6.2.5 Hydraulic Categories

Floodplain Development Manual (2005) defines flood prone areas according to the hydraulic categories shown in **Table 6-3**. The hydraulic categories provide an indication of the potential for development across different sections of the floodplain to impact on existing flood behaviour.

Table 6-3 Floodplain Development Manual (2005) Hydraulic Category Criteria

Hydraulic Category	Description
Floodway	Those areas where a significant volume of water flows during floods and are often aligned with obvious natural channels. They are areas that, even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur.
Flood storage	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. If the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. Substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flood flows.
Flood fringe	The remaining area of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.

The Floodplain Development Manual (2005) provides qualitative definitions for hydraulic categories rather than explicit quantitative criteria i.e. no clear numerical method defining the different hydraulic classifications is presented. The WorleyParsons (2015) study had derived a methodology as part of that study which encompassed a combination of interpretation and subjectivity specific to the objectives of the project at the time of the study. Adopting the same methodology is not possible therefore a set of revised criteria based on typical ranges was adopted to define each hydraulic category. This criteria set is presented in **Table 6-4**.

Table 6-4 Adopted Hydraulic Category Criteria

Hydraulic Category	Criteria
Floodway	Velocity * Depth > 0.5 m^2/s
Flood storage	Velocity * Depth < 0.5 m^2/s and Depth > 0.5 m
Flood fringe	Velocity * Depth < 0.5 m^2/s and Depth < 0.5 m

The adopted hydraulic categories based on the WorleyParsons Study (2015) are shown in **Figure 6-30**.

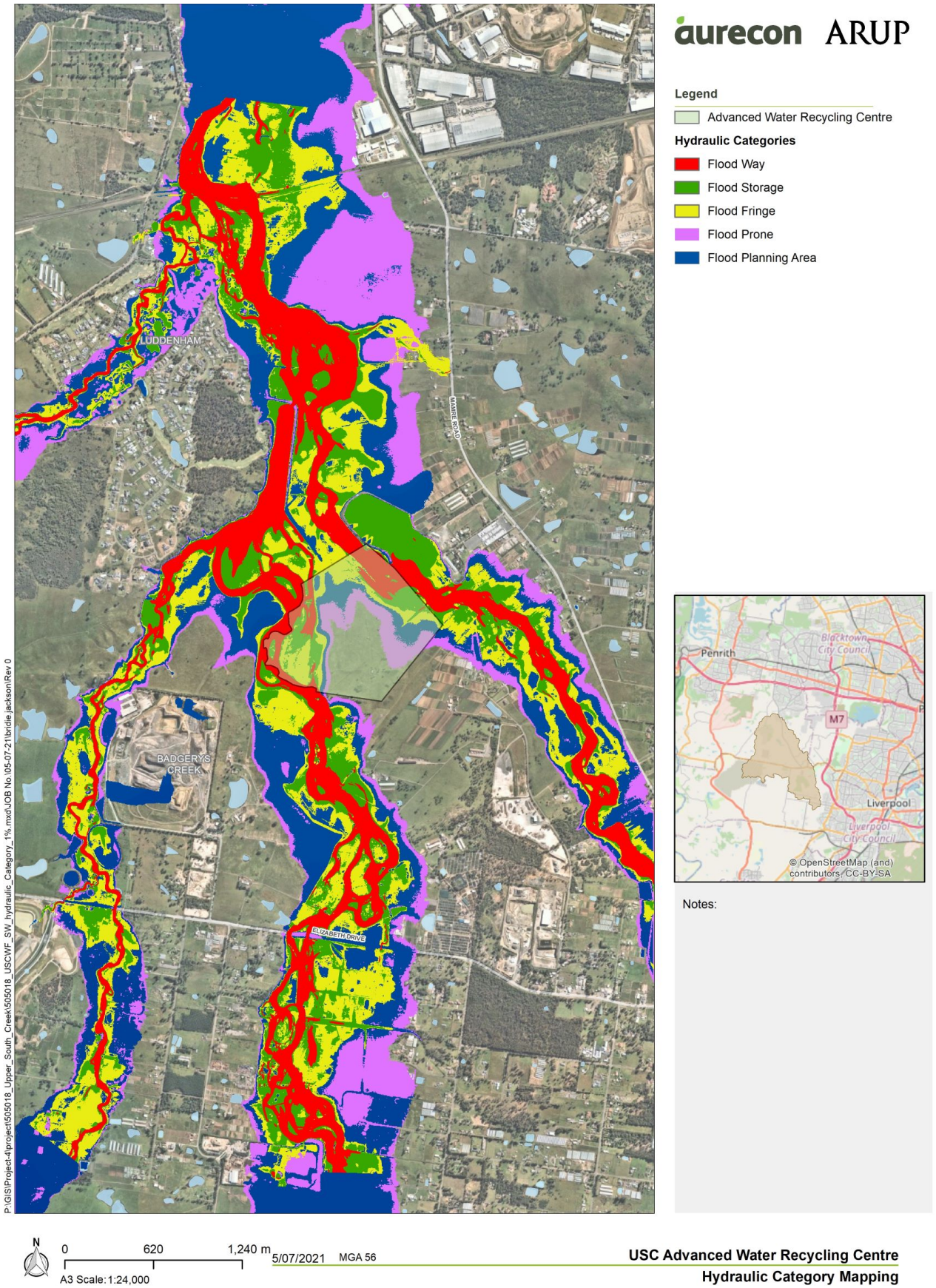


Figure 6-30 Hydraulic Category Mapping – WorleyParsons (2015)

6.3 South Creek Design Case Flooding Behaviour

To represent the proposed design case scenario, proposed design layouts of the ultimate 100ML development scenario were reviewed. The proposed design consists of a fill pad to accommodate the main operational components of the proposed development, three detention basins, a proposed wetland area, a swale and an access road. Refer to **Figure 4-10** for a representation of the proposed design extent.

The regional stormwater detention basins were considered in the design to mitigate the flood impacts on South Creek and Kemps Creek resulting from local development runoff. Site access is through a proposed road running approximately perpendicular from Clifton Ave. A swale (1 to 2 m deep) was provided to direct flows from the southern detention basin to South Creek. The proposed development is located outside the 1% AEP flood extent. As such, any changes to the flooding conditions is expected to remain localised and not affect the broader floodplain. As a result, the local drainage from the site was not modelled explicitly as part of this analysis however has been investigated as part of the site drainage. With regards to impact from local stormwater drainage on the South Creek catchment, the design intent would be to limit post development flows to no more than pre-development conditions.

6.3.1 Flood Depth and Level

The design peak flood depths and levels around the study area for the 10% AEP up to PMF event are shown in **Figure 6-31** through **Figure 6-38**.

Based on the modelling results, no significant change in regional flood conditions is expected as a result of the development, as the site fill pad is located outside the flooded zone for storm events up to 0.2% AEP and the descriptions provided in **Section 6.2.1** and **6.2.2** are still valid.

However, under the PMF event shown in **Figure 6-38**, changes in flood levels and depths occur due to the elevated pad which results in a blockage of flow and loss of flood storage. Floodwater levels along the west side of the development range from 39.7 to 40.2 m AHD, along the north side are about 39.7, along the east side from 40.1 to about 41.1 m AHD and along the south side are about 40.2 to about 41.1 m AHD.

For the 1% AEP FFA scenario, the fill pad slightly encroaches the flood extent on the eastern side causing a minor localised blockage and displacement of flow. Floodwater levels remain as per existing conditions along most portions of the boundaries; levels at the west side of the development range from 38.0 to 39.0 m AHD, along the north is approximately 38.0 m AHD, and along the east side range from 38.0 to 39.5 m AHD.

