has most floodwater storages at, or very near, full capacity with a very minor 0.07m^3/s of overland flow into Doncaster Ave from the site occurring. The pedestrian tunnel connecting the Infield and Spectator Precincts is expected to be inundated. Hazard remains quite benign for the Spectator Precinct, with mostly H1 or H2 which remains safe for people and some very small patches of H3 which becomes unsafe for children and the elderly.

The 0.5% AEP and 0.2% AEPs represent very rare flood events. Inundation extents are similar to the 1% AEP in the 0.2% AEP, with 15% of the Spectator Precinct area flooded but now the Officials Stand is fully surrounded by floodwater and the tunnel under the Queen Elizabeth II building is flooded as well as the Arena of the Horse. The racetrack area floodwater storages are exceeding capacity with overland flow into Doncaster Ave and Anzac Prd from the site now occurring. The pedestrian tunnel connecting the Infield and Spectator Precincts is inundated. Hazard remains similar to the 1% AEP.

The Probable Maximum Flood (PMF) is the largest flood conceivable for the site and is used to inform evacuation strategies. 35% of the Spectator Precinct is now inundated and most of the racetrack area is inundated including over 70% of the Infield Precinct. Overland flow is spilling out of the site into Doncaster Ave, Anzac Prd and through the vehicle tunnel within the Infield Precinct. All the tunnels are flooded, and the Officials Stand is inundated 0.6m above ground floor level. Other than portions of High Street and Wansey Rd, the site is surrounded by floodwater too hazardous for vehicles and people. Notably, all exits by vehicle from the site would have to traverse this hazardous floodwater.

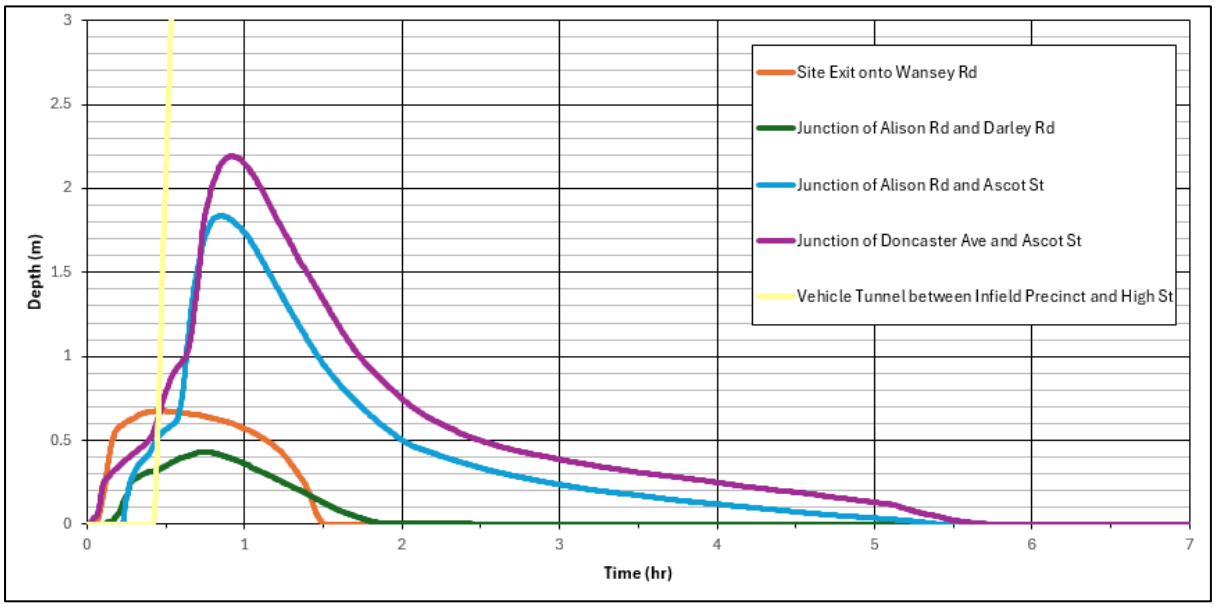
3.6 Duration of Inundation and Warning Time (Existing Conditions)

Floodwater depths over time provide estimates of duration of inundation and warning time for use in emergency planning. As the PMF is the largest conceivable flood for this location, it has been used to provide estimates based on recorded water levels over time from the TUFLOW model, which have been converted into depths over time and presented in Chart 1. This indicates that the time for floodwater to inundate to depths greater than 0.30m, the threshold which becomes dangerous to vehicles to travel through, is less than 30 minutes at all site entrances. This indicates a warning time of less than 30 minutes should be planned for.

The duration of inundation is shown to be less than 1 hour for site access points onto Wansey Rd and the Junction of Alison Rd and Darley Rd, and less than 6 hours for all other site exits. As noted in Chart 1, the duration of inundation for the vehicle tunnel between the Infield Precinct and High St is inconclusive with the available information.

Chart 1: Floodwater depths over time for the PMF at each site vehicle egress

Note: There is no drainage included within the 'Vehicle Tunnel between Infield Precinct and High St' in the TUFLOW Model. As such, only the warning time can be determined from the results, not the duration of inundation, as the location cannot drain in the model.



4. Event Day Conditions and TUFLOW Flood Model Impacts

The conditions during a non-race day event are summarised in Section 1.2. All events will be fully contained to the Spectator Precinct with overflow parking in the Infield Precinct, and will likely involve temporary structures that could be erected on the site to support a non-race day event including:

- Stages located in the Spectator Precinct, in addition to the main spectator zone adjacent to the QE II Stand and Winx Stand.
- Food, bar, amenities and supporting merchandise and administration stalls within the Spectator Precinct.
- Artist back of house in the Spectator Precinct.
- Staff, security and safety marshalling areas within the Spectator Precinct.

Whilst the proposal includes safety checks to ensure the structural integrity of the temporary structures during adverse weather conditions, this flood risk assessment has assumed a 'worst-case' scenario approach as detailed below:

- Assume the maximum capacity of 15,000 individuals, which can include high flood risk attendees such as children and the elderly.
- Concurrent use of both the Spectator and Infield Precincts to maximum capacity.
- All temporary structures will be assumed to be fully constructed.
- Temporary structures can collapse creating floating flood hazards.
- Increased rubbish and debris which will increase the blockage of stormwater drainage assets around the precincts.

4.1 Non-Raceday Conditions TUFLOW Model

The above 'worst-case' scenario is implemented as the 'Non-Raceday Conditions' used for this flood assessment. The 'Existing Conditions' TUFLOW model was updated to the 'Non-Raceday Conditions' TUFLOW model through the following updates:

- A '2d_lfcsh' was used to increase the blockage of the entire Spectator and Infield Precincts. Conservatively it was determined that a 50% blockage sufficiently accounts for:
    - Temporary structures are built using the 'worst case' layout as illustrated in the Temporary Structures Plan, MIGP 2024.
    - Different arrangements of temporary structures depending on the event.
    - Temporary structures can collapse and move, creating debris that can further block overland flow.
    - The materials used to construct the temporary structures.
    - The increased car presence in the parking areas of the Infield Precinct.
- Blockage of drainage structures around the site was increased to 50% for an on-grade inlet and 90% for a sag inlet to represent the potential higher availability of rubbish and debris.
- Conduits with a headwall inlet rather than a pit structure inlet were re-assessed with an increased availability of debris, which increased the 1% AEP debris potential from Low to Medium, with the resultant blockage factors as summarised in Table 6. If this resulted in a lower blockage factor than used in the Council TUFLOW model, it was updated to use the Council TUFLOW model approach to be conservative.

Table 6: ARR2019 culvert blockage factors for Non-Raceday Conditions

Structure Diameter (m)	Sag or Ongrade	1% AEP debris potential	Calculated Blockage Factor (%)		
			>5% AEP	5% AEP to 0.5% AEP	<0.5% AEP
0.375	On-grade	Med	25	50	100
	Sag	Med	100	100	100
0.750	On-grade	Med	25	50	100
	Sag	Med	100	100	100

All other items remained unchanged from the Existing Conditions TUFLOW Model.

4.2 Non-Raceday Conditions TUFLOW Flood Model Results

The Non-Raceday Conditions TUFLOW model was run for the same events, durations and temporal patterns as Existing Conditions as detailed in Table 3. Impacts have been generated by comparing Non-Raceday Conditions results to Existing Conditions results for water levels, flows and hazards for use in this flood risk assessment.

4.2.1 Impacts on Peak Levels ('Worst-case' Non-Raceday Condition vs Existing Conditions)

The impacts on peak flood levels are mapped in the following figures attached in Volume 2:

- Figure B01: 10% AEP Level Impacts due to a 'Worst-case' Non-Raceday Event Condition
- Figure B02: 1% AEP Level Impacts due to a 'Worst-case' Non-Raceday Event Condition
- Figure B03: 0.5% AEP Level Impacts due to a 'Worst-case' Non-Raceday Event Condition

In addition, tabulated water levels at the same key locations as presented in Section 3.1 and Image 5 are presented in Table 7 for all events. Differences are noted in brackets when they occur. Notably no detrimental offsite impacts are expected for all events.

Table 7: Water levels at key locations under the 'Worst-case' Non-Raceday Condition and changes from Existing Conditions

ID	Description	Water Level (mAHD) [changes in brackets in (m)]				
		10% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
	Onsite					
SITE1	Basin #1	29.46	30.35	30.53	30.64	31.08
SITE2	Basin #2	30.28	31.29	31.29	31.29	30.75
SITE3	Basin #3	28.40 (+0.01)	29.27 (+0.01)	29.36 (+0.01)	29.41 (+0.01)	29.88 (+0.03)
SITE4	Racetrack Sag Inlets	27.78 (+0.03)	29.27 (+0.01)	29.36 (+0.01)	29.41 (+0.01)	29.88 (+0.03)
SITE5[#]	East of the Officials Stand	31.15 (+0.01)	31.33 (+0.06)	31.36 (+0.07)	31.39 (+0.04)	31.90 (+0.14)
SITE6[#]	North of the Officials Stand	31.03	31.22 (+0.01)	31.27	31.36 (+0.02)	31.90 (+0.14)
SITE7	South of the Queen Elizabeth II Building			30.22 (Now wet)	30.24	30.35 (-0.03)
SITE8	Vehicle Tunnel to Infield Precinct					29.72 (-0.11)
SITE9	Pedestrian Tunnel between Infield and Spectator Precincts		25.52	25.65	26.37	30.55 (-0.01)
	Points of Entry to the Site					
POE1	Junction of Ascot St and Alison Rd	29.56	29.86	29.90	29.96	31.27
POE2	Wansey Rd, north of RRR Gate 10	43.85	43.98	44.01	44.06	44.37
POE3[#]	Junction of Alison Rd and Darley Rd	31.53	31.59	31.60	31.63	31.99
POE4	Junction of Ascot St and Doncaster Ave	27.39	27.83	27.87	27.94	29.21
	Offsite					
OFF1	Junction of Anzac Prd and Darling St	24.78	25.12	25.18	25.26	26.89
OFF2	Junction of Doncaster Ave and Todman Ave	26.84	27.07	27.10	27.14	27.98
OFF3	Junction of Doncaster Ave and Anzac Prd	23.71	24.34	24.42	24.52	26.83 (-0.01)
OFF4	Anzac Prd near Day Ave	26.43	26.61	26.64	26.68	27.16
OFF5	Anzac Prd near Harbourne Ln	25.87	25.99	26.03	26.10	26.62
OFF6	Junction of Arthur St and Wansey Ln	60.10	60.14	60.14	60.15	60.25
	Catchment Points of Egress					
CAT1	Anzac Prd near junction with Alison Rd	30.01	30.35	30.42	30.52	31.60
CAT2	Alison Rd near junction with Anzac Prd	30.16	30.59	30.64	30.71	31.69
CAT3	Junction of Gardeners Rd and Houston Rd	-	22.78	22.79	22.80	22.87
CAT4	Junction of Todman Avenue and Kensington Rd	25.44	25.68	25.71	25.77	26.71 (-0.01)

[#] The concurrent development could change flood results at this recording location

4.2.2 Impacts on Peak Flows ('Worst-case' Non-Raceday Condition vs Existing Conditions)

The impacts on peak flow are presented by comparing hydrographs in the following figures attached in Volume 2:

- Figure B04: 10% AEP Impacts on Flow due to a 'Worst-case' Non-Raceday Event Condition
- Figure B05: 1% AEP Impacts on Flow due to a 'Worst-case' Non-Raceday Event Condition
- Figure B06: PMF Impacts on Flow due to a 'Worst-case' Non-Raceday Event Condition

In addition, tabulated peak flows at the same key locations as presented in Existing Conditions and Image 6 are presented in Table 8 for all events. Differences are noted in brackets when they occur. The potential blockage increases during a 'worst-case' non-raceday event potentially cause a shift in the outflows from Doncaster Ave into Anzac Prd and High St for the very rare and extreme events. This is discussed further in the risk assessment presented in Section 5, but notably the changes in flow aren't corresponding to offsite increases to hazard or levels as presented in the figures for Sections 4.2.1 and 4.2.3. The changes do not impact the duration of inundation or warning time for the site or surrounding catchment as demonstrated in the hydrographs from Figures B04 to B06 where only the magnitude is shifting when changes occur.

Table 8: Peak flows at key locations under the 'Worst-case' Non-Raceday Condition and changes from Existing Conditions

ID	Description	Peak Flow (m^3/s) [changes in brackets in (m^3/s)]				
		10% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
	Overland Flow					
FLOW1	Inflow off of Alison Rd into the Site	0.91	2.17	2.54	3.35	35.51
FLOW2	Inflow off of Wansey Rd into the Site	<0.01	0.22	0.35	0.57	12.61
FLOW3[#]	Inflow into the Spectator Precinct	0.10	0.71	0.86	1.07	5.45 (5.35)
FLOW4	Outflow from the Site into Doncaster Ave	-	0.09 (+0.02)	0.64 (-0.09)	1.39 (-0.18)	24.23 (-3.29)
FLOW5	Outflow from the racetrack into Anzac Prd and High St	-	-	0.60 (+0.14)	1.82 (+0.17)	50.10 (+5.79)
FLOW6	Alison Rd downstream of the Site	2.45	3.75	4.15	4.82	60.53 (-3.15)
FLOW7	Day Ave downstream of the Site	11.67	30.74	33.26	36.15	88.33
	Stormwater Outlet Flow					
FLOW8	Site stormwater outlet draining into Council stormwater assets	0.55	0.62	0.63	0.63	0.63
[#] The concurrent development could change flood results at this recording location						

4.2.3 Impacts on Hazard Categories ('Worst-case' Non-Raceday Condition vs Existing Conditions)

The impact on flood hazard categories for the site are mapped in the following figures attached in Volume 2:

- Figure B07: 10% AEP Hazard Impacts due to a 'Worst-case' Non-Raceday Event Condition
- Figure B08: 1% AEP Hazard Impacts due to a 'Worst-case' Non-Raceday Event Condition
- Figure B09: 0.5% AEP Hazard Impacts due to a 'Worst-case' Non-Raceday Event Condition
- Figure B10: PMF Hazard Impacts due to a 'Worst-case' Non-Raceday Event Condition

Notably no increases in hazard categories are found offsite up to and including the 0.5% AEP, indicating that any water level differences or impacts on flow noted in Section 4.2.1 and 4.2.2 are not resulting in changes to hazard. Some hazard changes are noted in the PMF, but they are small pixels of changes and do not change the trafficability of the impact roads or increase hazard against properties from below H4, to H5 or H6 where buildings require special engineering design and construction to avoid failure. This is discussed further in the risk assessment in Section 5.

5. Discussion of Results and Risk

This section collates the information and results from this report to provide a review of the flood risk presented by the proposal with the aim of identifying any risk to the community, to the site or surrounding infrastructure and to the users of the site during a non-raceday event. These residual risks are managed through the emergency management plan (EMP).

- Section 5.1 provides an overview of the risk to the community or site based on the results presented in Section 4 for the full range of flood events.
- Section 5.2 discusses risks to the users of the site during a non-raceday event, which includes discussion on flood warning, evacuation strategies and a recommended approach for occupants to respond in an emergency.
- Section 5.3 presents any risk to the development or community due to future potential climate change conditions.
- Section 5.4 summarises any residual risk based on Sections 5.1 to 5.3

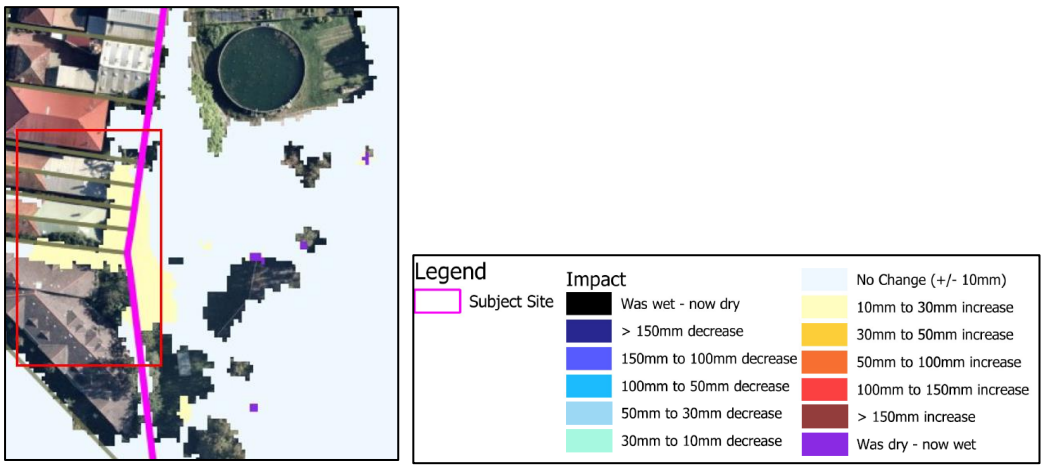
It should be made clear that the results and risk discussed below relate to the use of only the Spectator and Infield Precincts indicated in plans from MI Partners, and only during a non-raceday event. They do not include the concurrent proposed onsite hotel development in SSD-38019507. This concurrent development may change the presented results in this flood risk assessment local to its site but is not expected to impact the recommended emergency management measures presented below. The concurrent development will have its own emergency management plan and risk assessment as part of SSD-38019507.

5.1 Risk to the Community or Site

The proposal does not include any structural or terrain changes, but rather any risk to the community or site would be due to the use of the site for additional non-raceday events as presented in Section 1.2. A conservative approach to assess a 'worst-case' scenario in the Non-Raceday TUFLOW Flood Model was presented in Section 4, which found that any impacts of magnitude were fully contained to the site and only caused a small section of impacts in the Spectator precinct adjacent to the Grandstand and within the sag point within the racetrack.

Water level impacts, velocity impacts and impacts on the hazard categories indicate that there is a very low risk of the proposed non-raceday events modifying flood behaviour for the community. 10% AEP and the 1% AEP results show no offsite water level impacts at all. A small location of potential impact is noted in the 0.5% AEP results near the south-western boundary of the site as shown in Figure B03 and indicated in Image 8 for reference.

Image 8: Water level impacts noted in Figure B03.



The impacts recorded in the 0.5% AEP results are a +0.011m increase (11mm) in flood depths in a location where floodwater is ponding behind the buildings to 0.427m, which indicates a potential increase of <3% in flood depths. This impact is related to the increases in flows noted at 'FLOW5' in Table 5 in Section 4.2.2 but is also influenced by a limitation in the model representation of buildings which would be exaggerating depths and flows at this location. The model representation aside, a 3% increase in depths is unlikely to have a significant impact on the flood liability of the two buildings, as a 0.427m depth of floodwater would already indicate flooding well above floor level based on a visual assessment of the two buildings freeboard. This combined with no corresponding increases in hazard at this location in Figure B09, the impacts being due to a 'worst-case' scenario which includes several highly conservative assumptions for the impacts of temporary structures on blockage factors within the Royal Randwick Racecourse, and the impacts only present during a very rare flood event in excess of the 1% AEP design event, the associated risk posed by this increase is at most a very low flooding risk on the community.

As indicated in the hydrographs in Figures B04 to B06, there are no impacts on warning time or duration of inundation under the non-raceday scenario. Hazard impacts presented in Figures B07 to B10 indicate no increases in hazard category offsite for the 10% AEP, 1% AEP and 0.5% AEP events beyond small pixel changes, which aren't indicative of a change in hazard. For the PMF hazard changes are more noticeable, but the only concentrated changes are down High Street which are all decreases in hazard category. Any other offsite increases are small pixel changes of a potential increase by 1 hazard category. These increases do not indicate a change to the trafficability of the impacted roads or increased hazards against properties from below H4, to H5 or H6. As such, the proposal is considered to pose no to very low flood risk to the flood behaviour on the community.

In addition to the community risk assessment, this flood assessment has reviewed the impact within the site on any property or infrastructure. The water level impacts within the site are located at the Spectator precinct adjacent to the Officials Stand, or within the racetrack sag point storage area for all events.

The existing conditions scenario presented does not include the concurrent development onsite in SSD-38019507 for the proposed hotel indicated in Image 2. This may change results for impacts in the Spectator precinct at the Officials stand. Not considering the concurrent development, under existing conditions the Officials Stand is subject to inundation above floor level in events at or larger than the 1% AEP event. Impacts indicate that should temporary structures for a non-raceday event collapse and become floating hazards they could cause the Officials Stand to be inundated from 10mm above floor level to 70mm above floor level. This isn't considered to increase the flood risk of the building substantially, as a 70mm depth of inundation does not make the floodwater more hazardous to traverse and does not substantially increase any potential damage to the building due to no new internal fittings being inundated (i.e. is still below the level of typical electrical socket heights and still well below table height – two of the levels where flood damages can jump substantially). Whilst the risk at the Officials stand isn't increased substantially, there remains a residual risk of this building being flood liable as well as some uncertainty over the impacts of the concurrent development in SSD-38019507 on the building. The flood liability of the Officials stand is addressed in the emergency management plan.

The impacts within the racetrack sag point storage area do not impact on any infrastructure and haven't demonstrated any offsite impacts beyond what is discussed above. As such, it can be concluded that the proposal poses very low risk to infrastructure, with the only risk associated with the already flood liable Officials Stand. Impacts at the Officials Stand may be changed due to the concurrent development of the hotel in SSD-38019507.

5.2 Risk to People

5.2.1 Flood Liability of the Site

A summary of the flood liability of the site, with particular focus on the Spectator precinct, where the proposed non-raceday events would occur, is summarised below:

- There is a low risk of inundation for the Infield Precinct and most of the Spectator Precinct as only events higher than the 1% AEP inundate, and in the PMF the Spectator Precinct is mostly flood free.
- The Officials Stand has a high risk of inundation as it is at risk of inundation in an event as frequent as the 10% AEP and is inundated in a 1% AEP event.
- The non-race day events don't substantially increase the risk by impacting floodwater even based on a worst-case scenario as presented in Section 5.1.
- There is a very low risk of the temporary structures becoming a floating obstruction outside of the site, as even should they collapse the site naturally grades towards the racetrack area.
- The pedestrian tunnel between the Infield and Spectator Precincts is partially inundated in the 1% AEP and totally inundated in the PMF. The vehicle tunnel from the Infield Precinct to High Street is inundated in the PMF.
- Vehicle access out of the site is dangerous in a 10% AEP with flood depths in excess of 0.30m, the threshold which becomes dangerous to small vehicles, either located at points of egress from the site or major nearby intersections including from Image 5 and Table 4:
    - Points of Entry POE1, POE2 and POE3;
    - Locations along Anzac Parade at OFF1, OFF3 and OFF4; and
    - Catchment points of Egress at CAT1 and CAT2.

5.2.2 Expected Users of the Site

The expected users of the site during a non-raceday event are going to vary depending on the event. However, it is assumed that the following provides a robust summary for the flood risk assessment:

- The potential range of events suggest it is equally likely that able bodied adults, young children, young adults and the elderly may be present. Proportions will vary depending on the event.
- There may be people who require access to accessibility provisions due to limited mobility, or in the event of an emergency be subject to some injuries that limit their mobility.
- Tourists or visitors may be present with a possible wide range of languages.
- The staff maybe of a temporary nature, not familiar with the site and its emergency procedures.
- The presence of alcohol may mean that patrons could be inebriated during an emergency.
- It is unlikely very vulnerable people in need of significant medical care will be present in any regularity.

Based on the above, allowances for the presence of young children and the elderly, both high risk age groups in a flood emergency, is a residual risk for management in the emergency management plan. There should be consideration for accessibility to evacuate given the range of potential users of the site, but also in the effective communication during an emergency event. Communication risks also extend to the presence of alcohol at some events and potential language barriers. Staff are critical for any emergency response, but there is risk that temporary staff employed during a non-raceday event for the running of the event, setup, and cleanup, will have less familiarity with the site and emergency procedures.

5.2.3 Overview of the Type of Flooding

Flash flooding can be defined as flooding occurring '… within 6 hours of the precipitating weather event, and often involves rapid water level changes and flood water velocity. This definition excludes flooding caused by dam failure, storm surge or tsunami although similar emergency management principles may apply to these events' (AFAC 2018) and extracted from EM01 (DPE, 2023).

All events have a short critical duration for the proposed development site that indicate a flash flooding risk to the emergency management of the site (Section 3.6) and the hydrographs indicate rapid water level changes during a short duration storm. As such flash flooding is the best description for the type of flood behaviour most likely to provide a risk to the safety of users of the proposed development.

5.2.4 Flood Warning and Rate of Rise

As noted in EM01 (DPE, 2023), for flash flood catchments the time to flooding and flood duration are typically very short with minimal warning time. It also notes that emergency services (or emergency combat authorities such as the NSW State Emergency Service (SES)) will have little ability to warn individuals of the onset of flooding to the site. This is supported by the FPRMS&P (WMAWater, 2019) which notes:

- No official Bureau of Meteorology (BoM) warning system for the catchment due to the short time from rain falling until the flooding occurs.
- Severe Weather Warnings and Flood Watches and Warnings are issued by the BoM.
- Evacuation warnings are issues by the SES which is the legislated combat agency for floods in NSW.
- The SES maintains a flood intelligence system based on key flood warning gauges in NSW but there is no flood gauges within the study area and thus no flood intelligence system based on water levels.

Because of the above, warnings in flash flooding areas, such as the Royal Randwick Racecourse, are limited to severe weather warnings or flood watches for the area. For the site the recommended sources for information are the BoM weather alerts, but it is also noted on the "Botany Bay Precinct – Emergency Plan" (Randwick City Council website) that information can be given and warnings can be issued by:

- Radio and/or Television;
- Social media, including: Facebook, Twitter (NSW Police, NSW SES, Council);
- Standard Emergency Warning Signal;
- Emergency SMS to all mobile phones within a specific area; and
- Police and Emergency Service door knock.

The total warning time, that is the time from the potential flood inducing storm hitting the catchment and flooding to be experienced at the site, is shown by the depth over time information for the PMF event in Section 3.6, Chart 1. This indicate that a total warning time of less than 30 minutes should be accounted for in the emergency response measures, as indicated by the 60-minute critical storm event with the onset of the storm begins at timestep 0.0(hr) for all events. A review of the other events show a similar warning time with a less than 60 minute warning time consistently.

5.2.5 Evacuation Potential

As summarised in the EM01 (DPE, 2023), the preferred emergency response approach is evacuation of the area, but should only be the appropriate strategy where it has been demonstrated that there is sufficient:

- Warning time to evacuate before hazardous floodwater cuts evacuation.
- Where there is evacuation capacity on the roads proposed for the strategy.
- Capability to evacuate along the proposed routes.

The proposed site is within a flash flood catchment and as quoted in EM01 (DPE, 2023) 'attempting to evacuate may be worse than not evacuating given the dangers inherent in moving through flood waters, particularly fast-moving flash floodwaters. The timescale over which flash floods occur may limit the feasibility of evacuation as a response measure' (AFAC, 2018). As presented in Section 3.6 and discussed

in Section 5.2.4, a total warning time of less than 30 minutes from the onset of the storm should be planned for, which limits the use of evacuation as an effective risk management approach.

The site is within the Randwick City Council – Flood Emergency Subplan (2023), which is part of the local EMPLAN, which has been developed since the recommendation from the FPRMS&P (WMAWater, 2019). This delegates the responsibilities during an emergency in the preparation, response, and recovery phases. No specific evacuation centres have been identified in the catchment within the plan, none were recommended in the FPRMS&P (WMAWater 2019), and an Emergency Plan wasn't identified covering the development site on the Randwick City Council website. As such, this report will focus on the evacuation potential from the locations of the non-raceday events to out of the catchment area, should an evacuation order be given with enough warning before a flood inducing storm.

To attend the event there will be many patrons who use public transport and as mentioned in Section 1.2 it will be encouraged to use public transport to attend the event. Some parking is provided in the multi-deck carpark on Ascot St in the Spectator Precinct, but also within the Infield Precinct carpark as detailed in the Temporary Structures Plan (MIGP 2024). This suggests that should an emergency evacuation order be sent there needs to be sufficient warning given for patrons to utilise similar transport methods to evacuate.

The main road to evacuate from the site out of the catchment, should an evacuation order be issued for the area, is via Ascot St, Alison Rd or High St. Exiting from Ascot St and west along Alison Rd or north-west up Doncaster Ave provide the most direct routes to the M1 or Princes Highway which would be the closest arterial roads with sufficient capacity for travelling further west. From the Infield Precinct access is along High St onto Anzac Prd. Access to the Princes Highway via Gardeners Rd is an alternative which is potentially less flood liable, at least within the Kensington-Centennial Park catchment. There is little evacuation benefit for travelling further into the eastern suburbs in the event of a large evacuation order, but this may provide access to friends and family who can provide shelter. Given the use as an event facility there may be a limited likelihood of friends and family in the area to provide shelter.