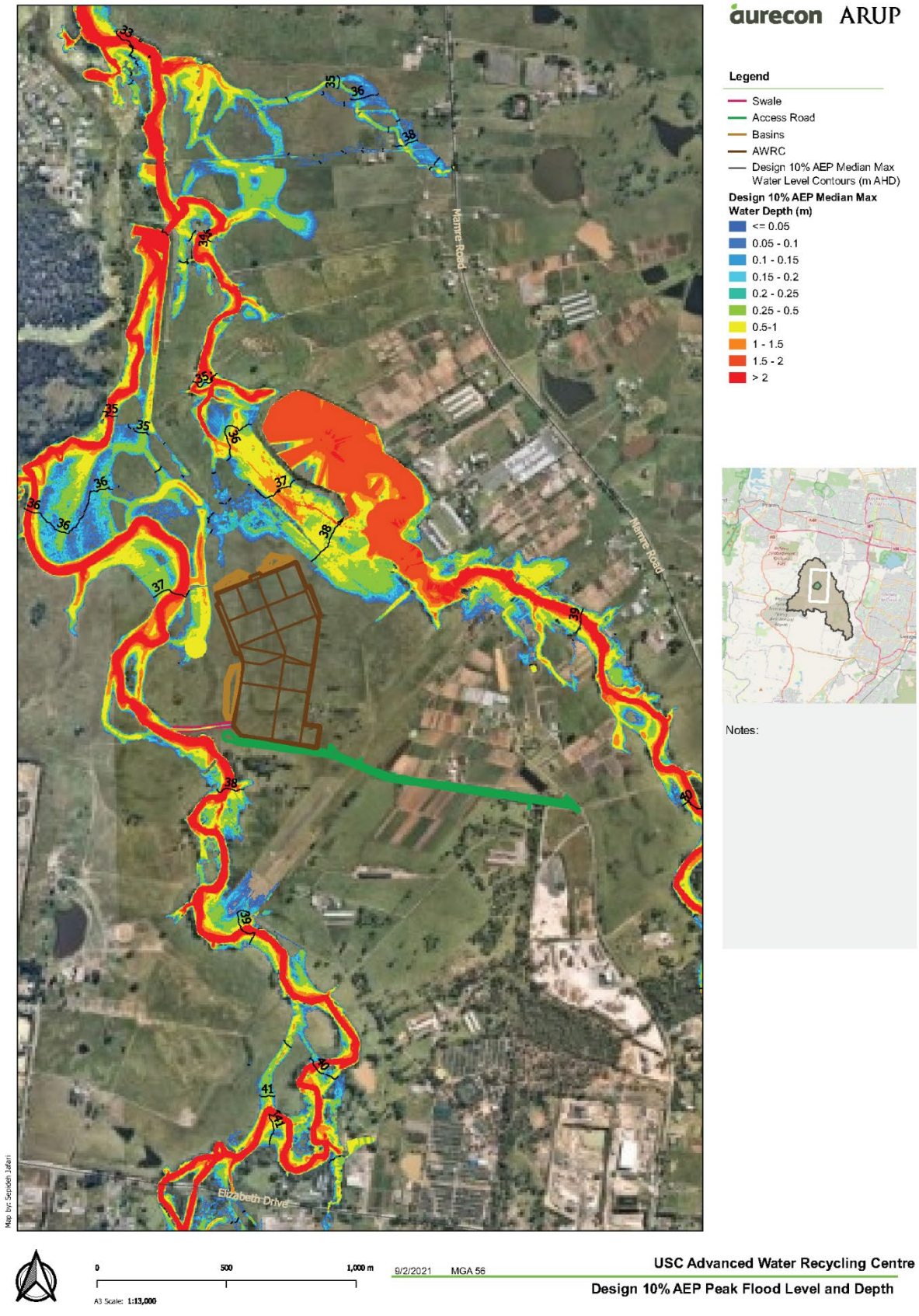


Figure 6-31 Design case 10% AEP peak flood levels and depths

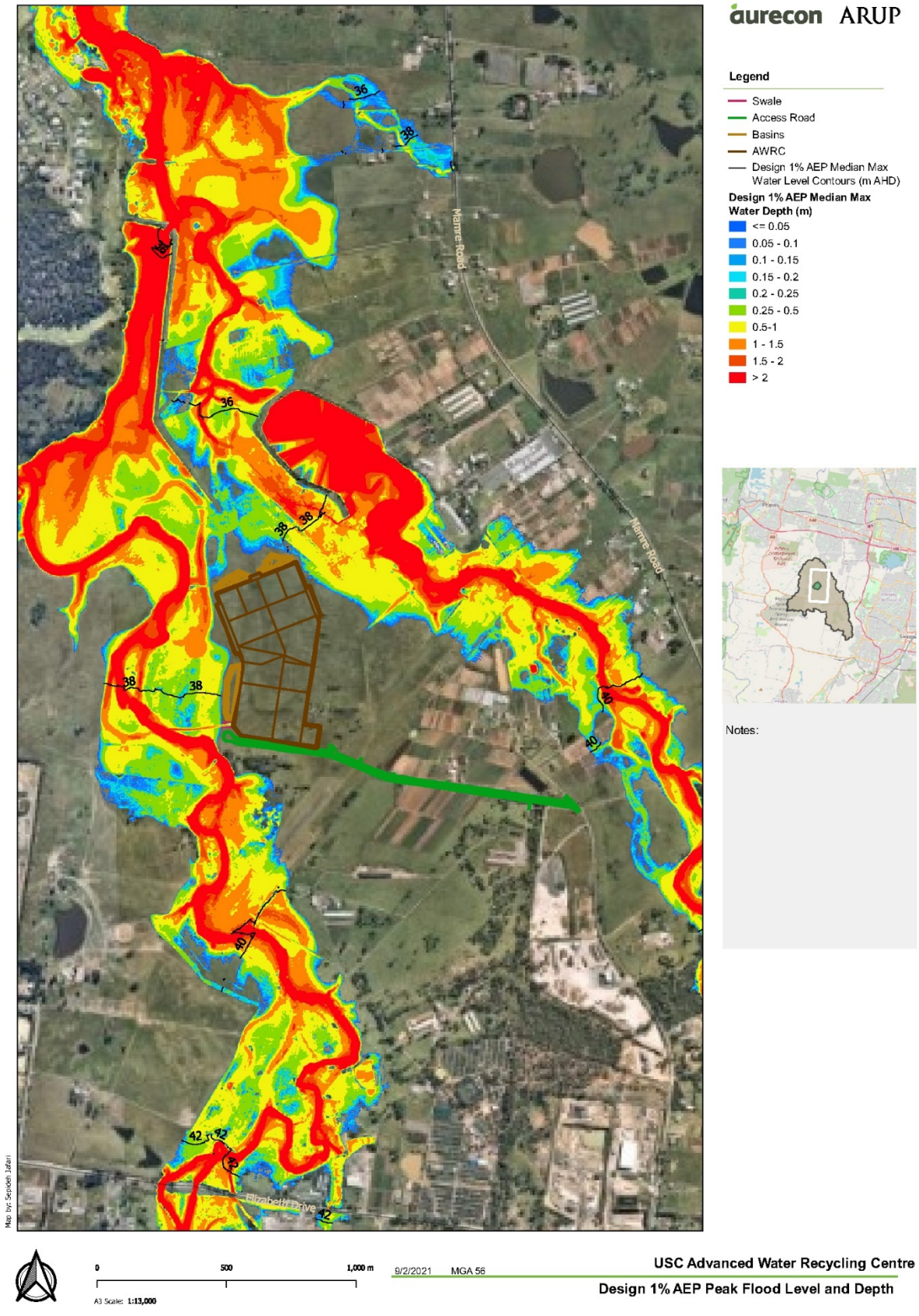


Figure 6-32 Design case 1% AEP peak flood levels and depths

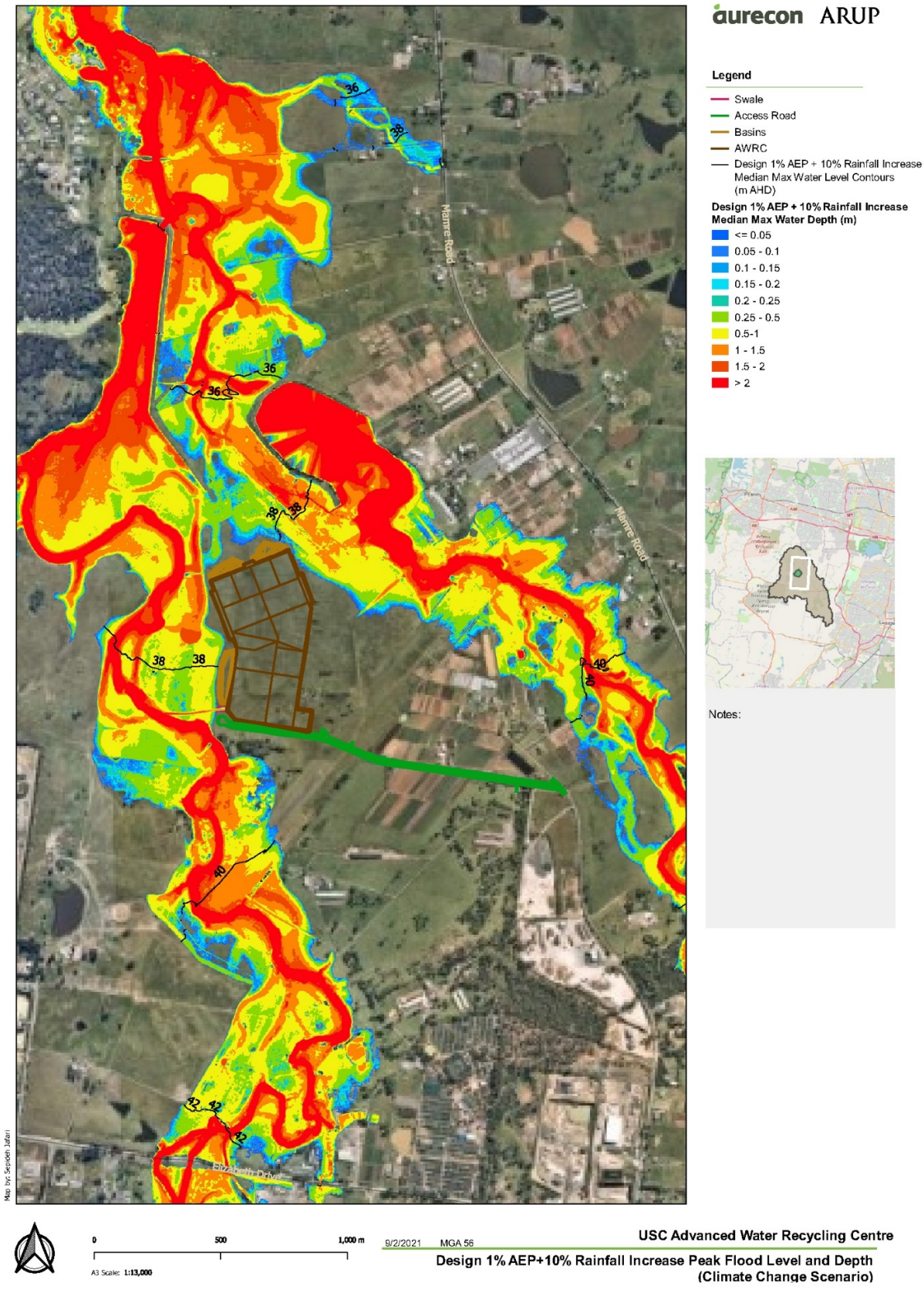


Figure 6-33 Design case 1% AEP + 10% rainfall increase peak flood levels and depths (Climate Change)

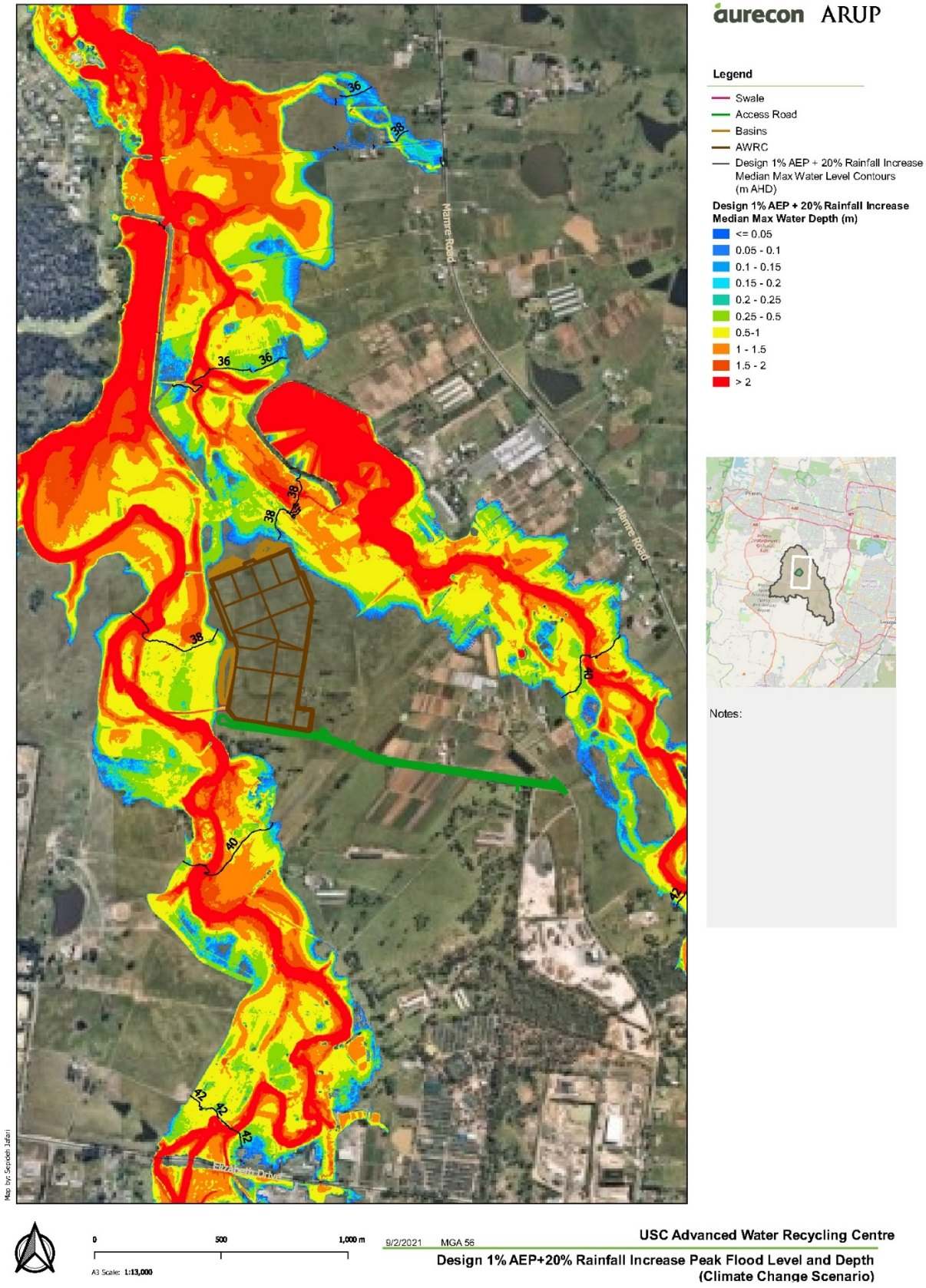


Figure 6-34 Design case 1% AEP + 20% rainfall increase peak flood levels and depths (Climate Change)