Evacuation potential during a flood inducing storm becomes hazardous in events as frequent as the 10% AEP, with both Alison Rd and Anzac Parade potentially subject to floodwater exceeding 0.30m, the threshold which starts providing danger to vehicles. Most of Anzac Prd becomes potentially hazardous in the 10% AEP and 1% AEP events including the junction of Anzac Parade and Alison Rd (CAT1 and CAT2 in Image 5) with H3 hazard, and the junctions of Anzac Prd and Darling St, Doncater Ave and Day Ave (OFF1, OFF3 and OFF4). Alison Rd is subject to high hazards at the junction with Darley Rd (POE3) with H2 hazard and the junction of Alison Rd and Wasley St (POE2) with H2 hazard. The PMF increases hazard to H5 and H6 for all evacuation routes.

In summary, there is only potential for evacuation should sufficient warning be given, as in events as frequent as the 10% AEP the evacuation routes become dangerous shortly after the onset of a flood inducing storm and in the PMF all evacuation routes are extremely dangerous. It is a known risk that it is difficult for people to accurately judge the severity of the flood during an emergency. Because of this a 'horizontal evacuation' strategy, such as exiting the catchment via a vehicle, is not the preferred emergency response strategy after the onset of the storm from the site.

An alternative strategy to horizontal evacuation is the implementation of a vertical evacuation scheme, such as a shelter-in-place strategy, to be enacted should a flood inducing event occur. Ideally people would not be present on the site and will have heeded weather warnings or warnings given by emergency combat authorities to not enter the area and there been sufficient time to evacuate, however there is always a risk that people are present on the site during a flood. The emergency

management plan presented in Volume 3 details the preferred strategy with some details in Section 5.2.6 of the suitability of the proposed development as a shelter-in-place location.

5.2.6 Shelter in Place and Duration of Inundation

Shelter-in-place is an alternative strategy for emergency risk management during a flood where people have not been able to evacuate out of the site before the onset of a flood inducing storm. With proper planning it can also provide a strategy to adopt should it be uncertain whether people should evacuate and avoid the high risks of potentially evacuating through floodwater. The site proposes the use of two areas for non-raceday events. The Spectator Precinct for all events, which may include the use of parking in the Infield Precinct. Access between the precincts is possible through an underground tunnel.

Results from this flood risk assessment have shown that the pedestrian tunnel can be inundated in the 1% AEP event and is not traversable in a PMF and that the vehicle tunnel from the Infield Precinct to High St is not traversable in a PMF. Should users of the Infield Precinct not be given sufficient warning to evacuate, they would be totally isolated in a PMF event. A large portion (70%) of the Infield Precinct is also inundated during a PMF, and there are no nearby structures in which to seek shelter. This makes the Infield Precinct unsuitable for a shelter-in-place strategy for managing flood risk.

The Spectator Precinct is mostly flood free in the PMF, except the Officials Stand which is flood liable in events as frequent as the 10% AEP. During a PMF event the Spectator Precinct would become a High Flood Island and surrounded by floodwater. The Queen Elizabeth II and the WINX buildings provide viable shelter-in-place venues for the maximum 15,000 people expected during a non-raceday event. An assessment on their potential as a shelter-in-place venue is provided in Table 9, using the 'Considerations for a Shelter-In-Place (SIP) strategy' (Draft Shelter-in-place Guidelines. DPE, 2022). The site has access to sufficient capacity and supplies to manage a short-term (<6 hours) shelter-in-place strategy suitable for managing the expected duration of inundation for the site. There is some capacity for longer durations (up to 48 hours) but only for an estimated 10,000 people with the available floor space the limiting factor.

Table 9: Assessment of Queen Elizabeth II and WINX buildings as a shelter-in-place venue using the 'Considerations for a Shelter-In-Place (SIP) strategy' (Draft Shelter-in-place Guidelines. DPE, 2022)

Item	Comment
The duration for flood inundation is less than six hours	As demonstrated in Chart 1 in Section 3.6, the duration of flood inundation is less than 6 hours for the PMF event. Review of other events, including the 12 hour 1% AEP critical duration, indicate a less than 6-hour window then evacuation from the site wouldn't be possible.
The development is not located in an area of high-risk (e.g. floodways and H5 or H6 hazard areas)	Buildings in the Spectator Precinct aren't subject to H5 or H6 hazards as shown in Figure A18. As shown in Figure A19 the site is classed as Flood Fringe and no Floodway is shown in the Spectator Precinct.
Access to on-site systems to provide power, water and sewerage services during and beyond the event for the full range of flooding	Queen Elizabeth II and WINX buildings have power, water and sewerage available. It is unknown whether there is a backup power source. The buildings have onsite catering facilities and food storage.
The location of storage of food, water and medical emergency for SIP purposes should be above the PMF level and available during and beyond the event for the full range of flooding	Both buildings have stored food and water suitable for emergency purposes. For the Queen Elizabeth II building storage is split between Level 3 and the basement, where the basement is below PMF level. Some medical access and supplies are available through the additional medical facilities provided during planned events. There is possible emergency vehicle access to the site from Prince of Wales Hospital through H1 hazard floodwater up to and including the 1% AEP event.

Shelter in Place flood level is above PMF	Queen Elizabeth II building and the WINX stand are flood free in the PMF above ground level as shown in Figure A05. The PMF level at the underground tunnel is at 30.40m AHD which does not exceed the Queen Elizabeth ground floor level of 31.50m AHD. WINX building has no nearby floodwater in the PMF. Queen Elizabeth II building offers 6 additional floors above ground level for vertical refuge and WINX has 2 floors.
Shelter in Place provides a minimum flood space per person	Minimum floor space is suggested to be $1m^2$ per person for short durations (< 6 hours) and $2m^2$ per person for long durations (up to 48 hours). Capacity estimates for short durations based on as built floor plans give: • Queen Elizabeth II building: 16,000 people • WINX Stand: 4,000 people
Shelter in Place must be structurally safe and accessible during floods up to the PMF	Queen Elizabeth II and WINX buildings are recent developments (post 2012) and outside of hazardous floodwater as shown in Figures A18 and A19. Structural soundness would have been confirmed by a suitably qualified engineer during the development. Queen Elizabeth II and WINX buildings are accessible to the whole Spectator Precinct without going through floodwater in all events. They are isolated from the Infield Precinct in many flood events, so an alternate strategy is proposed for there.

During consultation with the NSW SES, they "Recommend that any proposed refuge location is above the height of the PMF, and aligns with the Red Cross Preferred Sheltering Practices for Emergency Sheltering in Australia, including water supply, waste management, sanitation, food, and shelter and space management.". This advice was received on the 27th May 2024. As discussed, the proposed refuge locations are above the height of the PMF. The Red Cross Preferred Sheltering Practices for Emergency Sheltering in Australian is aimed at Temporary Sheltering (greater than 18 hours), but some key takeaways were adapted for consideration at the site in Table 10.

Table 10: Key takeaways from the Red Cross Preferred Sheltering Practices for Emergency Sheltering in Australia.

Sheltering Item	Category	Recommendation
Emergency Phase	Immediate Sheltering	The immediate sheltering phase is from 1 to 18 hours and is the most appropriate for emergency planning for the site as the expected duration of hazardous floodwater limiting vertical evacuation potential is less than 6 hours.
Sanitation	Inside Toilets	Access to 300 toilets is recommended for immediate sheltering needs of the expected maximum capacity of the site during a non-raceday event.
	Outside Toilets	Locate outside toilets within 50m of the Queen Elizabeth II building or WINX building.
Water Supply	Drinking	Plan for 4L per person per day.
Shelter and Space	Space	It is recommended $1.2m^2$ per person is available. Between the Queen Elizabeth II and WINX buildings there is an estimated $1.35m^2$ per person.
	Temperature	Maintain inside temperatures between 20 and 25 degrees Celsius.
Waste Management	Services	Plan for garbage disposal locations on every floor and the regular emptying of them to areas not used for sheltering.
Food	Food availability	Recommend avoiding food choices containing common food allergies (e.g. peanuts) and consider the needs of diabetics.

5.3 Risks due to Climate Change

Climate change is expected to worsen flood risk over time as higher greenhouse gas concentrations lead to increases in high intensity rainfall and sea levels. There are four greenhouse gas concentration

projections named RCP 2.5, 4.5, 6.0 and 8.5, with RCP 2.5 being the most optimistic (emissions plateau and then decline) and 8.5 the least optimistic (emissions continue to grow). For the RCP 4.5 and RCP 8.5 scenarios, the precipitation intensity for the site was obtained from the Australian Rainfall and Runoff (ARR) Data Hub and shown in Table 11 for 2050 and 2090 projections.

Table 11: Climate change factors – percentage increase in rainfall intensity

Year	Increase in Rainfall Intensity	
	RCP 4.5	RCP 8.5
2050	+6.4%	+9.0%
2090	+9.5%	+19.7%

To assess the potential risks due to climate change, the Existing Conditions and Non-Raceday Conditions TUFLOW models were run with a rainfall intensity increase of 19.7% representing a 2090 RCP 8.5 greenhouse gas concentration projection, the least optimistic. Sea level rise is not expected to impact levels at the site based on it not being considered for the FPRMS&P (WMAWater, 2019), the relatively high elevations of the area, not being coastal and without a nearby tidally influenced watercourse. As such, results do not include sea level rise.

The climate change depths, levels and impacts are mapped in the following figures attached in Volume 2 for the 'worst-case' non-raceday conditions 10% AEP and 1% AEP events:

- Figure C01: 10% AEP Depths and Levels for 2090 RCP8.5 Climate Change Scenario
- Figure C02: 1% AEP Depths and Levels for 2090 RCP8.5 Climate Change Scenario
- Figure C03: 10% AEP Level Impacts for 2090 RCP8.5 Climate Change Scenario
- Figure C04: 1% AEP Level Impacts for 2090 RCP8.5 Climate Change Scenario

As shown in Figure C01, the 10% AEP levels under climate change are expected to subject the Officials Stand to inundation above floor level. There is some expected increased inundation for the pedestrian tunnel between the Infield Precinct and Spectator Precinct, and there is inundation south of the Officials stand under a 1% AEP climate change scenario. The impacts in Figures C03 and C04 indicate that conclusions drawn in Section 5.1 and 5.2 of the potential impacts of a 'worst-case' non-raceday event are similar to what is expected under current day conditions with no further risk indicated for the community due to climate change.

5.4 Overview of Residual Risks

The residual risks identified in Sections 5.1 to 5.3 and from the results presented in Sections 3 and 4 indicate the following:

- Catchment is at risk of flash flooding with minimal warning time once the storm starts. (Section 3.6 and 5.2.3)
- Evacuation from the site is dependent on receiving and communicating risks to attendees during a non-raceday event. These warnings would be from regional storm warnings from the SES, NSW Police, BoM or local radio (Section 5.2.4)
- Warning time would have to be sufficient to allow for attendees who have used public transport to attend an event to seek transportation out of the catchment (5.2.6)
- Any users of the development who remain at the site, or are caught unaware by the onset of a flood inducing storm, are unlikely to find a safe vehicle evacuation route from the site with dangers of being caught in hazardous floodwater (Section 5.2.5)
- The range of potential attendees indicate that communication of warnings must account for potential language barriers, inebriated attendees, children and the elderly (Section 5.2.2)
- Staff may be temporarily employed for an event and not familiar with the emergency procedures of the site.

- Setup and cleanup before and after an event will be occurring and accounted for in the emergency procedures of the site (Section 5.2.2)
- The Infield Precinct does not offer a suitable shelter-in-place venue and is at risk of isolation and inundation during a PMF event (Section 5.2.6)
- The Spectator Precinct is mostly flood free with access from all locations to the Queen Elizabeth II building and WINX buildings which are suitable for a short term (<6 hour) shelter-in-place strategy and some capacity to manage a long term (up to 48 hours) shelter-in-place strategy for the maximum 15,000 expected attendees during a non-raceday event (Section 5.2.6).
- The Officials Stand in the Spectator Precinct is flood liable in the 10% AEP event to the PMF event (Section 5.1 and Section 5.3).
- If adopting a shelter-in-place strategy in the Queen Elizabeth II building, some food storage is located in the basement which is below the expected PMF level (Section 5.2.6).
- Some parking for events at the Spectator Precinct is located in the Infield Precinct with the only access via an underground pedestrian tunnel which is flood liable in the 1% AEP to PMF events (Section 5.2.6).
- Onsite medical supplies are dependent on event day first aid tents and facilities (Section 5.2.6).
- People are likely to want to evacuate in a flood, if not told the risks associated with doing so (EM01, DPE 2023)
- Even if told of the risk people may still attempt to evacuate if they do not accept the risk (EM01, DPE 2023)

Based on the residual risks to the site, the emergency management plan focusses on:

- Establishing a chain of command to distribute warnings of the potential onset of flood inducing storms to prioritise the evacuation of the site well before the onset of the storm itself.
- The communication of warnings through multiple channels to minimise reliance on temporary staff and minimise limitations to communicate risk due to alcohol, language or age barriers.
- A separate emergency approach for the Infield and Spectator Precincts.
- Detailing a shelter-in-place strategy for the management of people isolated by floodwater in the Spectator Precinct.

The emergency management plan is presented in Volume 3 of this report.

6. Compliance with SEARs and relevant statutory requirements

The relevant project SEARs for this flood assessment are summarised in Table 12, including a breakdown of the items into key components. This flood risk assessment has shown that compliance is achieved without additional flood mitigation solutions beyond the emergency management plan and future flood risk safety protocol recommendations.

Table 12: Compliance with relevant SEARs

SEARs		Key component of SEARs	Status
Item	Description		
Key Issues **3. Operation**	Item 7: a draft Emergency Evacuation Plan detailing potential site risks and provide a framework for the management of such risks; and	Draft Emergency Evacuation Plan (flooding)	Compliant - Volume 3 presents the draft emergency management plan with recommendations for the best practices for minimising risk to users of the site during a flood emergency.
Key Issues **12. Flooding**	The EIS must: • identify any flood risk on-site having regard to adopted flood studies, the potential effects of climate change, and any relevant provisions of the NSW Floodplain Development Manual and other local or State studies and guidance; and • identify required management measures and design solutions to minimise the impacts of flooding on the proposed development, and procedures in the event of an emergency.	Flood Risk with regards to adopted flood studies (FS) and floodplain risk management studies (FPRMS)	Compliant - Adopted FS (WMAWater 2013) and FPRMS&P (WMAWater 2019) have been reviewed and this assessment undertaken using an adapted 2D flood model based on the adopted Council's TUFLOW flood model for the Kensington-Centennial Park catchment. This report includes mapping consistent with the FPRMS&P (WMAWater 2019).
		Flood Risk with regard to the potential effects of climate change	Compliant - Section 5 presents a detailed flood risk assessment, including climate change. Residual risks are identified in Section 5.4 and managed through the draft emergency management plan presented in Volume 3.
		Flood Risk with regards to the NSW Floodplain Development Manual (DPE 2023)	Compliant – this flood risk assessment has been completed using the NSW Floodplain Development Manual (DPE 2023) and its recommendations.
		Flood Risk with regards to the Flood Risk management toolkit (DPE 2023) with particular reference to the LU01 guidelines (DPE 2023)	Compliant - This report includes the full scope as recommended in the LU01 guidelines (DPE 2023) including: • Detailed risk assessment (Section 5) • Mapping of velocities, flood function and supporting emergency evacuation figures (Section 3.2 and 3.3

			• Includes a wide range of flood events (10% AEP to PMF) • Hydrographs into and out of the site (Section 3.2) • Duration of inundation and warning time (Section 3.6) • Draft emergency management plan (Volume 3) • Climate change assessment (Section 5.3)
		Solutions to minimise impacts of flooding on the proposed development	Compliant – proposed development is shown to have no concerning impacts that need minimising.
		Procedures in the event of an emergency	Complaint – procedures presented in the draft emergency management plan in Volume 3.
Engagement	The EIS must detail engagement undertaken and demonstrate how it was consistent with the Undertaking Engagement Guidelines for State Significant Projects. Detail how issues raised and feedback provided have been considered and responded to in the project. In particular, applicants must consult with: • the relevant Department assessment team • any relevant local councils • any relevant agencies • the community • if the development would have required an approval or authorisation	Consultation with Department assessment team: Department of Climate Change, Energy, the Environment and Water (DCCEEW)	In progress - DCCEEW are being consulted with this report for feedback during the SSDA submission.
		Consultation with local council: Randwick City Council	Compliant - Both the Randwick City Council's LEP (2012) and DCP (2013) have been consulted in preparation of this report. It is understood that the current DCP updates (Sep 2023) do not apply to the water and flood management of the site. In progress - Council will be consulted for feedback during the SSDA submission.
		Consultation with agency: SES	Compliant - SES have been consulted regarding the draft emergency evacuation as summarised in Section 1.5
		Consultation with community	In progress – a community consultation is being conducted for this project.

7. Conclusions and Recommendations

This flood risk assessment has been prepared by GRC Hydro Pty Ltd (GRC Hydro) to accompany a detailed State Significant Development Application (SSDA) for the Australian Turf Club Limited (the applicant) at the Royal Randwick Racecourse (the site). This Stage 2 report presents the full flood risk assessment based on the Flood Risk Management Manual (DPE 2023) and guidelines from the Flood Risk Management Toolkit (DPE 2023) to accompany the SSDA.

Results have been presented for the 10% AEP to the PMF for Existing Conditions in Section 3 and a 'Worst-case' Non-Raceday Condition scenario in Section 4. The risk assessment in Section 5 has shown the proposal presents a very low risk to the community, very low risk to infrastructure and no risk due to future climate change. Risk for the users of the site during an event has been assessed, with residual risks identified from a wide range of risk categories and a draft emergency management plan presented detailing the preparation, response and recovery phases to minimise these risks.

Attached is Volume 2 which contains all mapped result figures. Volume 3 contains the draft emergency management plan.

The flood risk assessment presented over Volumes 1, 2 and 3 has shown full compliance with issued SEARs in Section 6. The recommendations are:

- Feedback from the DCCEEW and Randwick City Council during the SSDA are incorporated into future project phases,
- Feedback from the consultation with NSW SES received 27th May 2024 is incorporated when planning for evacuation from the site either before or after a flood emergency and consulting the Transport for NSW where possible during the process,
- Updates to reflect the results of the community consultation,
- Incorporate the draft emergency management plan presented in Volume 3 into the operational emergency procedures for future events,
- Recommend the installation of flood warning systems or depth indicators in the pedestrian tunnel and vehicle tunnel accessing the Infield Precinct, should they not already exist.

Yours Sincerely



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Director
NER 2435438

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Tel: +61 413 631 447



Legend

Subject Site

Level Contour (m AHD)

Major Contour (0.5m interval)

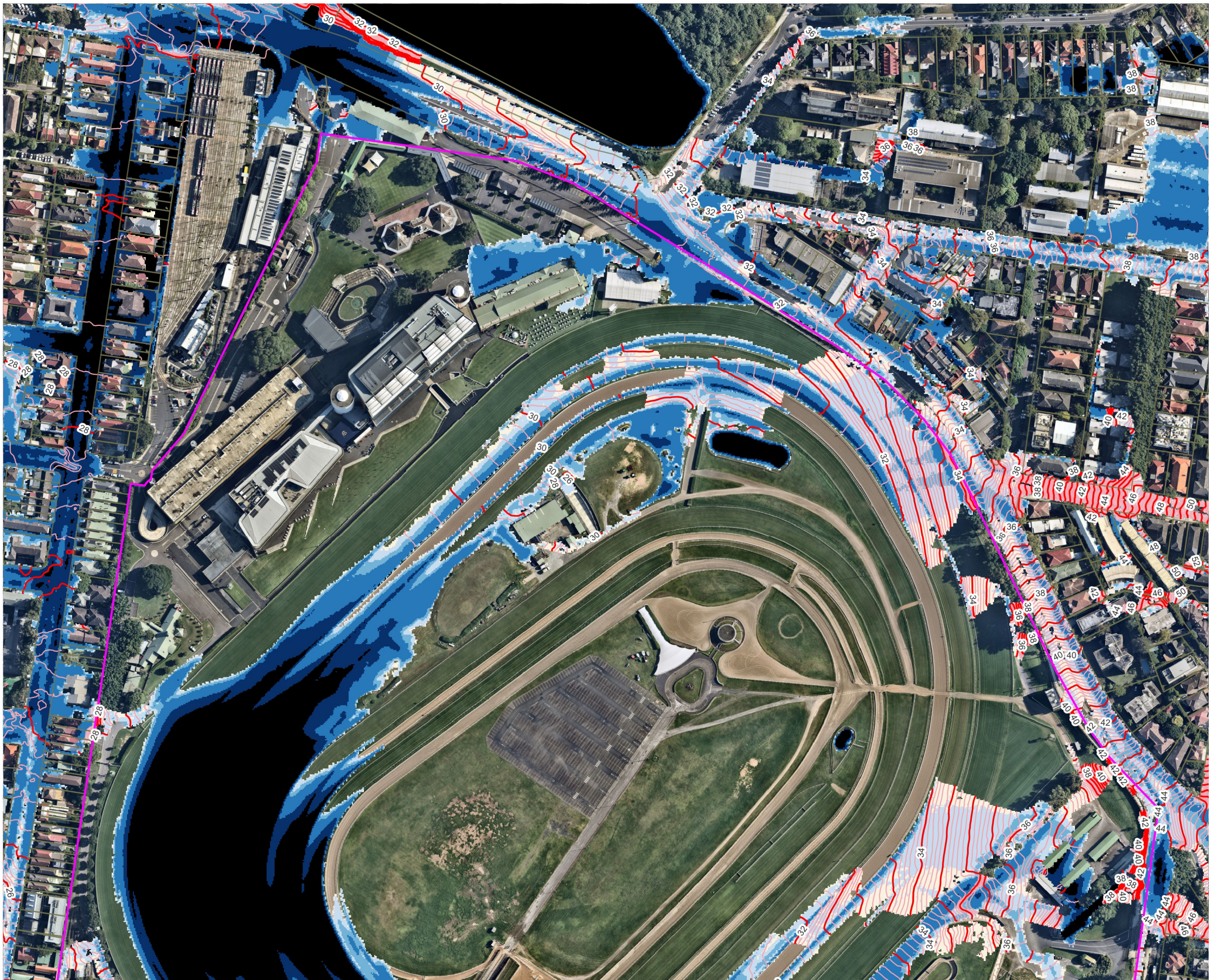
Minor Contour (0.1m interval)

Depths (m)

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- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- > 0.50

TITLE:	**Existing Conditions 10% AEP Depths and Levels**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A01**

grc HYDRO



Legend

Subject Site

Level Contour (m AHD)

Major Contour (0.5m interval)

Minor Contour (0.1m interval)

Depths (m)

- <= 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- > 0.50

TITLE:	**Existing Conditions 1% AEP Depths and Levels**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**

DATE: **05-2024**	SCALE: **1:3500**	FIGURE No. **A02**

grc HYDRO



Legend

Subject Site

Level Contour (m AHD)

Major Contour (0.5m interval)

Minor Contour (0.1m interval)

Depths (m)

<= 0.01

0.01 - 0.05

0.05 - 0.10

0.10 - 0.30

0.30 - 0.50

> 0.50

TITLE:	**Existing Conditions 0.5% AEP Depths and Levels**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A03**

grc HYDRO



Legend

Subject Site

Level Contour (m AHD)

Major Contour (0.5m interval)

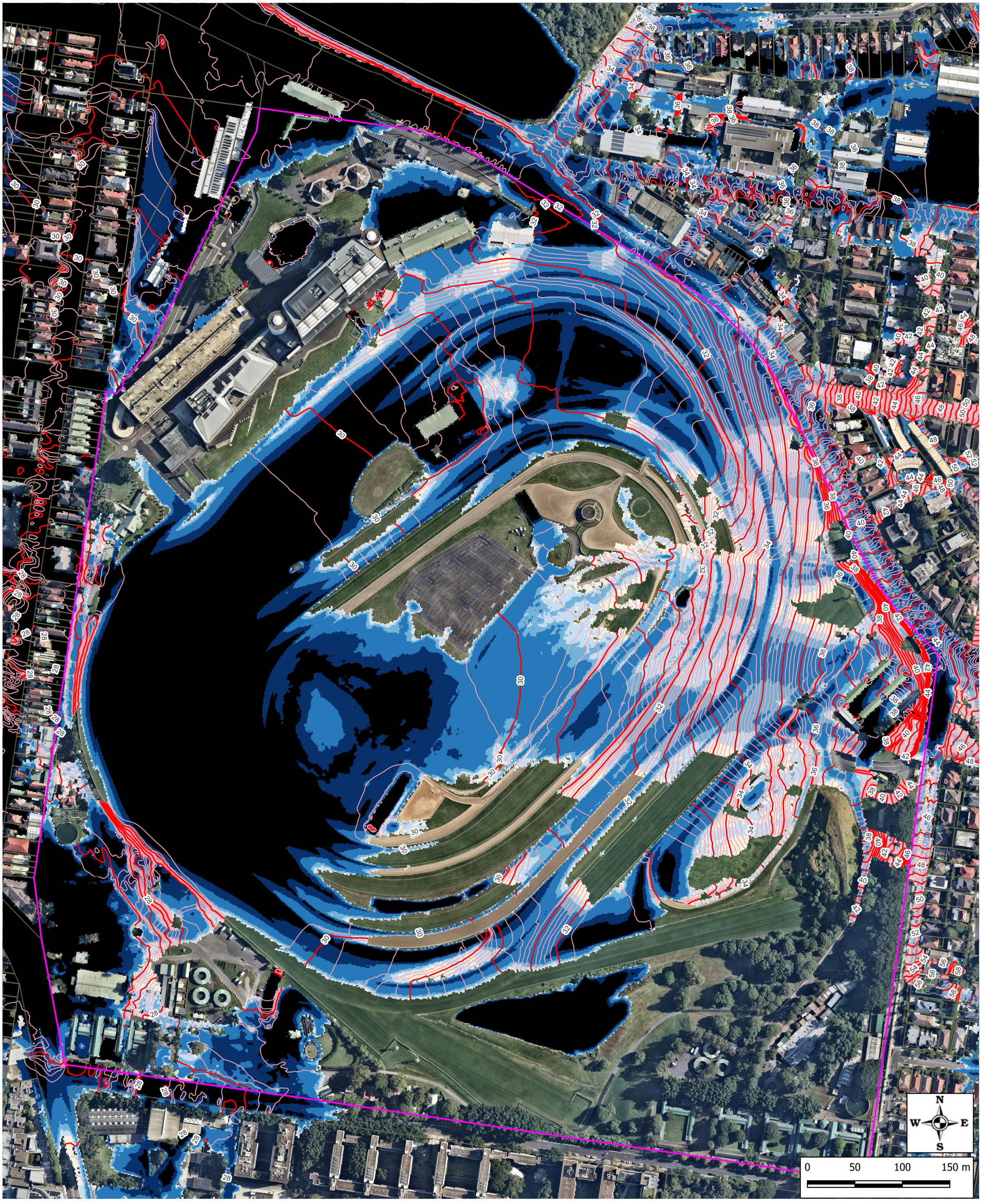
Minor Contour (0.1m interval)

Depths (m)

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- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- > 0.50

TITLE:	**Existing Conditions 0.2% AEP Depths and Levels**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A04**

grc HYDRO



Legend

Subject Site

Level Contour (m AHD)

Major Contour (0.5m interval)

Minor Contour (0.1m interval)

Depths (m)

- <= 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- > 0.50

TITLE:	**Existing Conditions PMF Depths and Levels**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A05**

grc HYDRO



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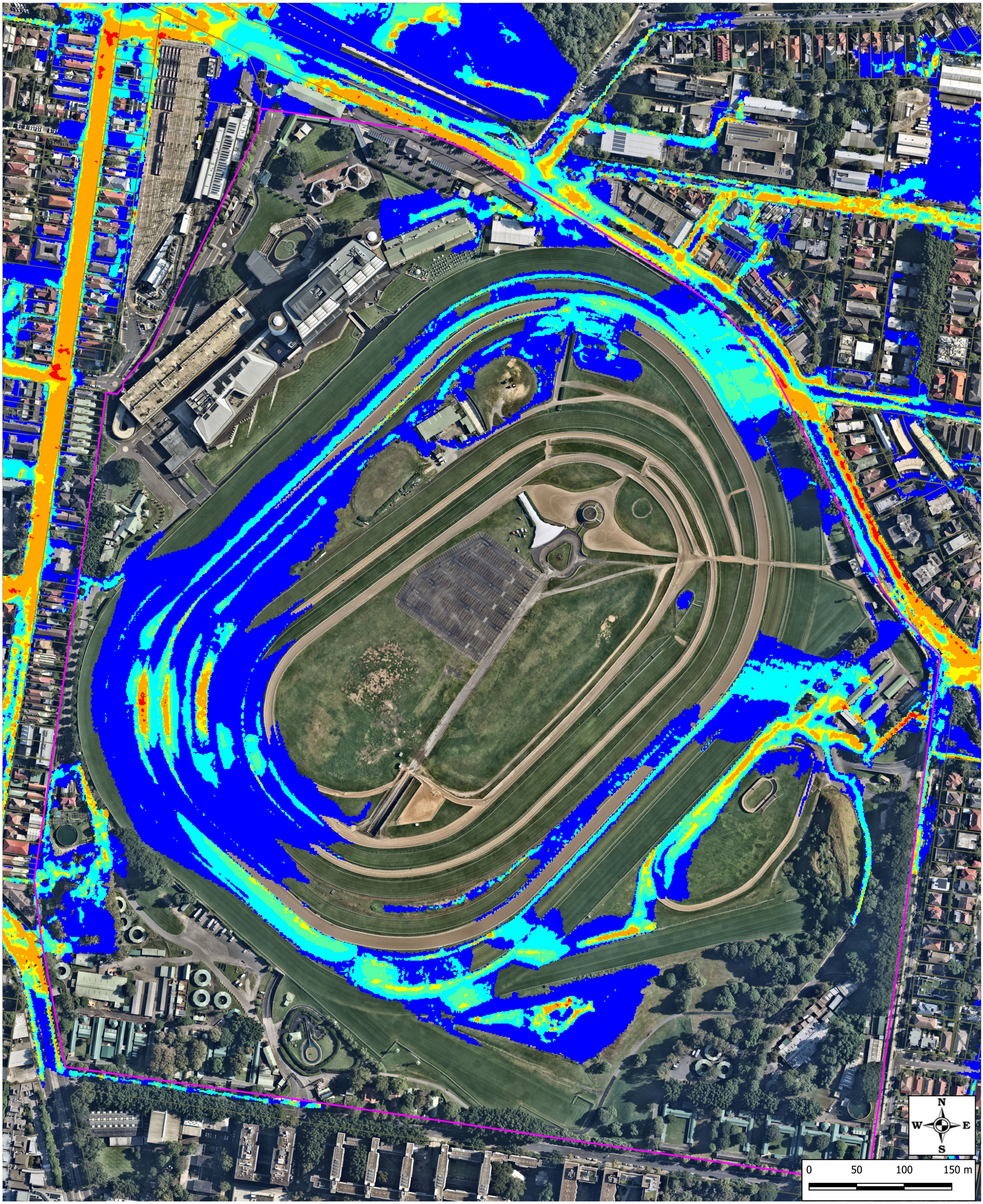
Subject Site