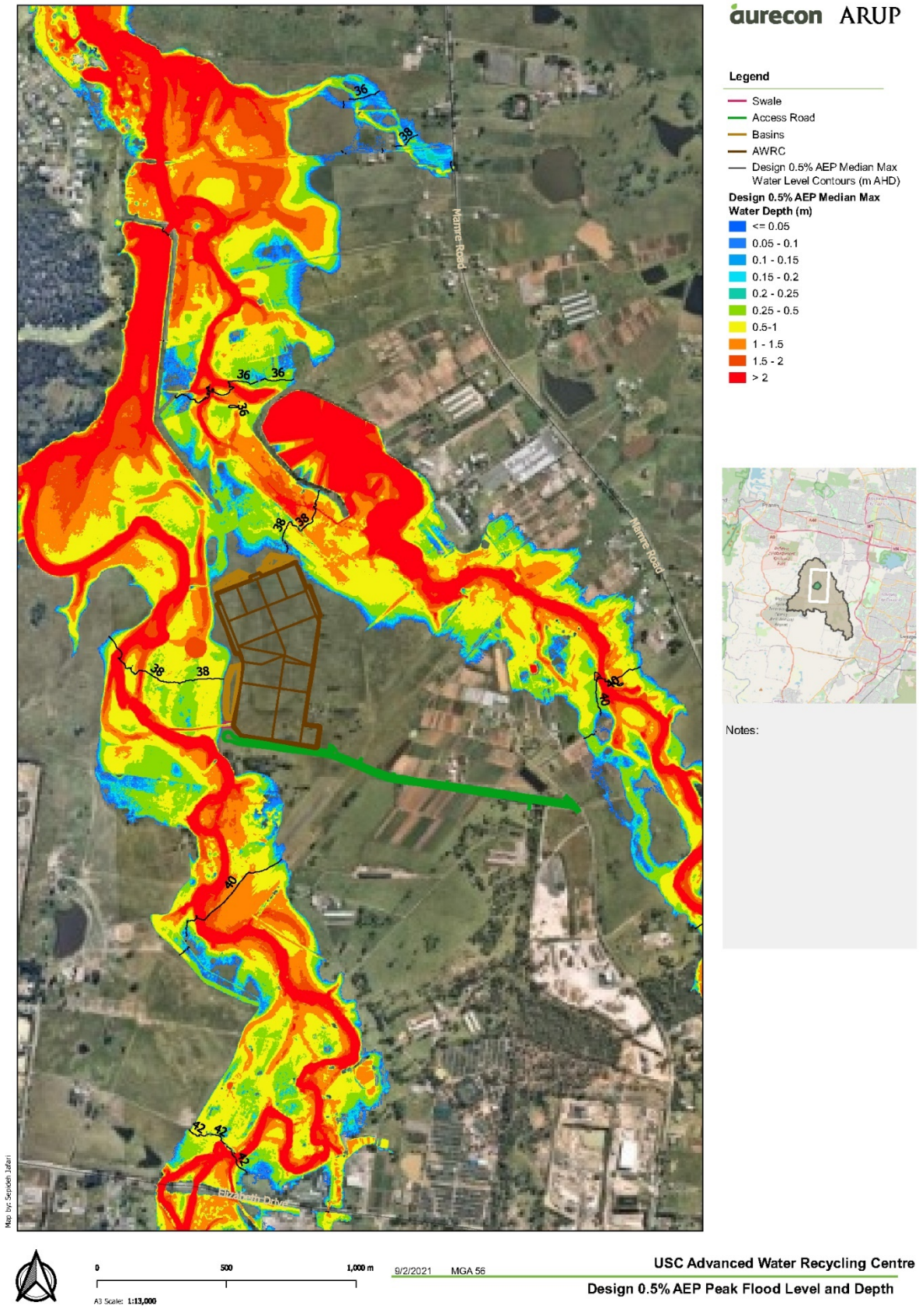


Figure 6-35 Design case 0.5% AEP peak flood levels and depths

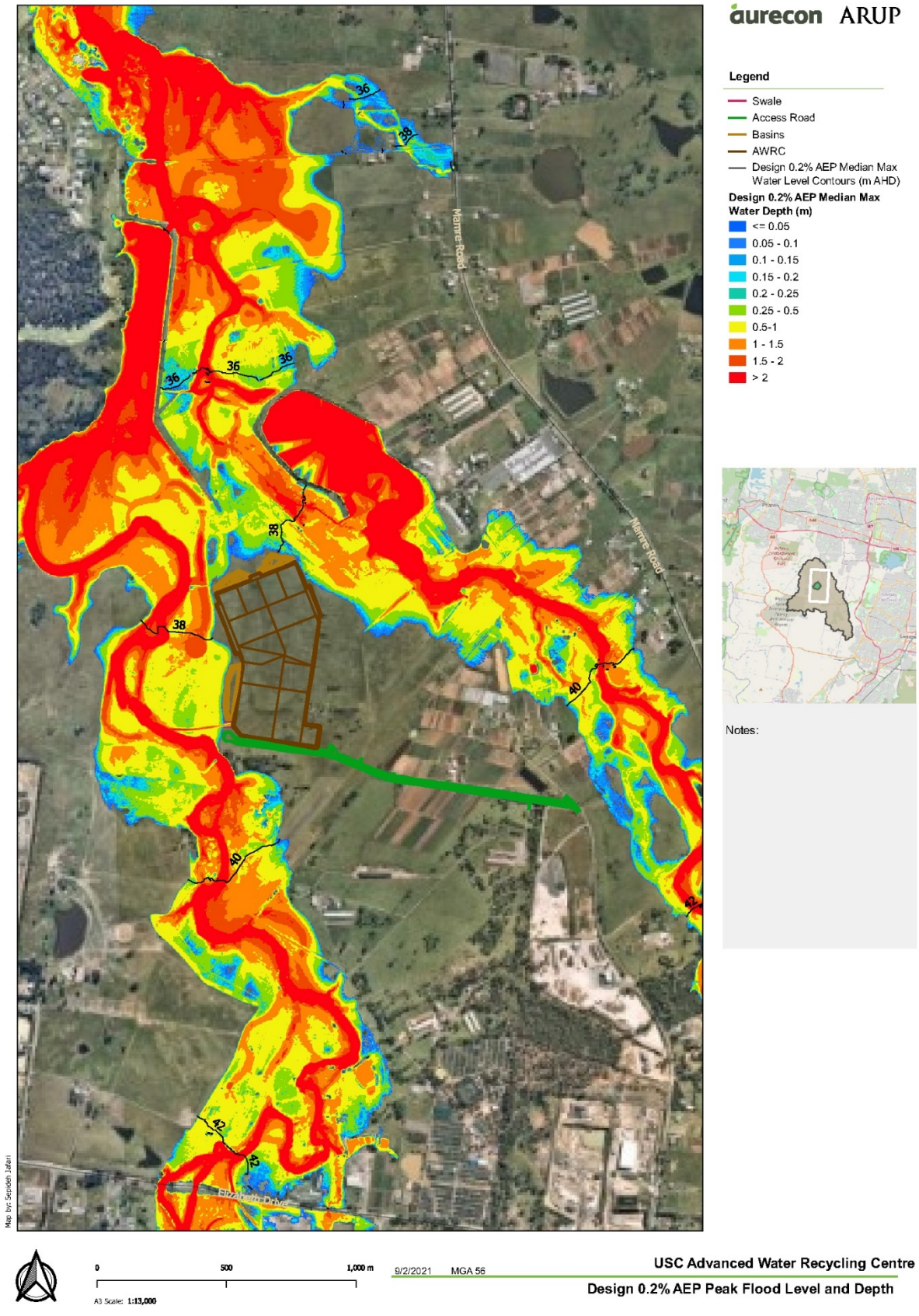


Figure 6-36 Design case 0.2% AEP peak flood levels and depths

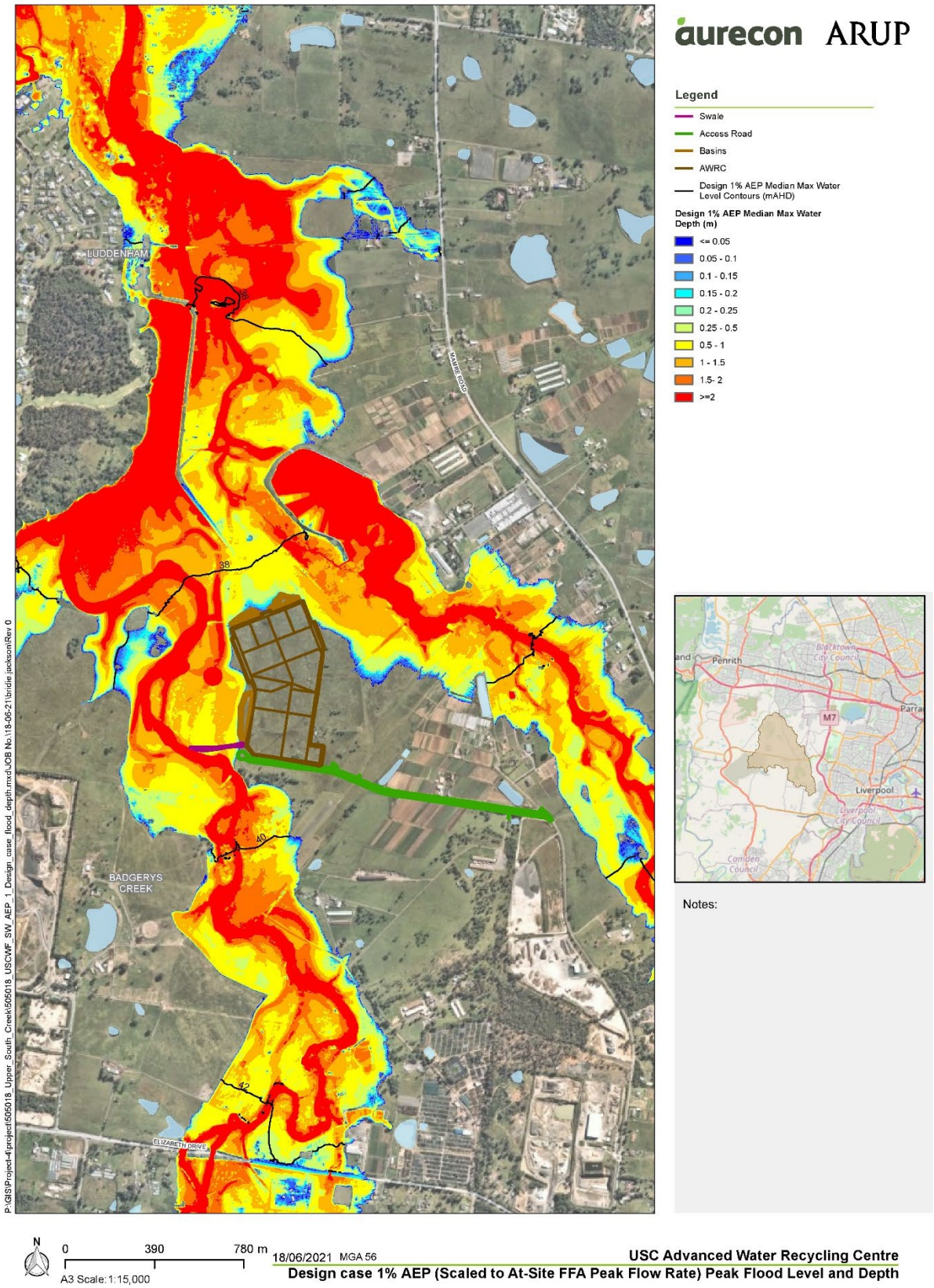


Figure 6-37 Design case 1% AEP FFA peak flood levels and depths

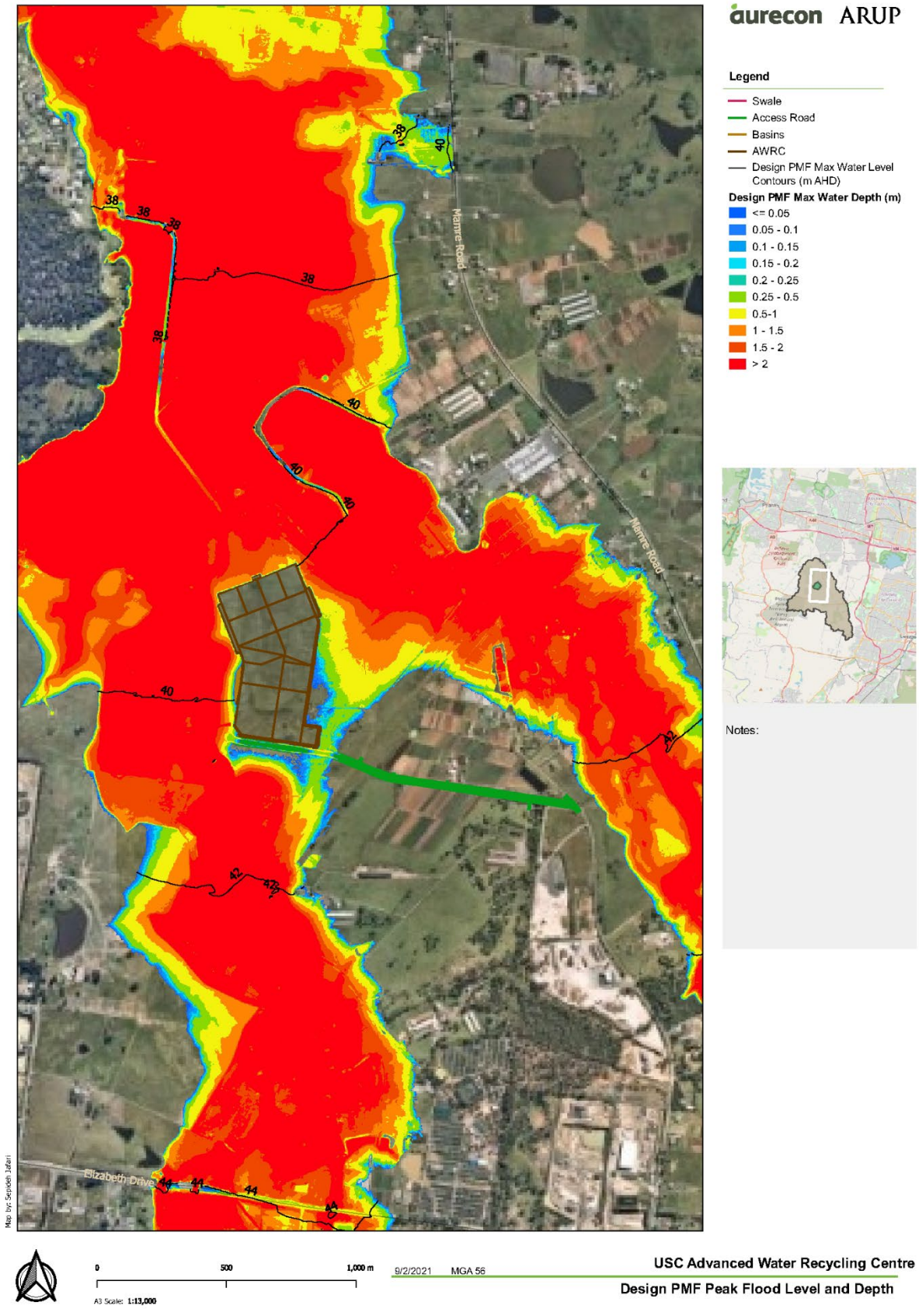


Figure 6-38 Design case PMF peak flood levels and depths

6.3.2 Velocity

The design peak flood velocities around the study area for the 10% AEP up to PMF event are shown in **Figure 6-39** through **Figure 6-46**.

No significant changes in peak flood velocities within the development site and adjacent floodplain are expected under the AEP events modelled including the 1% AEP FFA scenario and the description provided in **Section 6.2.3** is still valid here.

During the PMF event (shown in **Figure 6-46**), flood velocities around the development site are almost the same as existing scenario with decreasing slightly along the northern side. Peak flood velocities are about 0.25 m/s along the northern side.