Velocity

- < 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

TITLE:	**Existing Conditions 10% AEP Velocities**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A06**

grc HYDRO



Legend

Subject Site

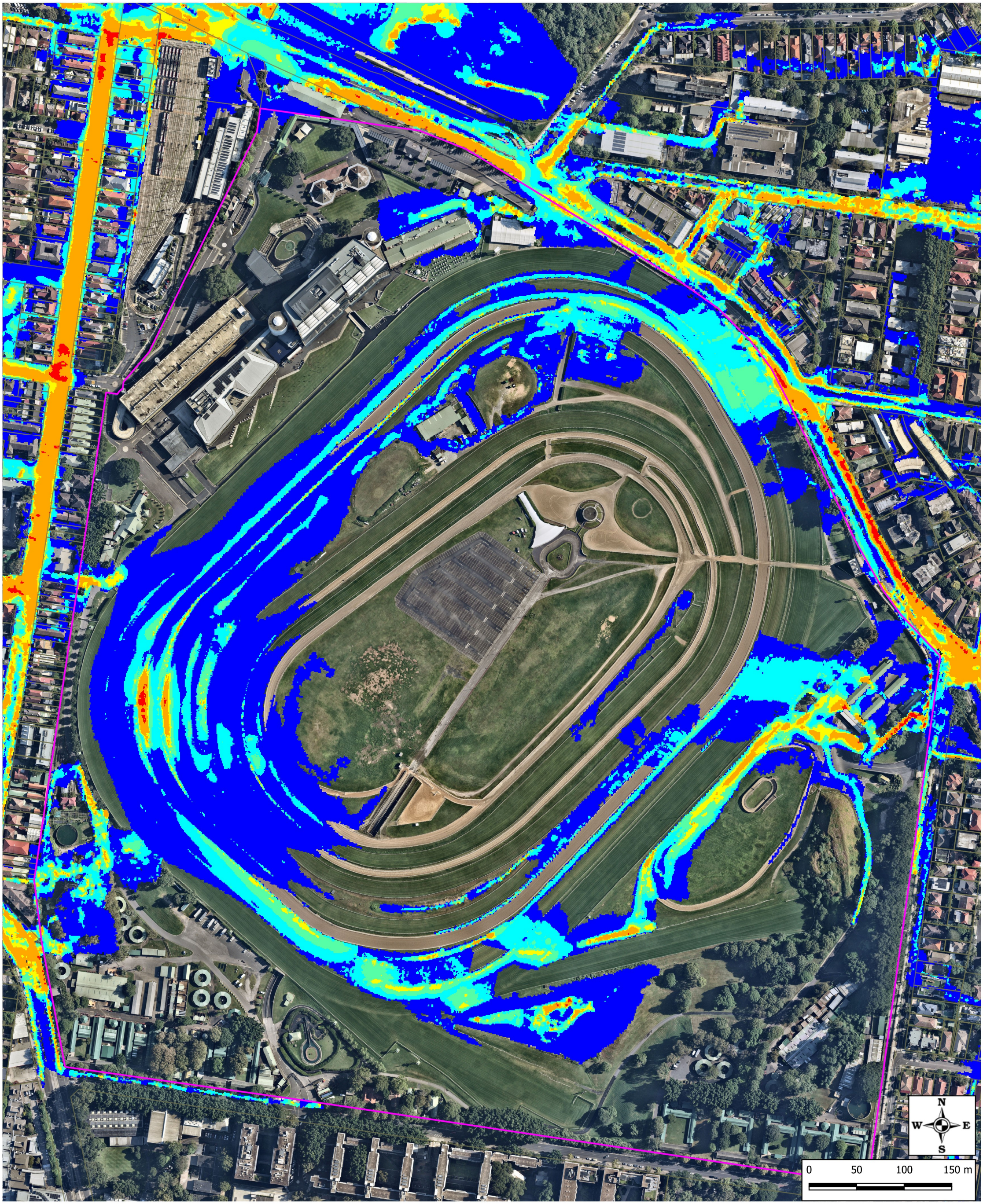
Velocity

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- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

TITLE:	**Existing Conditions 1% AEP Velocities**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**

DATE: **05-2024**	SCALE: **1:3500**	FIGURE No. **A07**

grc HYDRO



Legend

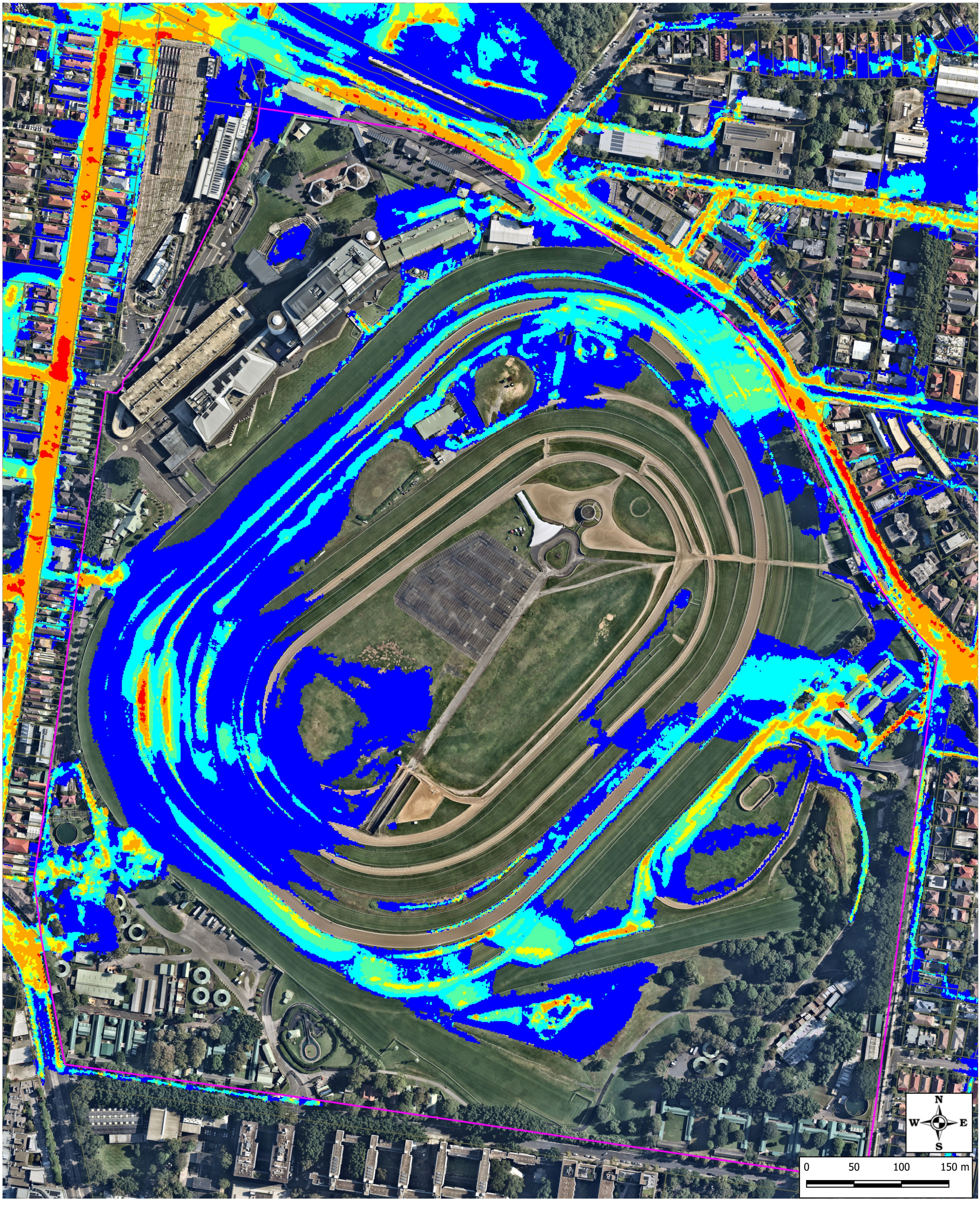
Subject Site

Velocity

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- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

TITLE:	**Existing Conditions 0.5% AEP Velocities**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500**
FIGURE No.	**A08**

grc HYDRO



Legend

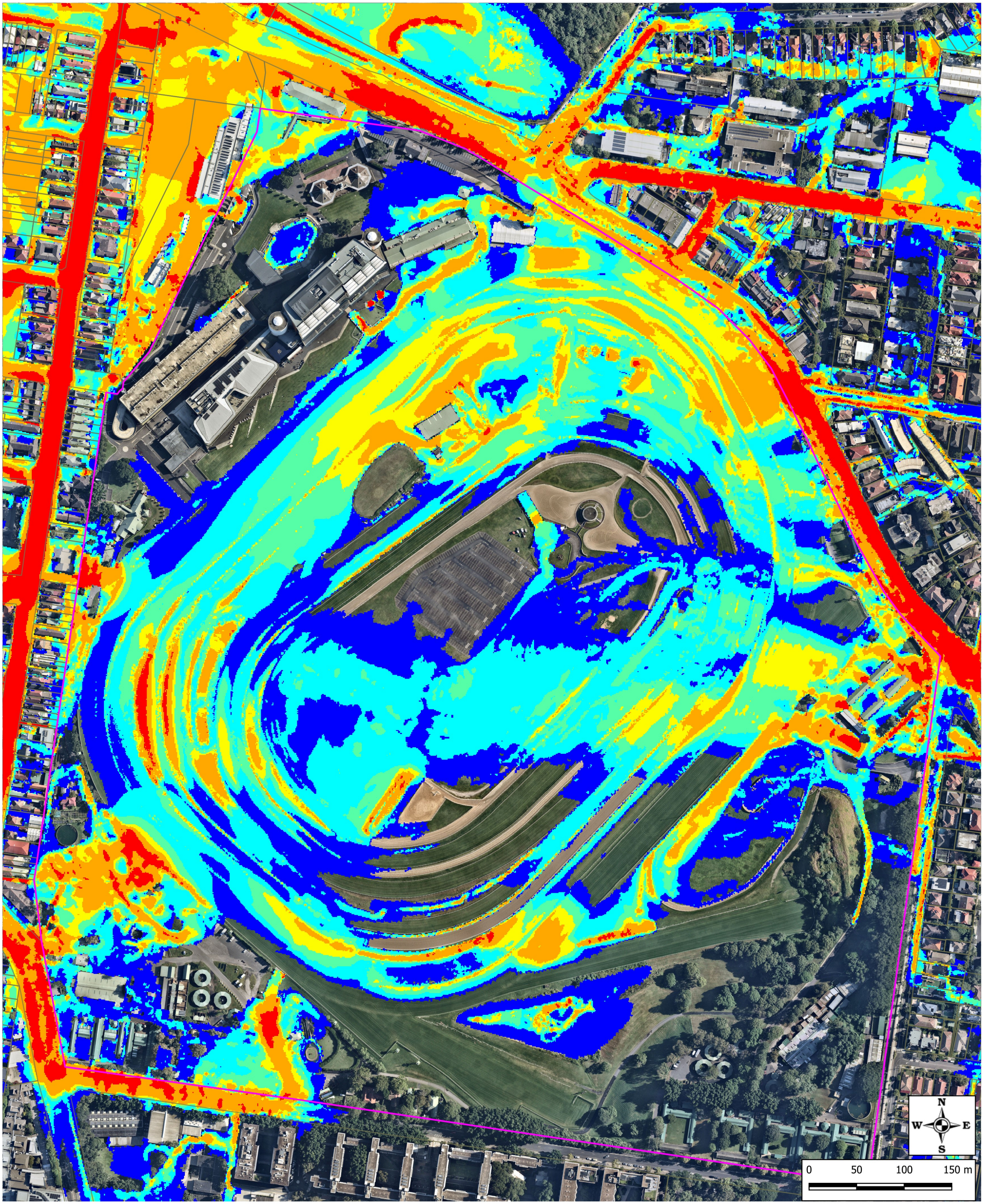
Subject Site

Velocity

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- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

TITLE:	**Existing Conditions 0.2% AEP Velocities**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A09**

grc HYDRO



Legend

Subject Site

Velocity

- < 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

TITLE:	**Existing Conditions PMF Velocities**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A10**

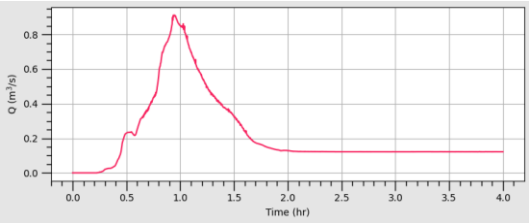
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***Title:* Existing Conditions 10% AEP Flow Hydrographs**	
Project: Royal Randwick Racecourse Non-Race Day – Flood Risk assessment	
Project No.: 240009	
Date: 05 - 2024	***Figure No: A11***