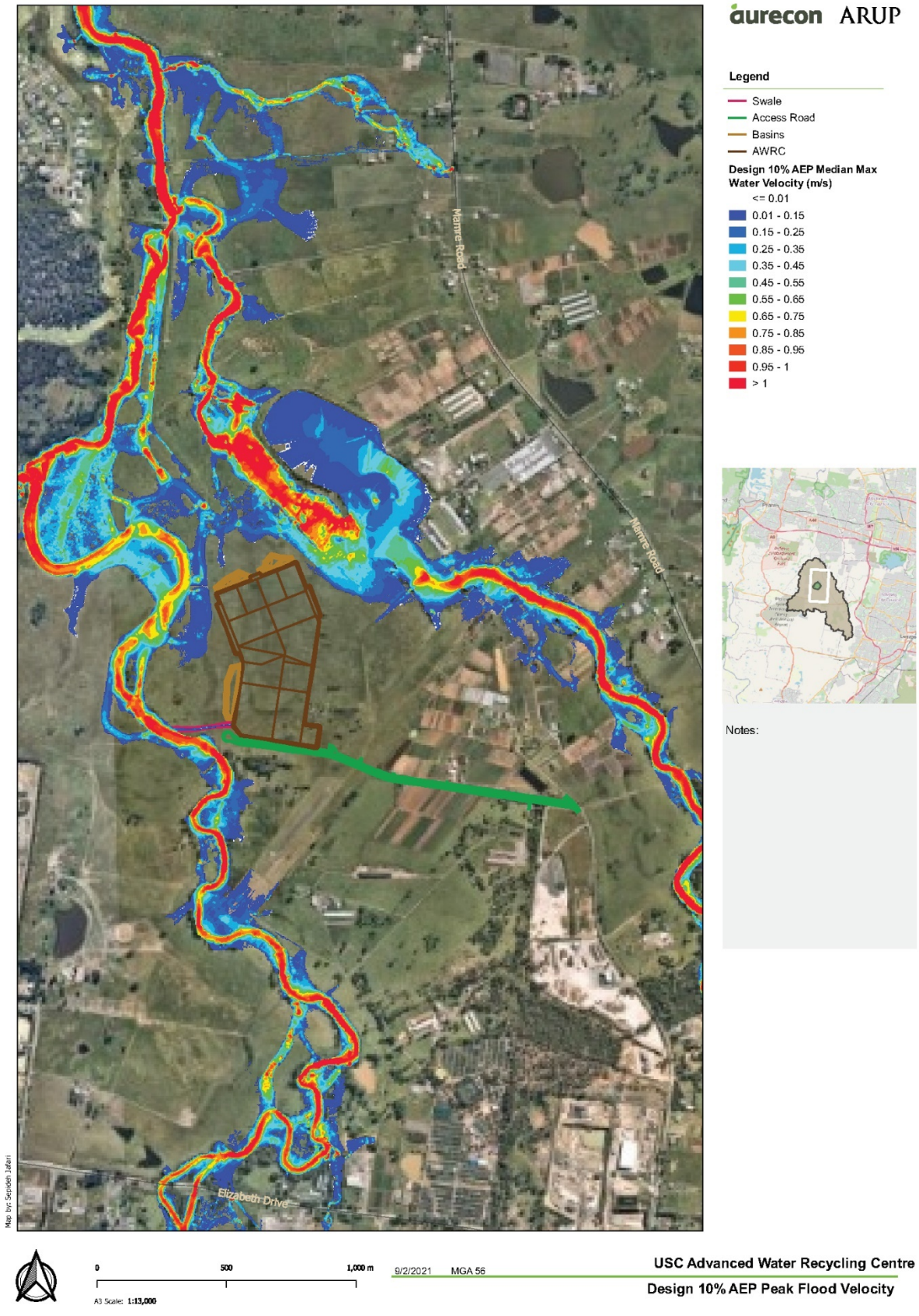


Figure 6-39 Design case 10% AEP peak flood velocity

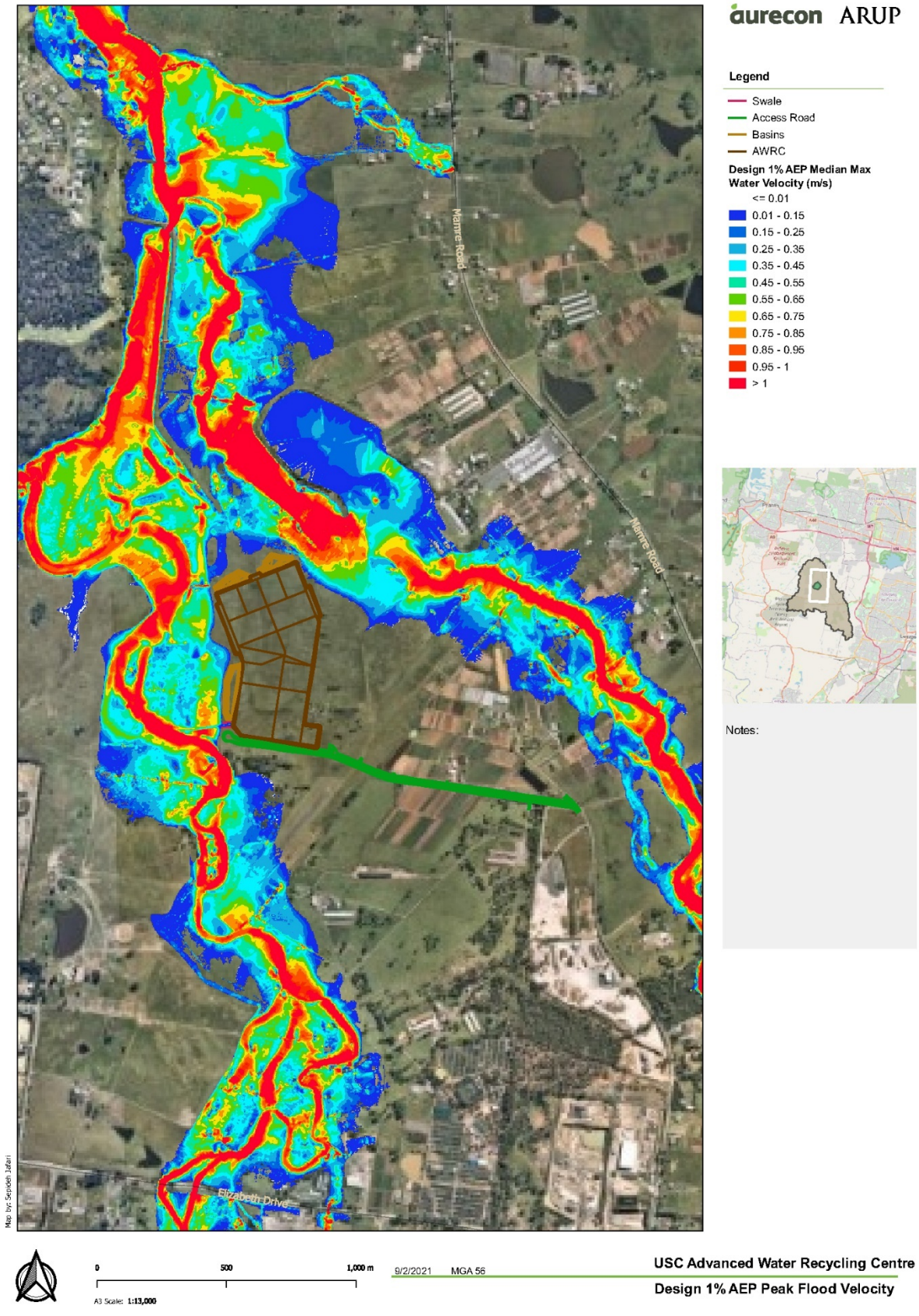


Figure 6-40 Design case 1% AEP peak flood velocity

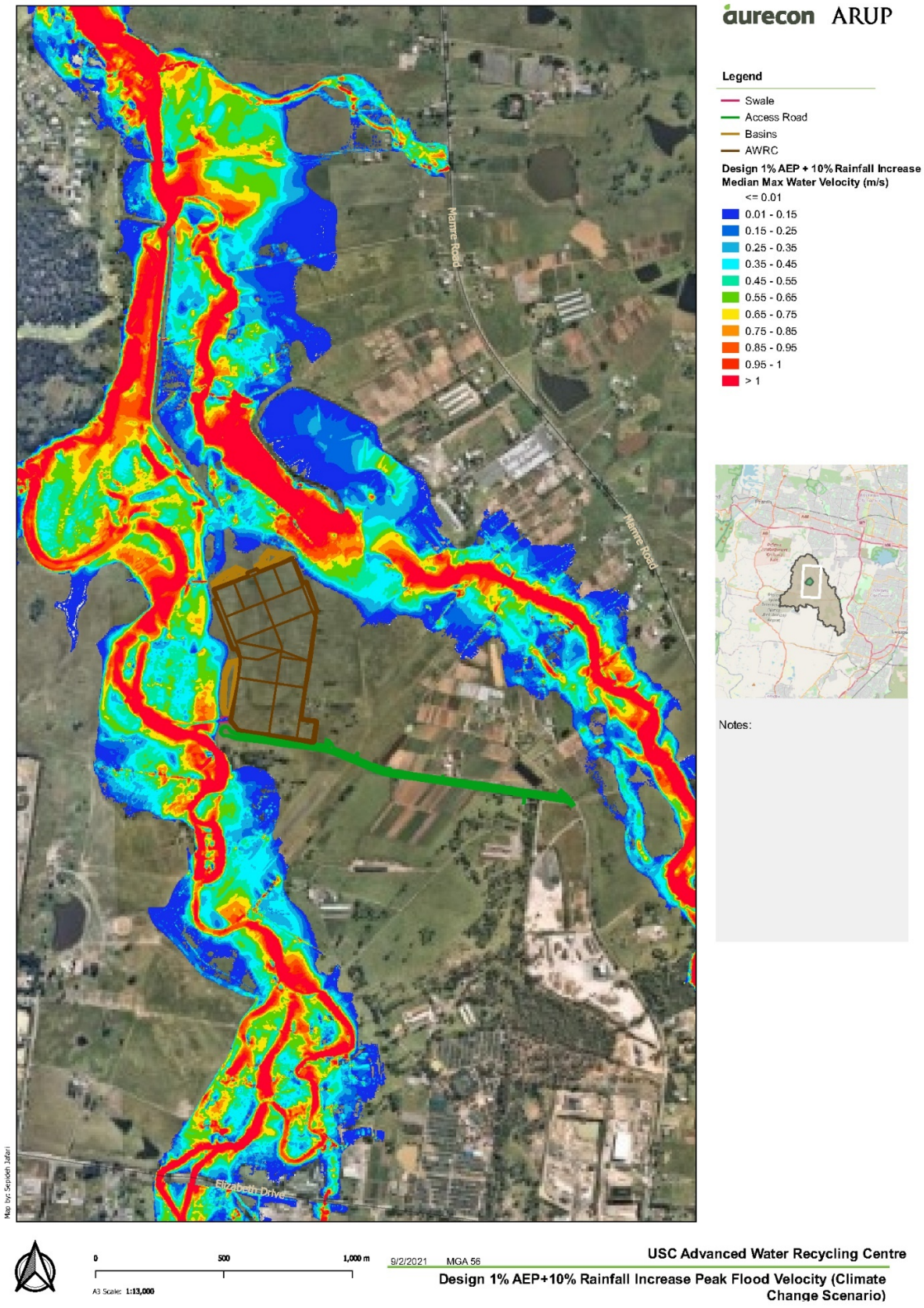


Figure 6-41 Design case 1% AEP + 10% rainfall increase peak flood velocity (Climate Change Scenario)

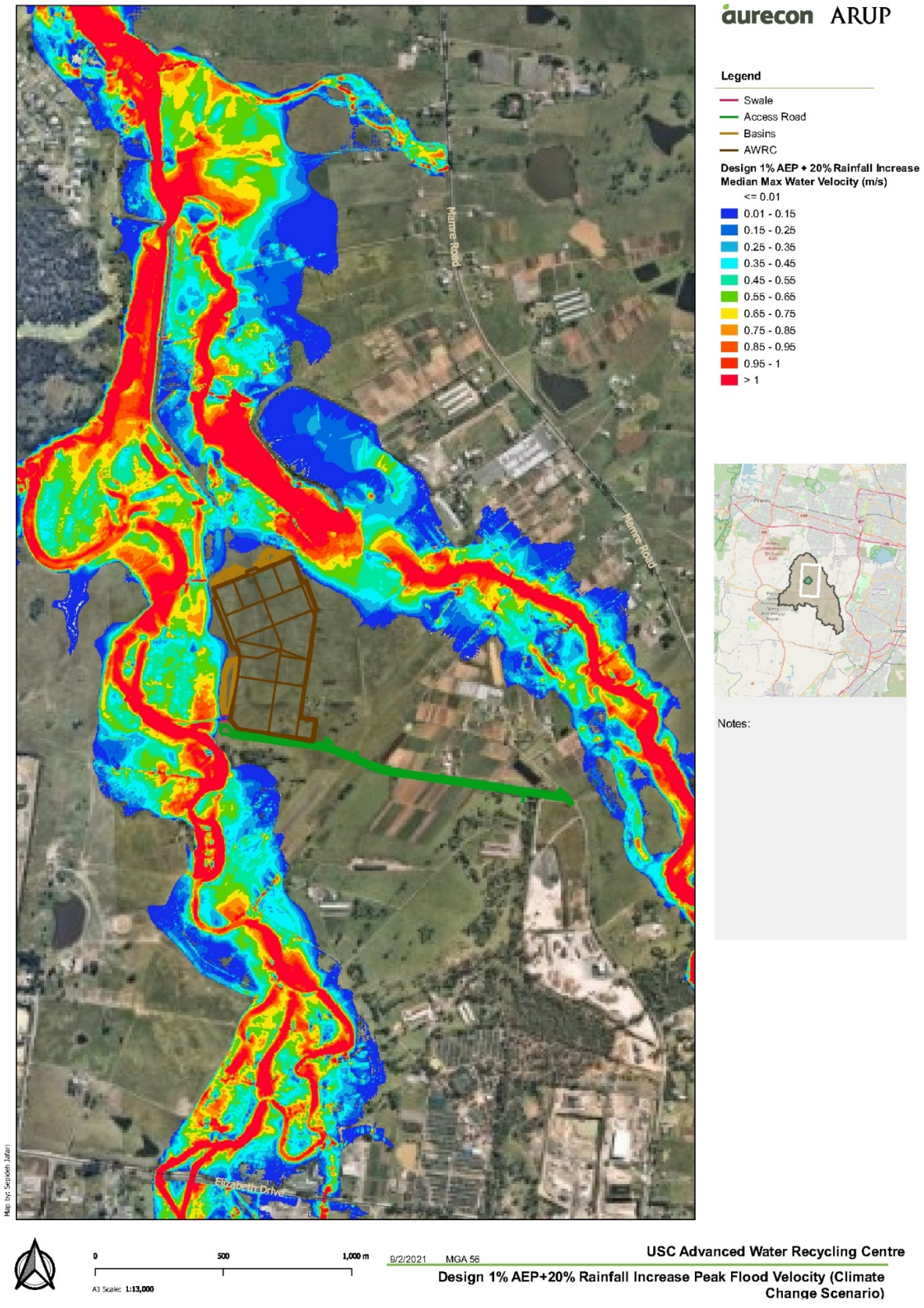


Figure 6-42 Design case 1% AEP + 20% rainfall increase peak flood velocity (Climate Change Scenario)