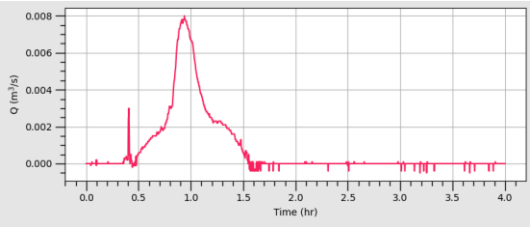
- *60-minute storm in pink*
  - *Start of storm at Time (hr) = 0*
  - *End of storm at Time (hr) = 1*
- *See report Image 5 for reference locations.*

Inflows

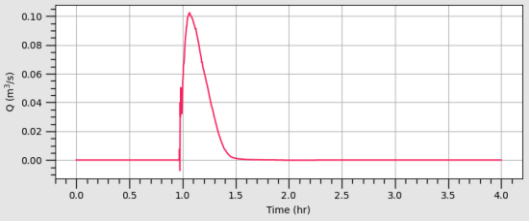
FLOW1



FLOW2



FLOW3



Outflows

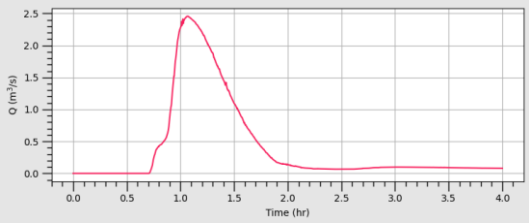
FLOW4

No outflow

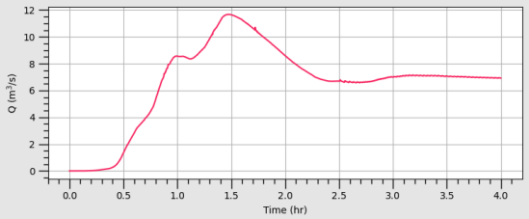
FLOW5

No outflow

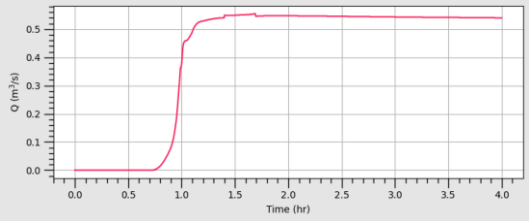
FLOW6



FLOW7



FLOW8

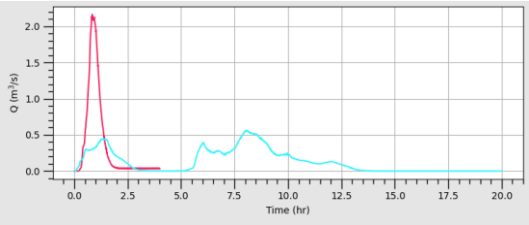


***Title:* Existing Conditions 1% AEP Flow Hydrographs**	
Project: Royal Randwick Racecourse Non-Race Day – Flood Risk assessment	
Project No.: 240009	
Date: 05 - 2024	***Figure No: A12***

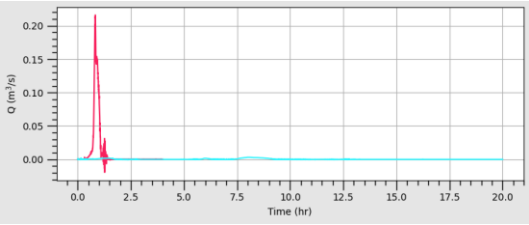
- *60-minute storm in pink*
  - *Start of storm at Time (hr) = 0*
  - *End of storm at Time (hr) = 1*
- *See report Image 5 for reference locations.*
- *720-minute storm in blue*
  - *Start of storm at Time (hr) = 0*
  - *End of storm at Time (hr) = 12*

Inflows

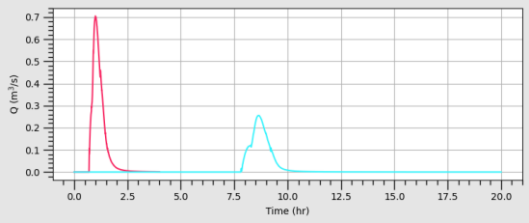
FLOW1



FLOW2

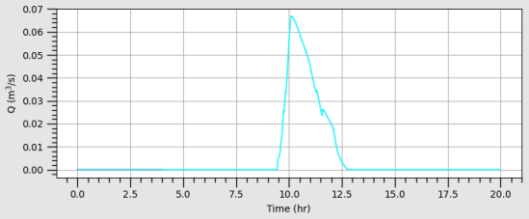


FLOW3



Outflows

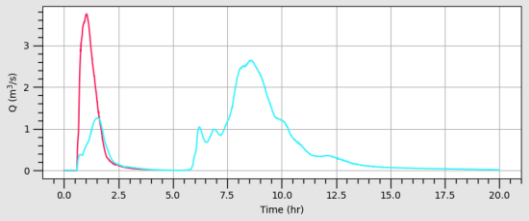
FLOW4



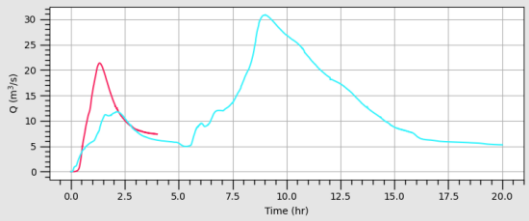
FLOW5

No outflow

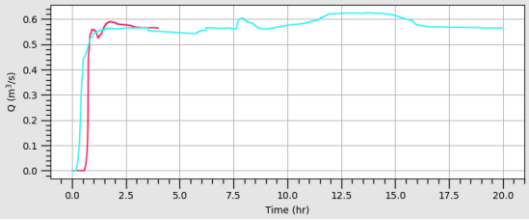
FLOW6



FLOW7



FLOW8

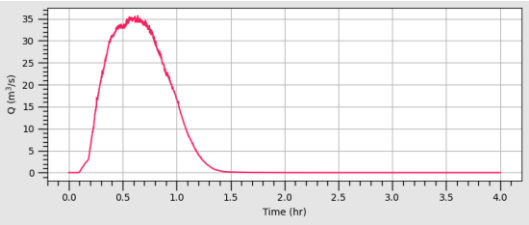


***Title:* Existing Conditions PMF Flow Hydrographs**	
Project: Royal Randwick Racecourse Non-Race Day – Flood Risk assessment	
Project No.: 240009	
Date: 05 - 2024	***Figure No: A13***

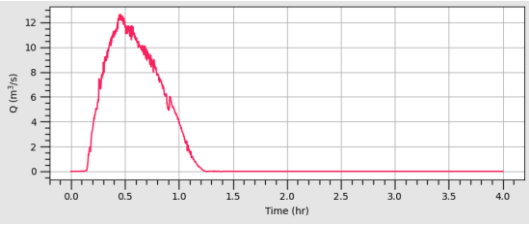
- *60-minute storm in pink*
  - *Start of storm at Time (hr) = 0*
  - *End of storm at Time (hr) = 1*
- *See report Image 5 for reference locations.*

Inflows

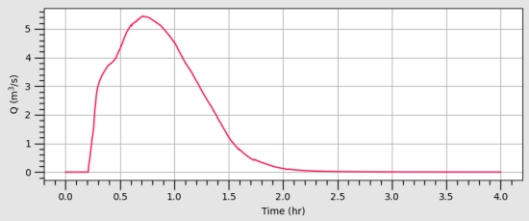
FLOW1



FLOW2

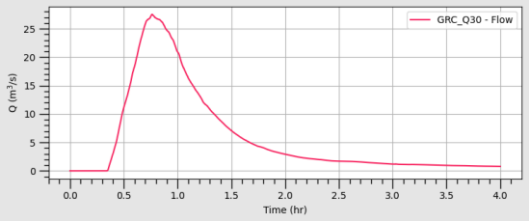


FLOW3

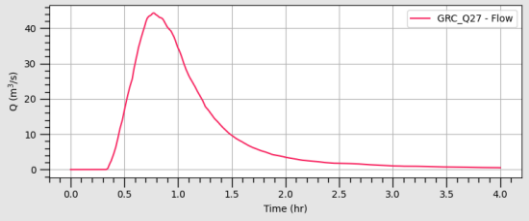


Outflows

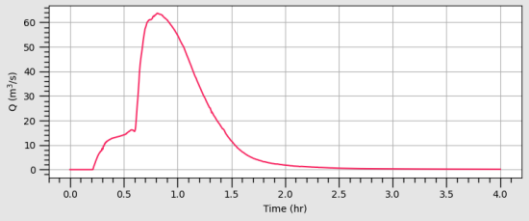
FLOW4



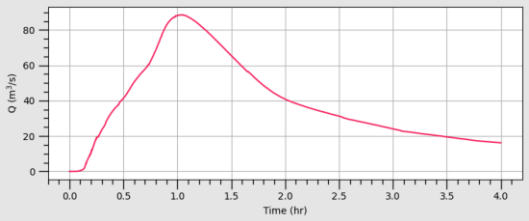
FLOW5



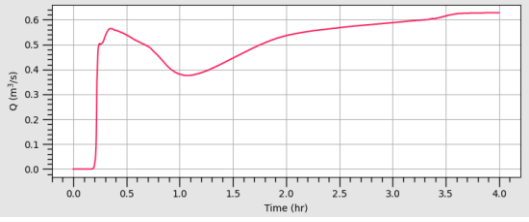
FLOW6



FLOW7



FLOW8





Legend

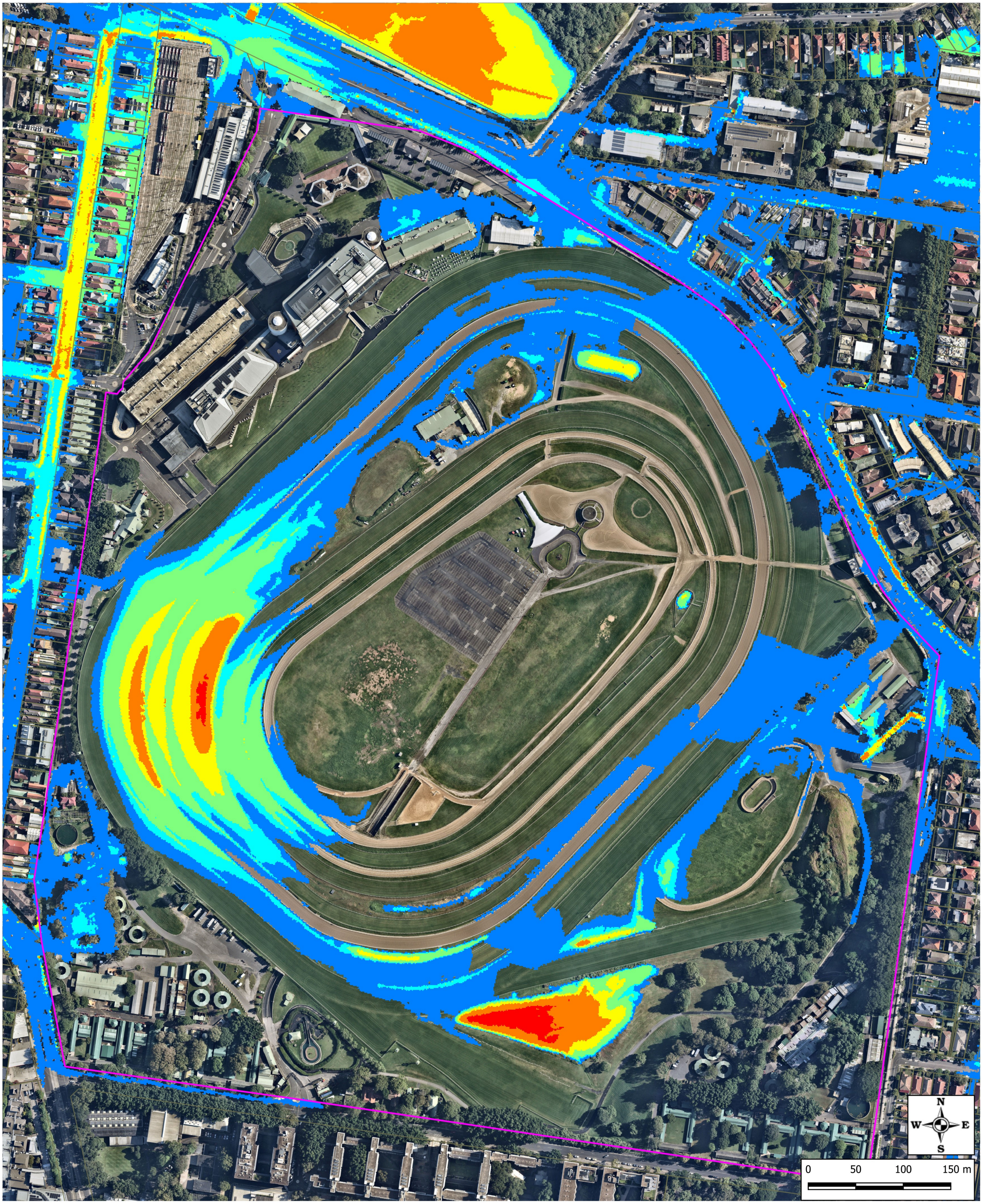
Subject Site

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

TITLE:	**Existing Conditions 10% AEP Hazards**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A14**