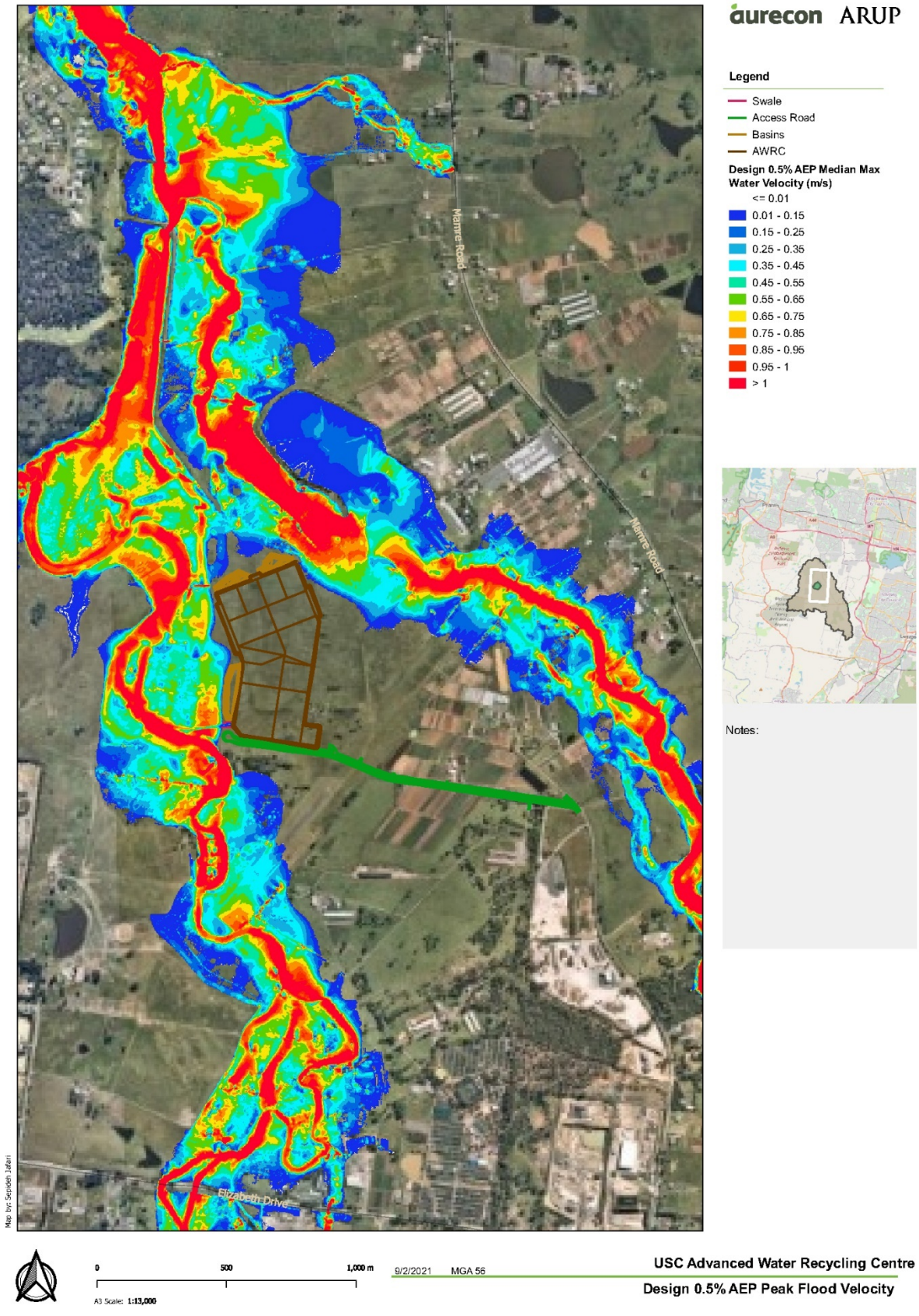


Figure 6-43 Design case 0.5% AEP peak flood velocity

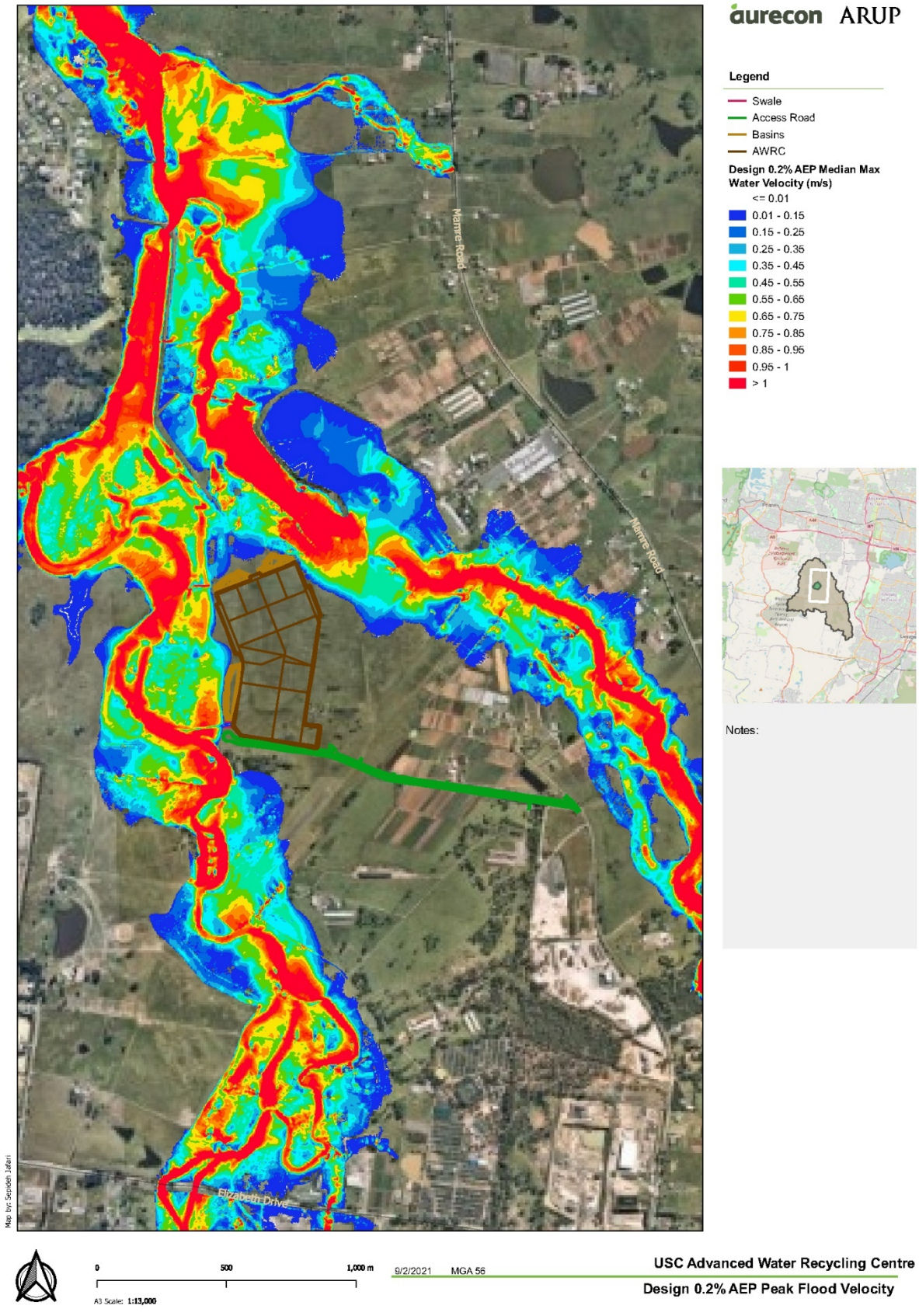


Figure 6-44 Design case 0.2% AEP peak flood velocity

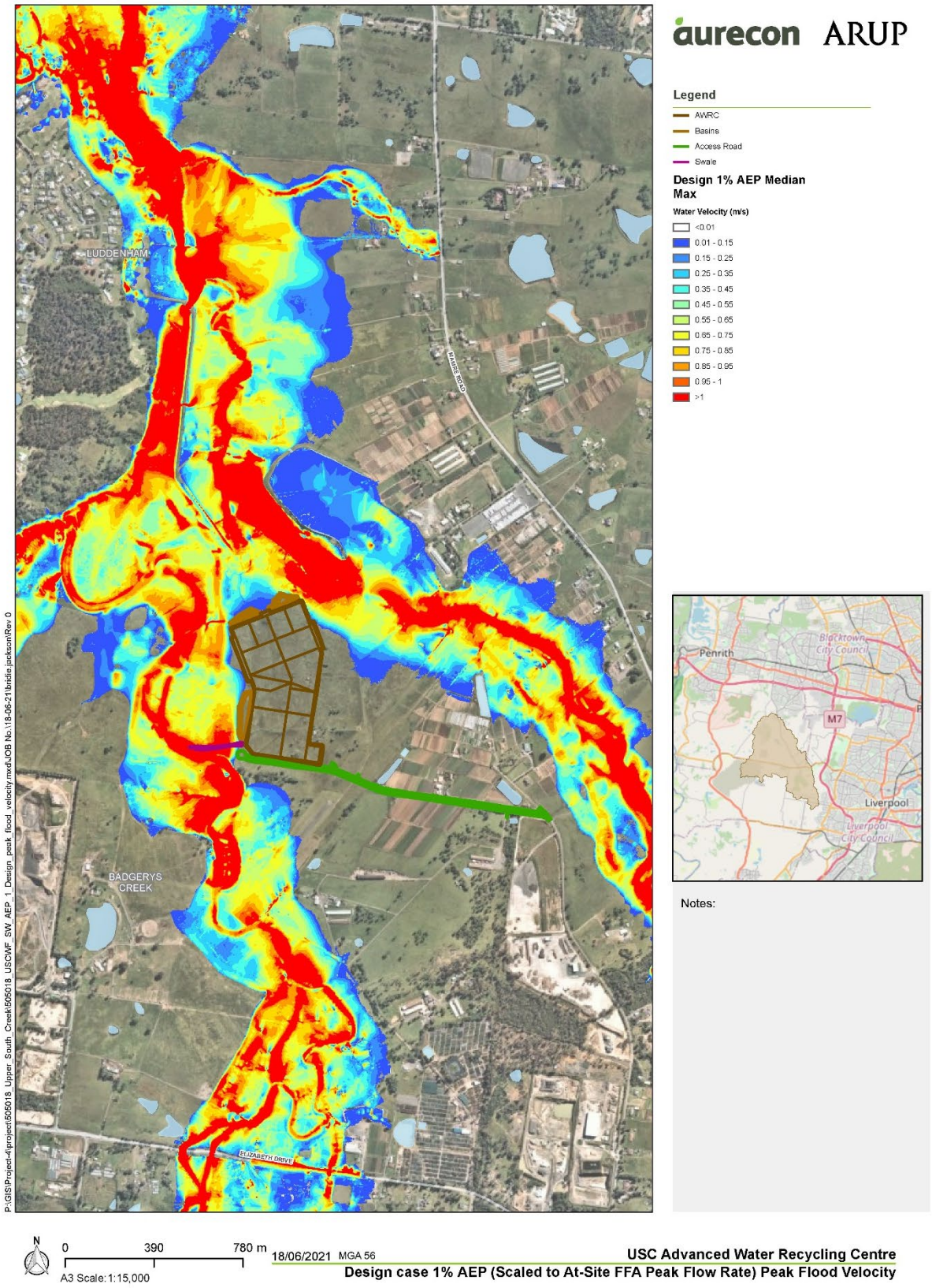


Figure 6-45 Design case 1% AEP FFA peak flood velocity

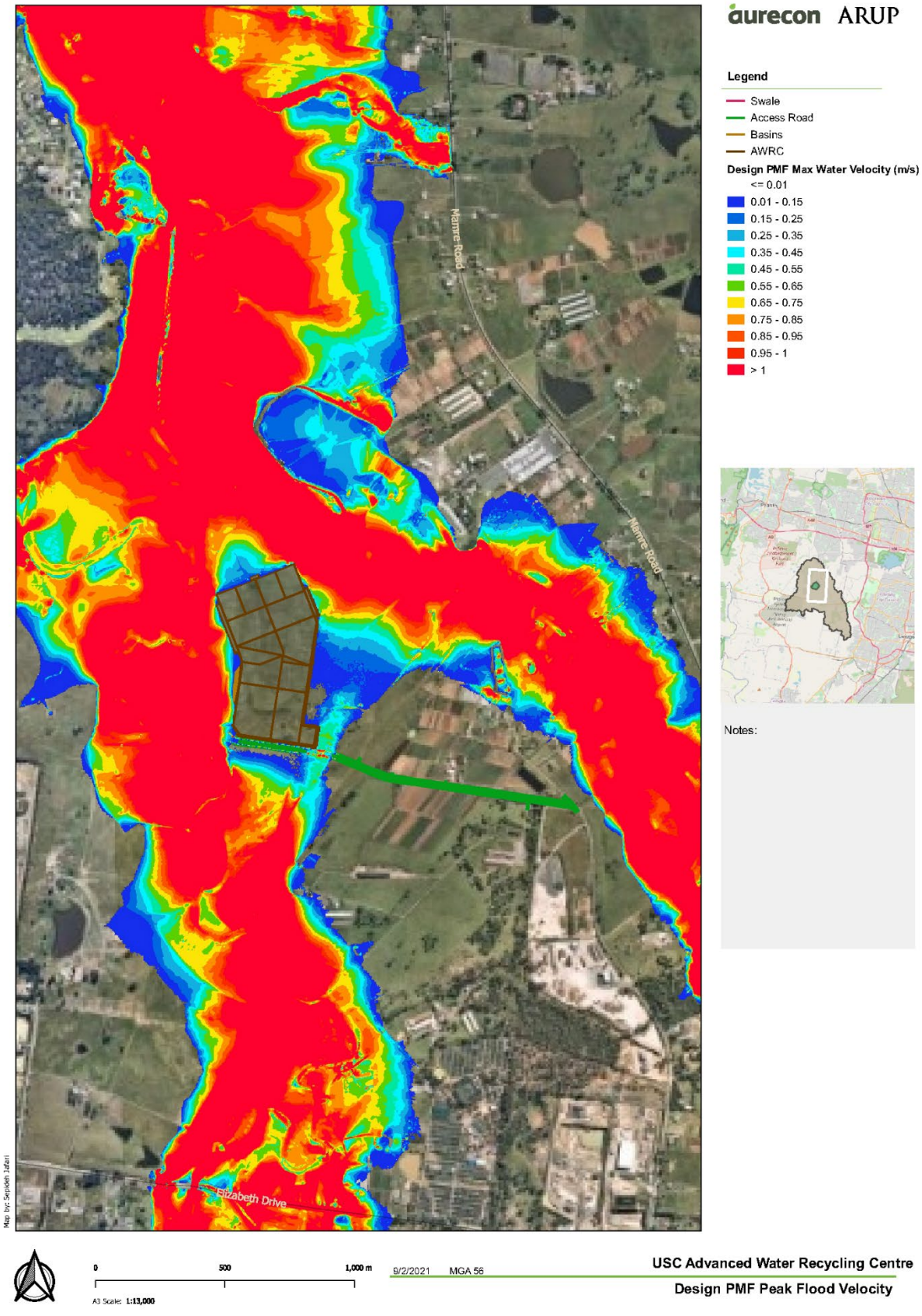


Figure 6-46 Design case PMF peak flood velocity

6.3.3 Flood Hazard

Design hazard maps around the study area for 10% AEP to PMF events are shown in **Figure 6-47** through **Figure 6-54**.

Flood hazard categories under AEP events are similar to the existing scenario due to the development is located outside the 1% AEP event. Accordingly, during AEP events, the inundated areas within the proposed development boundary are mostly classified as H1 to H3 and limited areas of H4 and H5 are due to high flow depth or a high combination of flow depth and velocity.

Similarly, under the PMF event (**Figure 6-54**), the majority of the flooded area is classified as H5 which is unsafe for vehicles and people and any building in this area can be exposed to structural damage or failure.