grc HYDRO



Legend

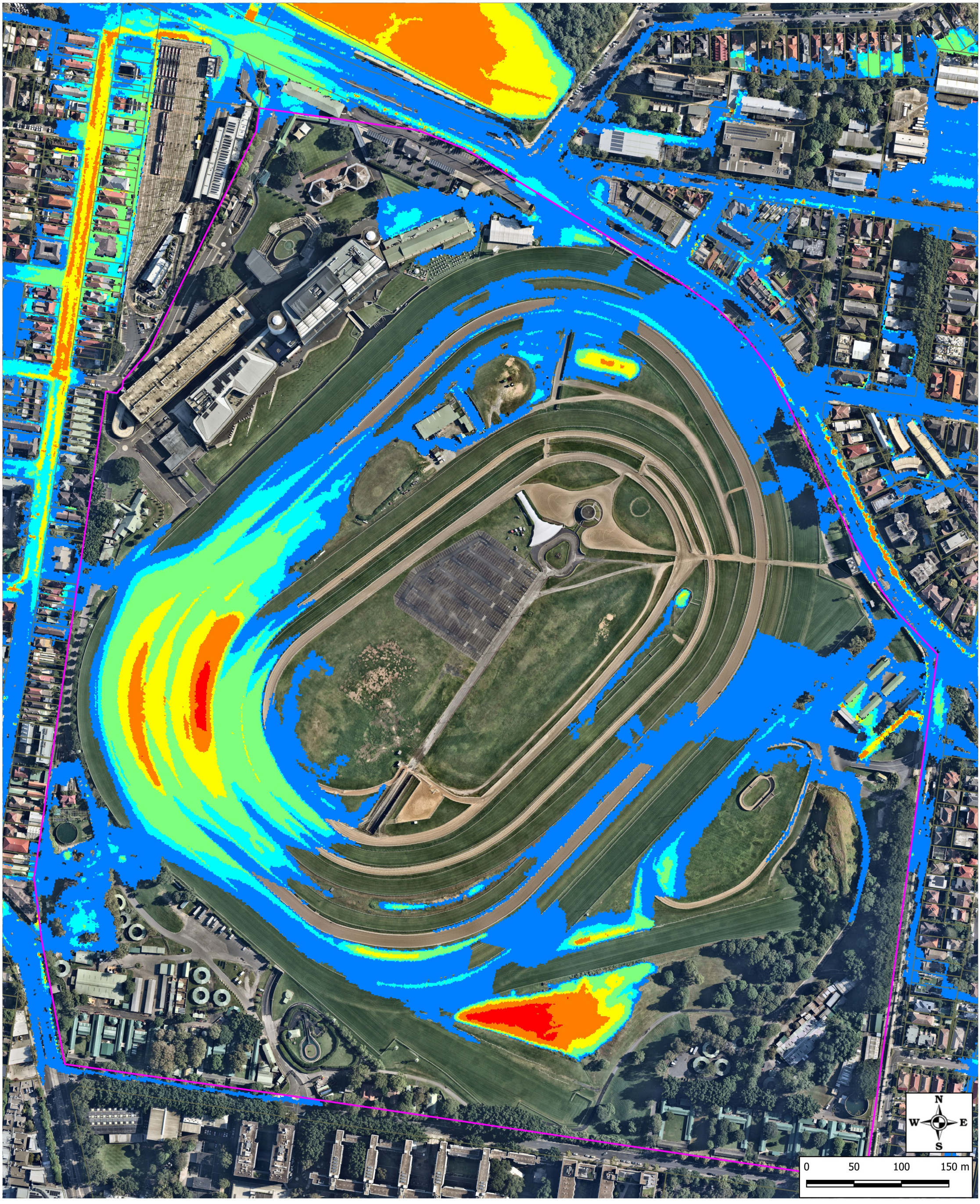
Subject Site

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

TITLE:	**Existing Conditions 1% AEP Hazards**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A15**

grc HYDRO



Legend

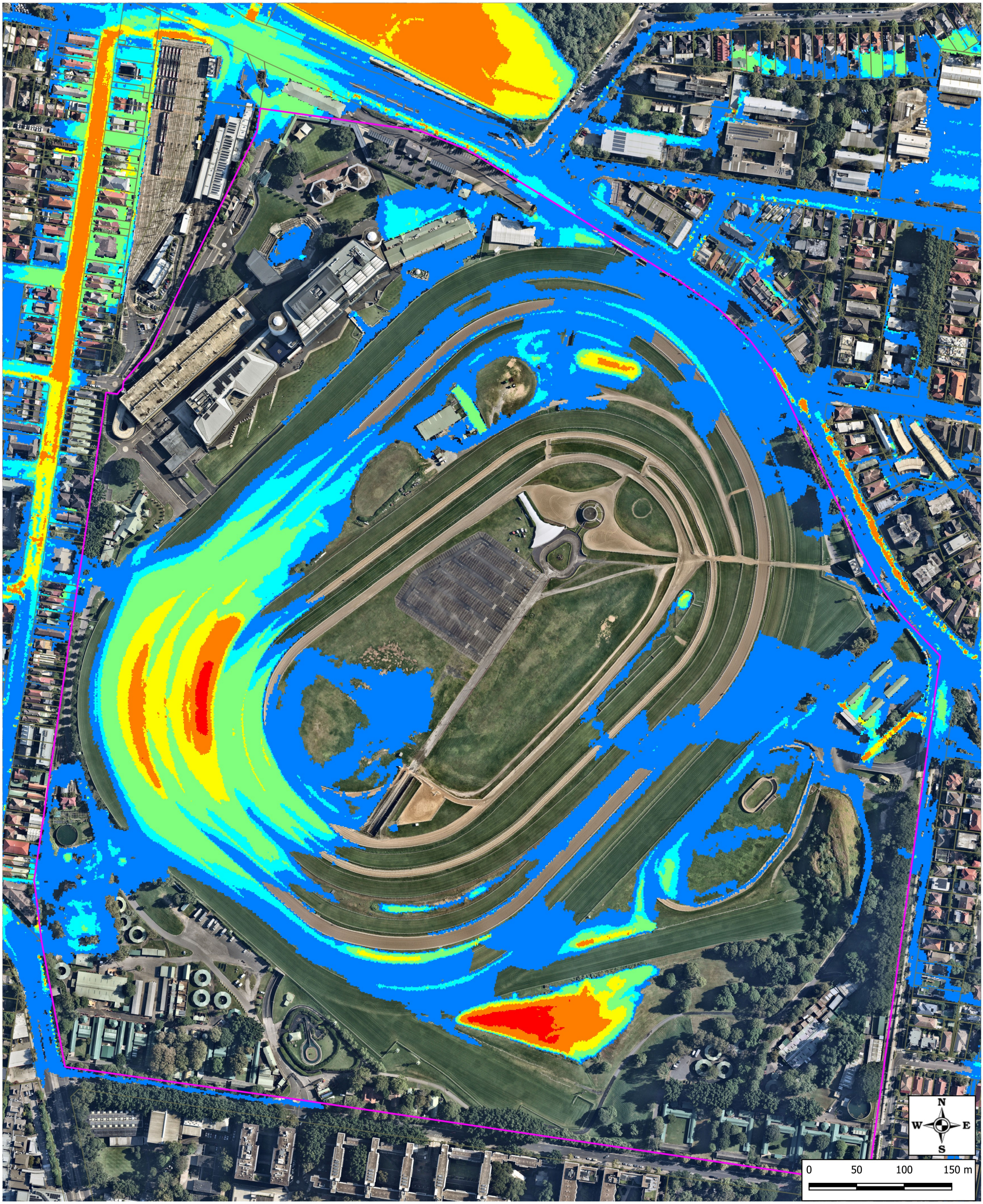
Subject Site

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

TITLE:	**Existing Conditions 0.5% AEP Hazards**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A16**

grc HYDRO



Legend

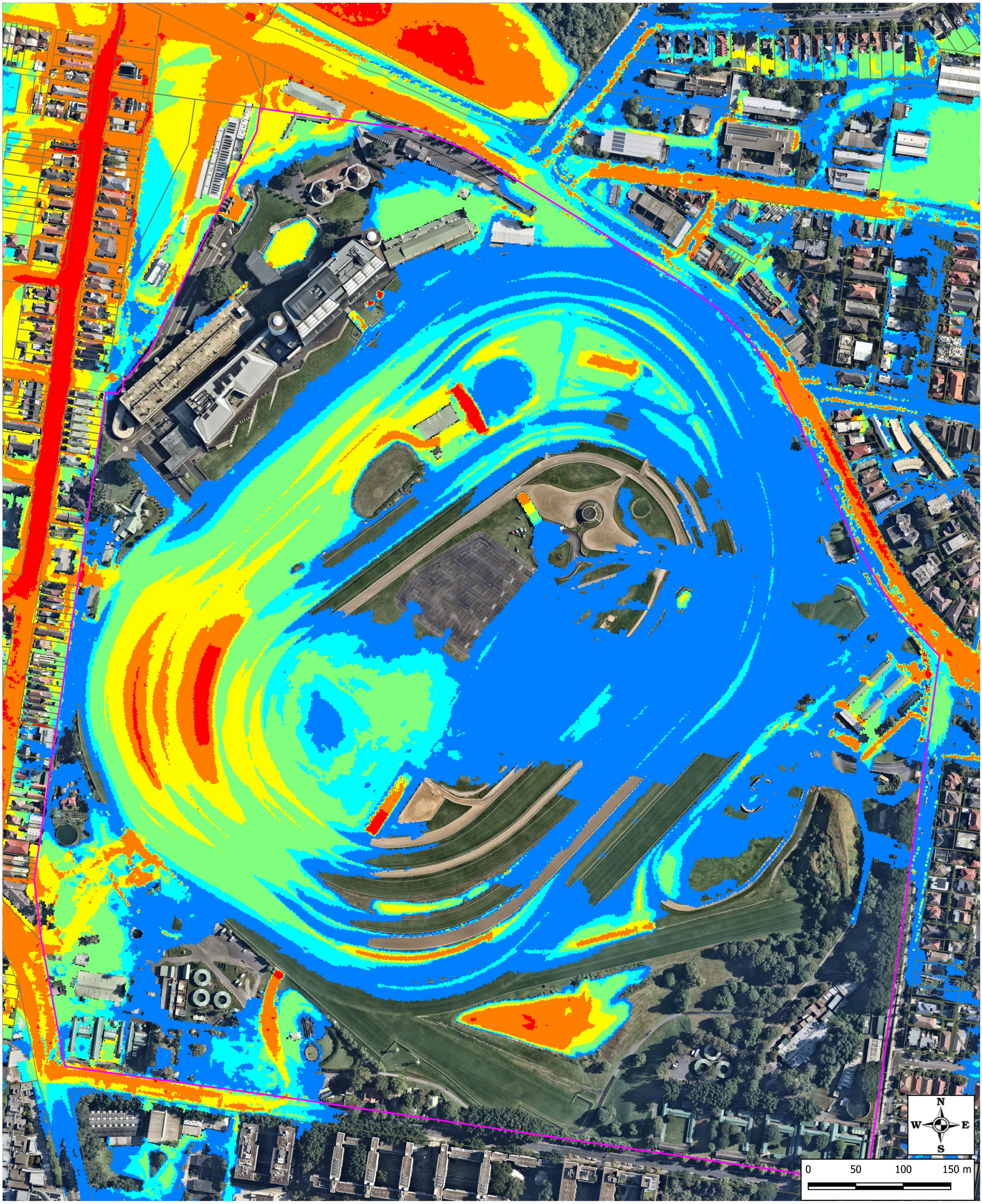
Subject Site

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

TITLE:	**Existing Conditions 0.2% AEP Hazards**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A17**

grc HYDRO



Legend

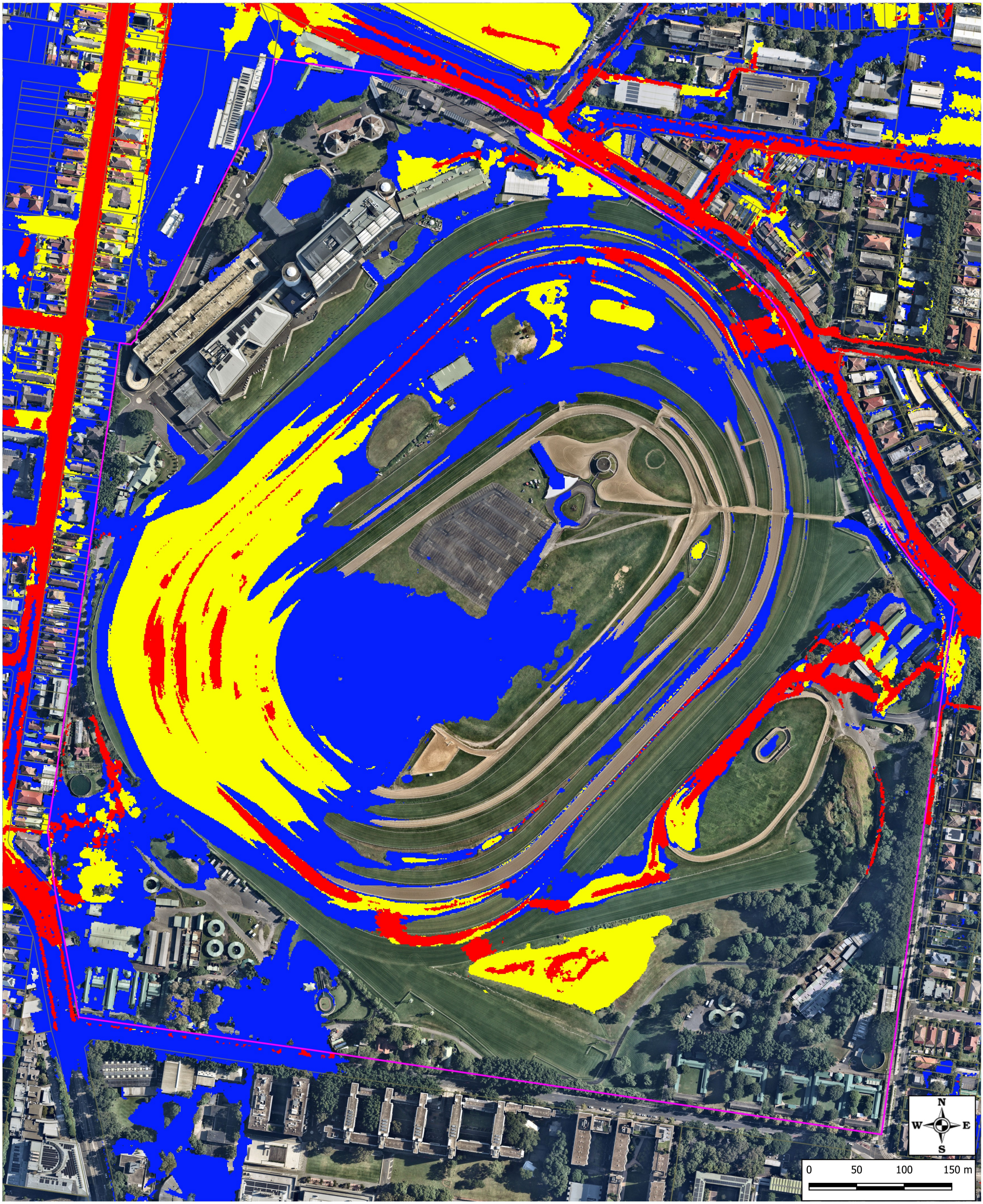
Subject Site

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

TITLE:	**Existing Conditions PMF Hazards**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A18**

grc HYDRO



Legend

Subject Site

Flood Function

Floodway

Flood Storage

Flood Fringe

TITLE:	**Existing Condition – flood function**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **A19**

grc HYDRO



Legend

Subject Site

Impact	
Was wet - now dry	No Change (+/- 10mm)
> 150mm decrease	10mm to 30mm increase
150mm to 100mm decrease	30mm to 50mm increase
100mm to 50mm decrease	50mm to 100mm increase
50mm to 30mm decrease	100mm to 150mm increase
30mm to 10mm decrease	> 150mm increase
	Was dry - now wet

TITLE:	**10% AEP Level Impacts due to a 'Worst-case' Non-Raceday Event Condition**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**

DATE: **05-2024**	SCALE: **1:3500**	FIGURE No. **B01**

grc HYDRO



Legend

Subject Site

Impact

- Was wet - now dry
- > 150mm decrease
- 150mm to 100mm decrease
- 100mm to 50mm decrease
- 50mm to 30mm decrease
- 30mm to 10mm decrease
- No Change (+/- 10mm)
- 10mm to 30mm increase
- 30mm to 50mm increase
- 50mm to 100mm increase
- 100mm to 150mm increase
- > 150mm increase
- Was dry - now wet