6.3.4 Hydraulic Categories

Given the proposed development is located outside the 1% AEP extent, no significant change is expected in existing hydraulic categories and, in this regard refer to **Figure 6-30**.

6.3.5 Flood Immunity

The AWRC site is shown to be flood free in all events up to the PMF event when southern side of the AWRC may become flooded. This flooding creates an island and may cut off evacuation routes.

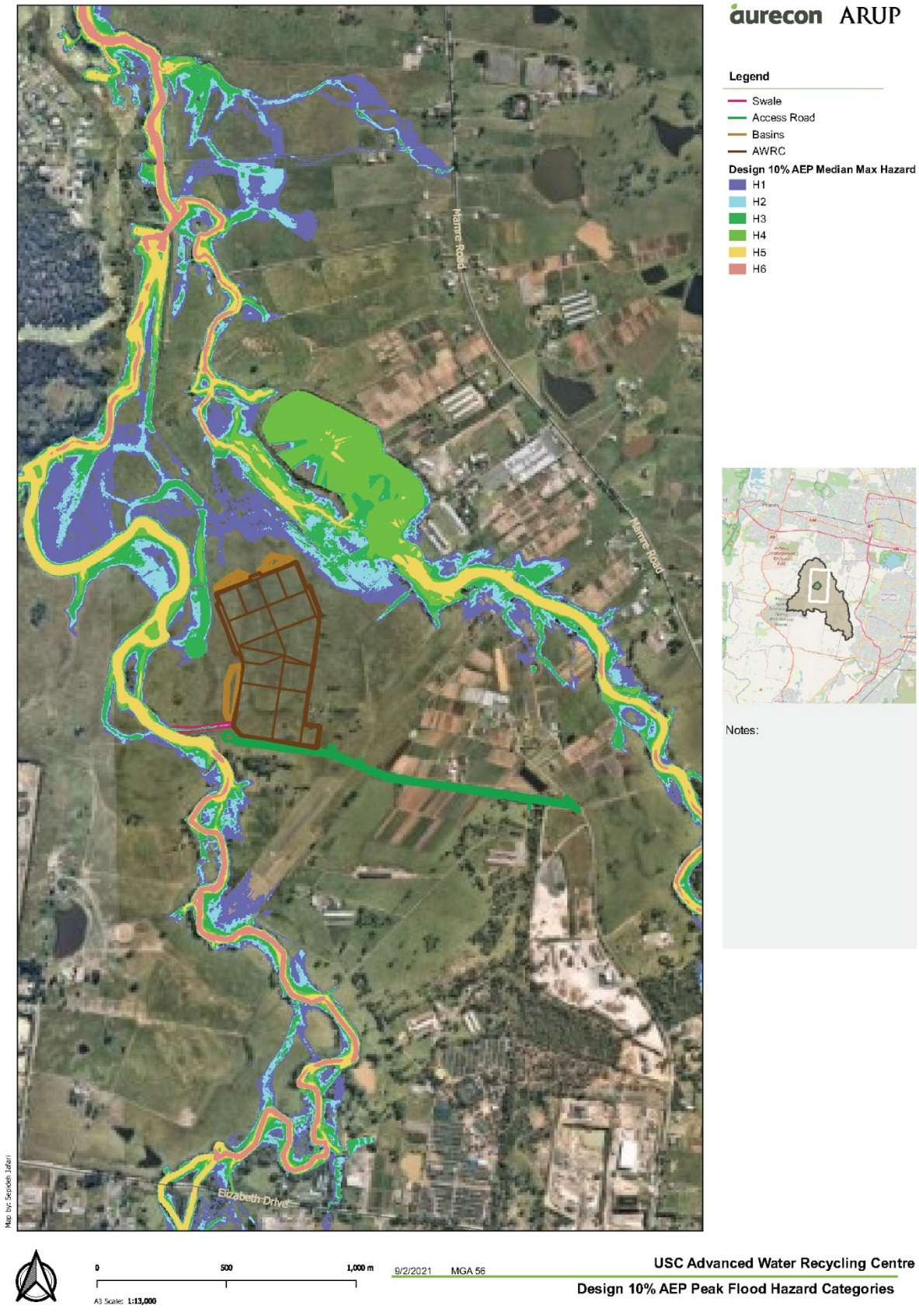


Figure 6-47 Design case 10% AEP flood hazard categories

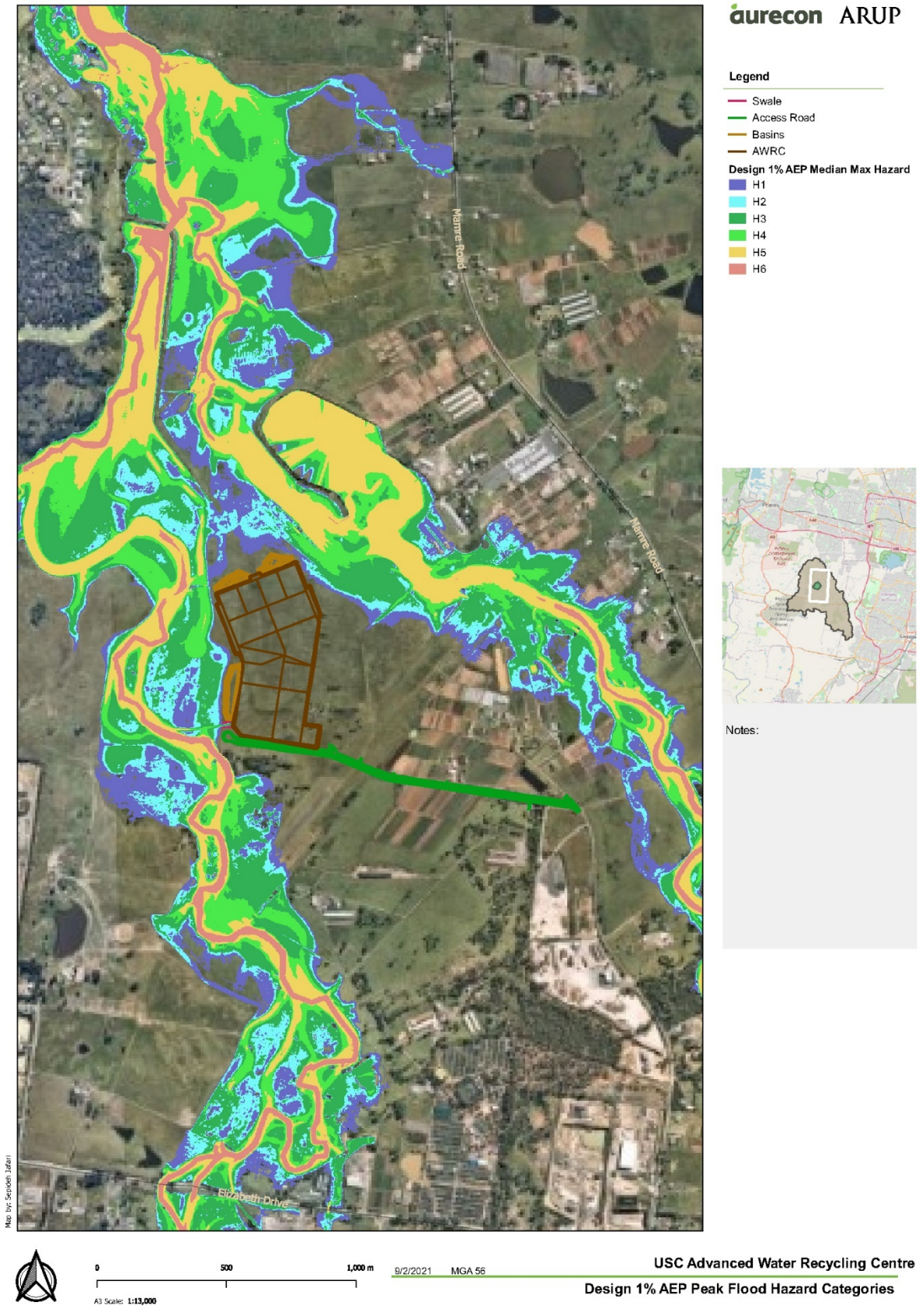


Figure 6-48 Design case 1% AEP flood hazard categories

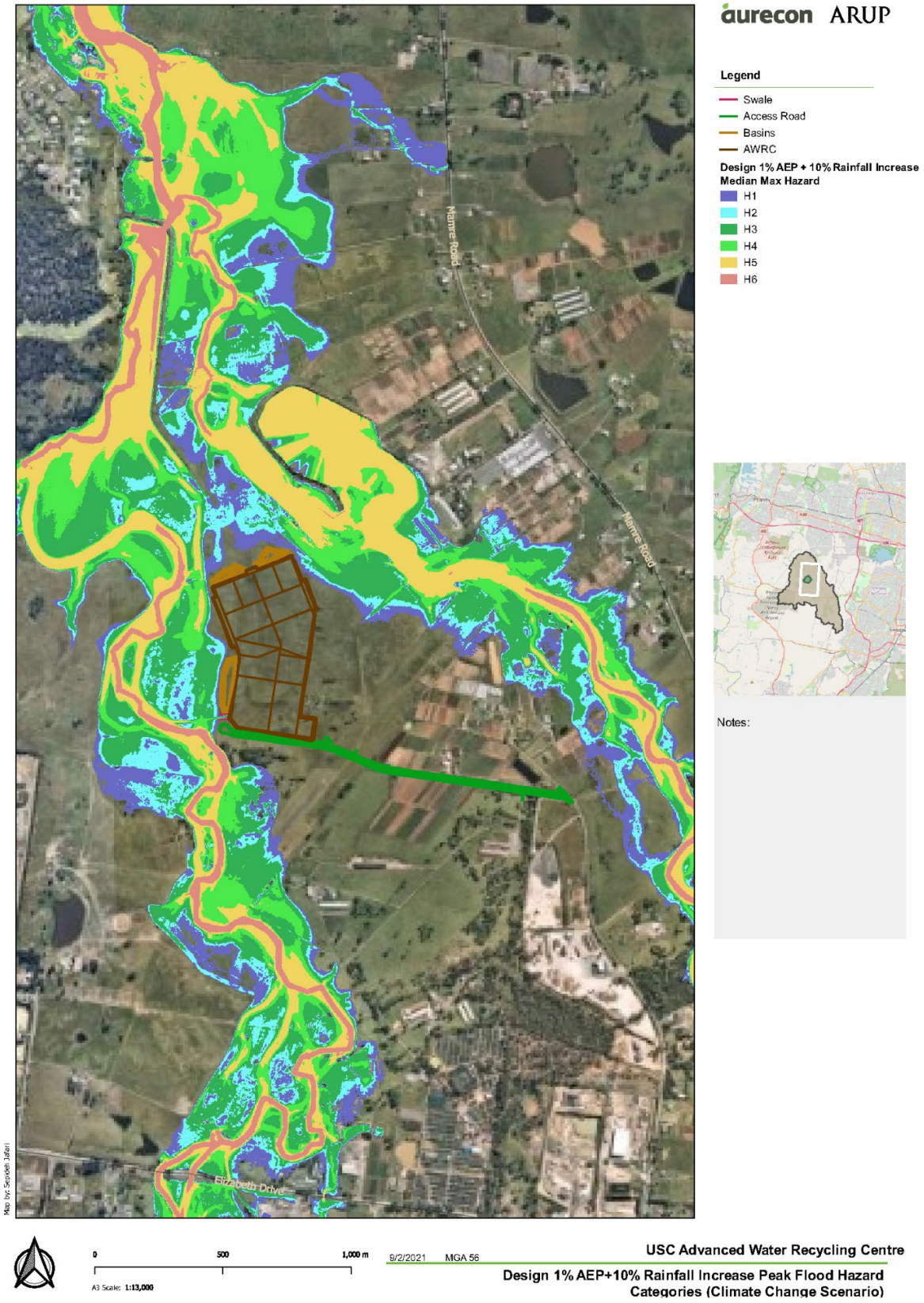


Figure 6-49 Design case 1% AEP + 10% rainfall increase flood hazard categories (Climate Change)