TITLE:	**1% AEP Level Impacts due to a 'Worst-case' Non-Raceday Event Condition**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **B02**

grc HYDRO



Legend

Subject Site

Impact

- Was wet - now dry
- > 150mm decrease
- 150mm to 100mm decrease
- 100mm to 50mm decrease
- 50mm to 30mm decrease
- 30mm to 10mm decrease
- No Change (+/- 10mm)
- 10mm to 30mm increase
- 30mm to 50mm increase
- 50mm to 100mm increase
- 100mm to 150mm increase
- > 150mm increase
- Was dry - now wet

TITLE:	**0.5% AEP Level Impacts due to a 'Worst-case' Non-Raceday Event Condition**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **B03**

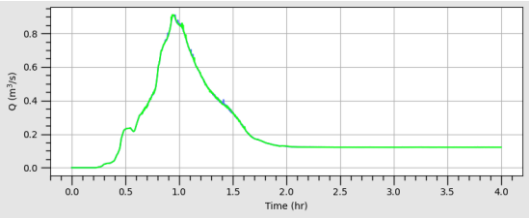
grc HYDRO

Title: 10% AEP Impacts on Flow due to a 'Worst-case' Non-Raceday Event Condition	
Project: Royal Randwick Racecourse Non-Race Day – Flood Risk assessment	
Project No.: 240009	
Date: 05 - 2024	***Figure No: B04***

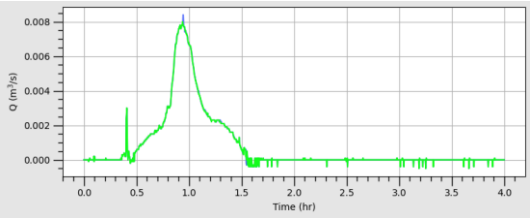
- *60-minute storm in green for Existing Conditions and blue for Proposed Conditions*
  - *Start of storm at Time (hr) = 0*
  - *End of storm at Time (hr) = 1*
- *See report Image 5 for reference locations.*

Inflows

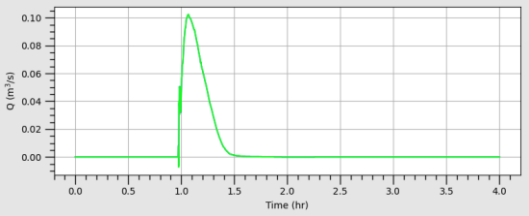
FLOW1



FLOW2



FLOW3



Outflows

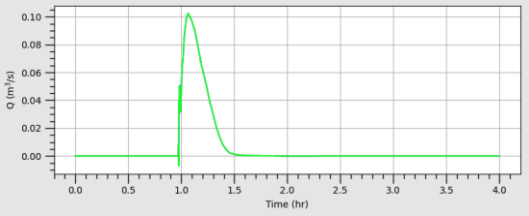
FLOW4

No outflow

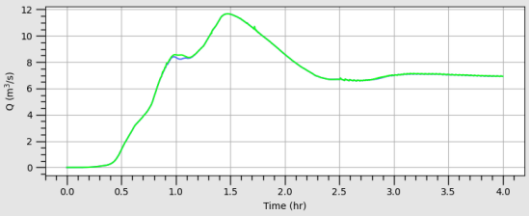
FLOW5

No outflow

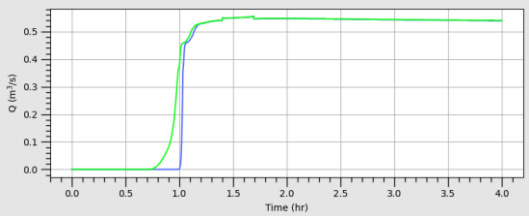
FLOW6



FLOW7



FLOW8

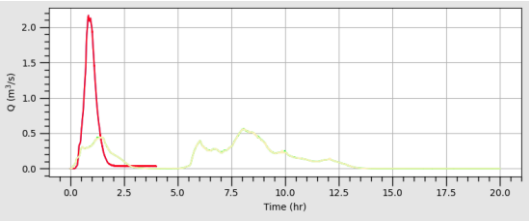


Title: 1% AEP Impacts on Flow due to a 'Worst-case' Non-Raceday Event Condition	
Project: Royal Randwick Racecourse Non-Race Day – Flood Risk assessment	
Project No.: 240009	
Date: 05 - 2024	***Figure No: B05***

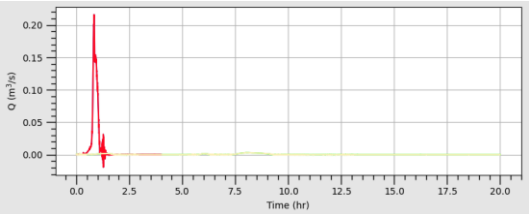
- *60-minute storm in blue for Existing Conditions and red for Proposed Conditions*
  - *Start of storm at Time (hr) = 0*
  - *End of storm at Time (hr) = 1*
- *See report Image 5 for reference locations.*
- *720-minute storm in green for Existing Conditions and yellow for Proposed Conditions*
  - *Start of storm at Time (hr) = 0*
  - *End of storm at Time (hr) = 12*

Inflows

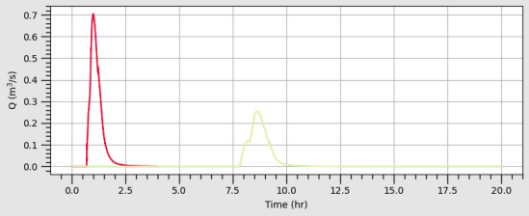
FLOW1



FLOW2

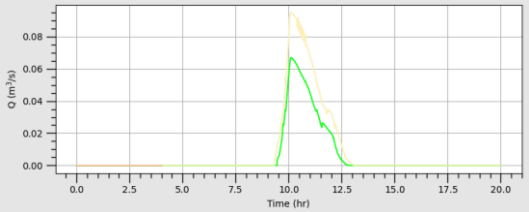


FLOW3



Outflows

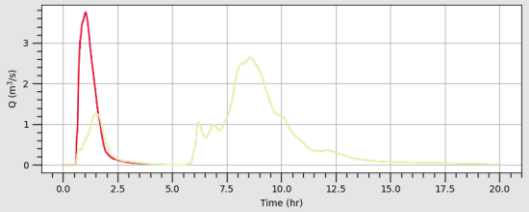
FLOW4



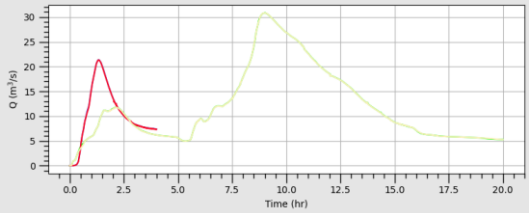
FLOW5

No outflow

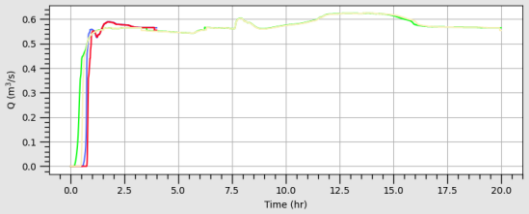
FLOW6



FLOW7



FLOW8

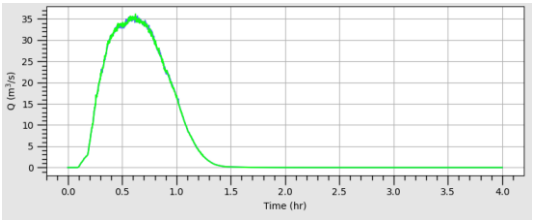


Title: PMF Impacts on Flow due to a 'Worst-case' Non-Raceday Event Condition	
Project: Royal Randwick Racecourse Non-Race Day – Flood Risk assessment	
Project No.: 240009	
Date: 05 - 2024	***Figure No: B06***

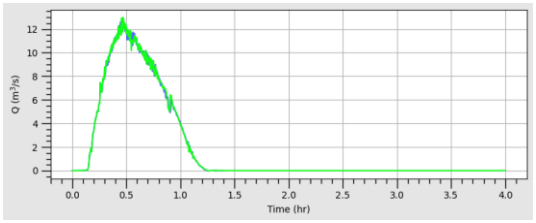
- *60-minute storm in blue for Existing Conditions and green for Proposed Conditions*
  - *Start of storm at Time (hr) = 0*
  - *End of storm at Time (hr) = 1*
- *See report Image 5 for reference locations.*

Inflows

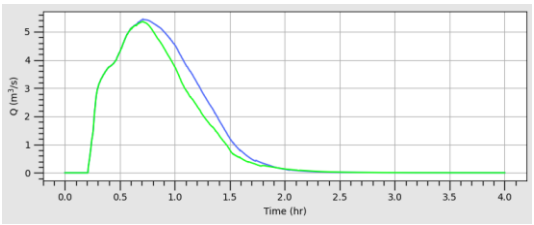
FLOW1



FLOW2

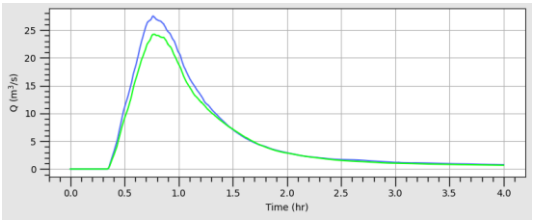


FLOW3

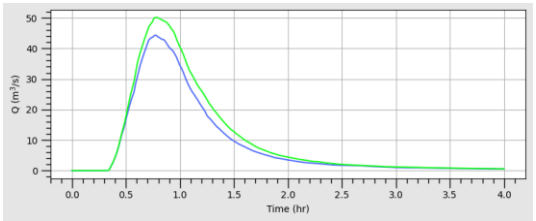


Outflows

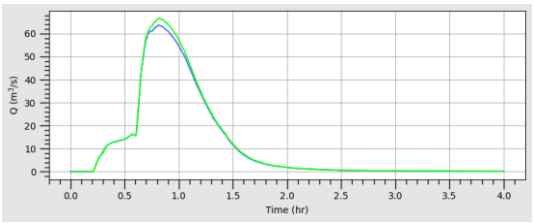
FLOW4



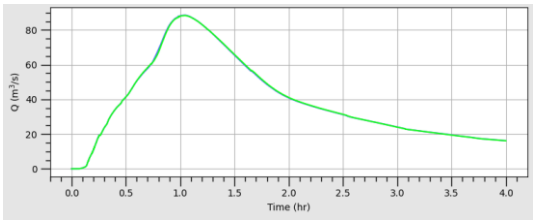
FLOW5



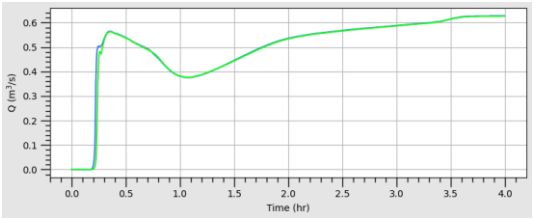
FLOW6



FLOW7



FLOW8



N

W E

S

0 50 100 150 m

Legend

Subject Site

Impact

- 5 categories better (H6 to H1)
- 4 categories better
- 3 categories better
- 2 categories better
- 1 category better
- No change
- 1 category worse
- 2 categories worse
- 3 categories worse
- 4 categories worse
- 5 categories worse (H1 to H6)

TITLE:	**10% AEP Hazard Impacts due to a 'Worst-case' Non-Raceday Event Condition**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500**
FIGURE No.	**B07**

grc HYDRO



Legend

Subject Site

Impact

- 5 categories better (H6 to H1)
- 4 categories better
- 3 categories better
- 2 categories better
- 1 category better
- No change
- 1 category worse
- 2 categories worse
- 3 categories worse
- 4 categories worse
- 5 categories worse (H1 to H6)

TITLE:	**1% AEP Hazard Impacts due to a 'Worst-case' Non-Raceday Event Condition**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** — FIGURE No. **B08**

grc HYDRO



Legend

Subject Site

Impact

- 5 categories better (H6 to H1)
- 4 categories better
- 3 categories better
- 2 categories better
- 1 category better
- No change
- 1 category worse
- 2 categories worse
- 3 categories worse
- 4 categories worse
- 5 categories worse (H1 to H6)

TITLE:	**0.5% AEP Hazard Impacts due to a 'Worst-case' Non-Raceday Event Condition**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **B09**

grc HYDRO

Legend

Subject Site

Impact

- 5 categories better (H6 to H1)
- 4 categories better
- 3 categories better
- 2 categories better
- 1 category better
- No change
- 1 category worse
- 2 categories worse
- 3 categories worse
- 4 categories worse
- 5 categories worse (H1 to H6)

N

W E

S

0 50 100 150 m

TITLE:	**PMF Hazard Impacts due to a 'Worst-case' Non-Raceday Event Condition**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **B10**

grc HYDRO



Legend

Subject Site

Level Contour (m AHD)

Major Contour (0.5m interval)

Minor Contour (0.1m interval)

Depths (m)

<= 0.01

0.01 - 0.05

0.05 - 0.10

0.10 - 0.30

0.30 - 0.50

> 0.50

TITLE:	**10% AEP Depths and Levels for 2090 RCP8.5 Climate Change Scenario**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500**
FIGURE No.	**C01**

grc HYDRO



Legend

Subject Site

Level Contour (m AHD)

Major Contour (0.5m interval)

Minor Contour (0.1m interval)

Depths (m)

- <= 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- > 0.50

TITLE:	**1% AEP Depths and Levels for 2090 RCP8.5 Climate Change Scenario**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**

DATE: **05-2024**	SCALE: **1:3500**	FIGURE No. **C02**

grc HYDRO



Legend

Subject Site

Impact

- Was wet - now dry
- > 150mm decrease
- 150mm to 100mm decrease
- 100mm to 50mm decrease
- 50mm to 30mm decrease
- 30mm to 10mm decrease
- No Change (+/- 10mm)
- 10mm to 30mm increase
- 30mm to 50mm increase
- 50mm to 100mm increase
- 100mm to 150mm increase
- > 150mm increase
- Was dry - now wet

TITLE:	**10% AEP Level Impacts for 2090 RCP8.5 Climate Change Scenario**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **C03**

grc HYDRO



Legend

Subject Site

Impact

- Was wet - now dry
- > 150mm decrease
- 150mm to 100mm decrease
- 100mm to 50mm decrease
- 50mm to 30mm decrease
- 30mm to 10mm decrease
- No Change (+/- 10mm)
- 10mm to 30mm increase
- 30mm to 50mm increase
- 50mm to 100mm increase
- 100mm to 150mm increase
- > 150mm increase
- Was dry - now wet

TITLE:	**1% AEP Level Impacts for 2090 RCP8.5 Climate Change Scenario**
PROJECT:	**Royal Randwick Racecourse Non-Race Day - Flood Risk Assessment**
PROJECT No.	**240009**
DATE: **05-2024**	SCALE: **1:3500** FIGURE No. **C04**

grc HYDRO