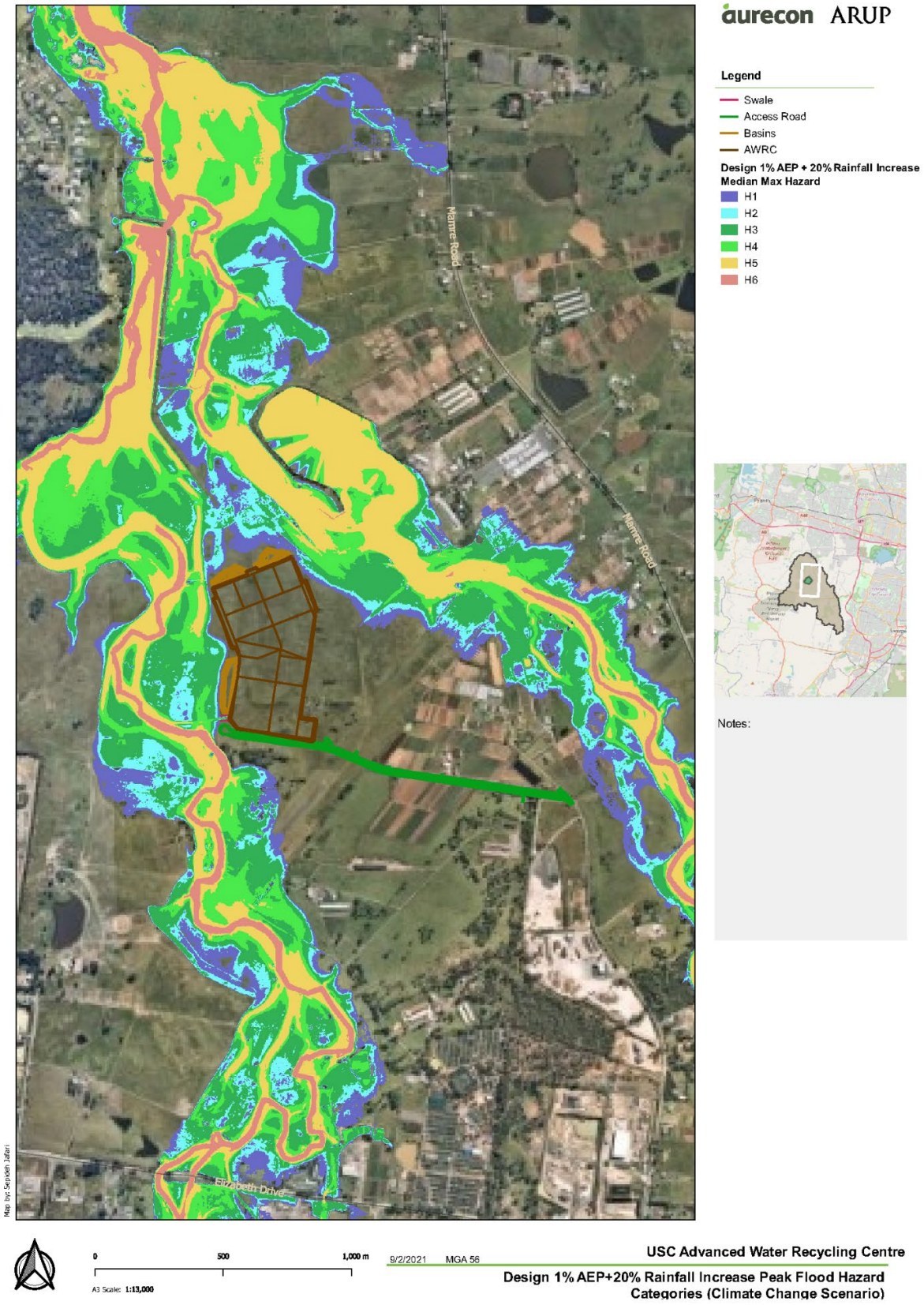


Figure 6-50 Design case 1% AEP + 20% rainfall increase flood hazard categories (Climate Change)

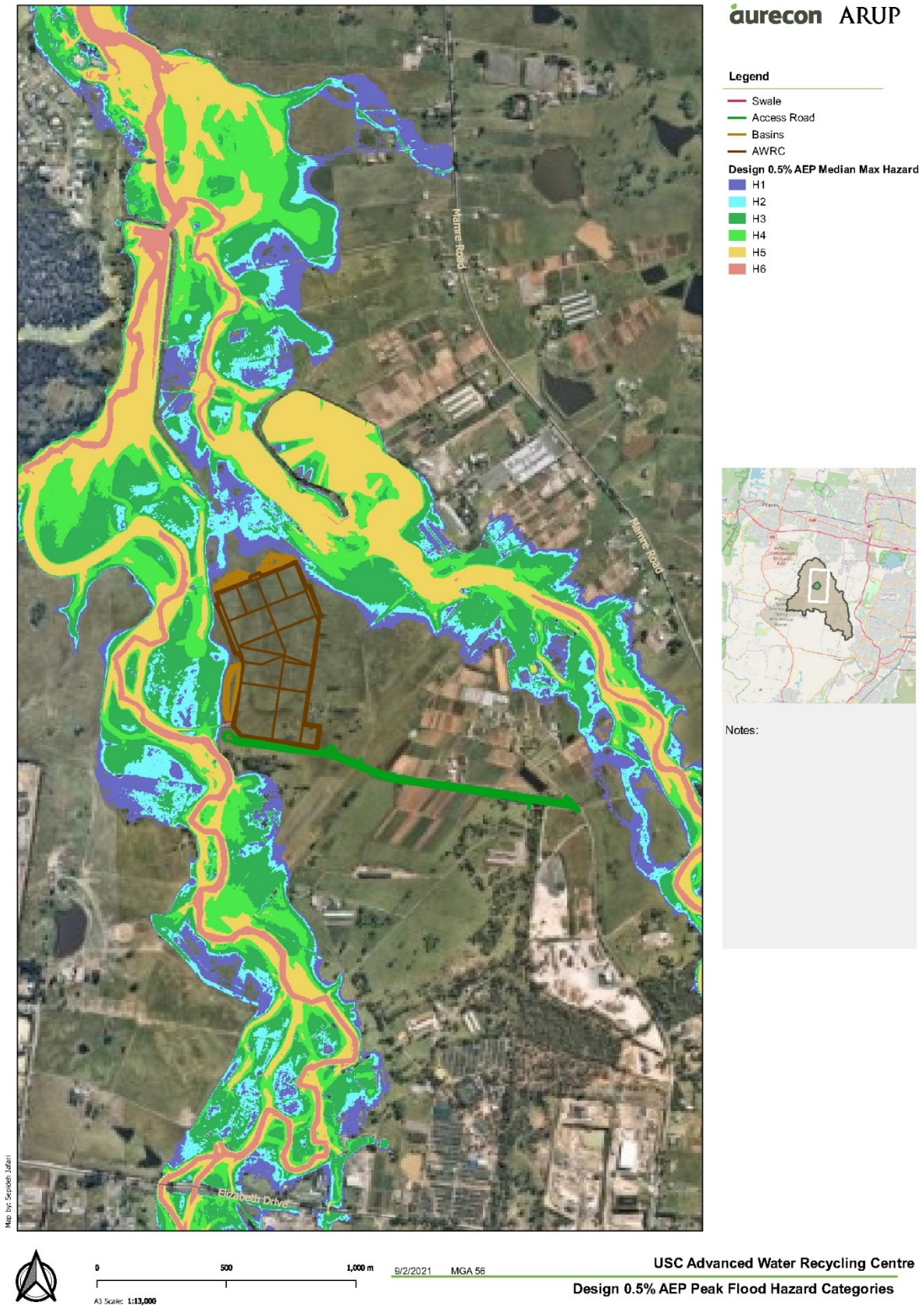


Figure 6-51 Design case 0.5% AEP flood hazard categories

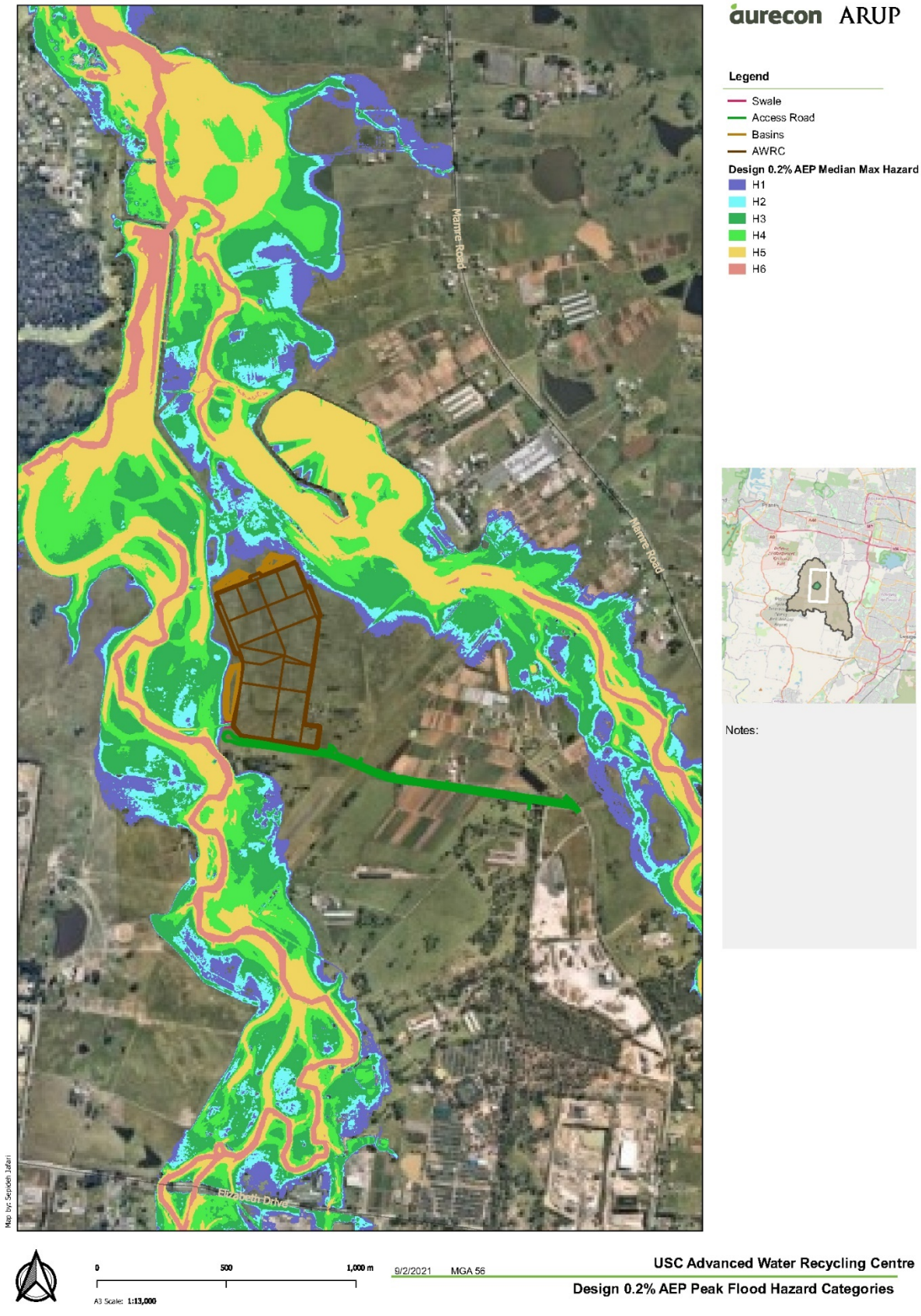


Figure 6-52 Design case 0.2% AEP flood hazard categories

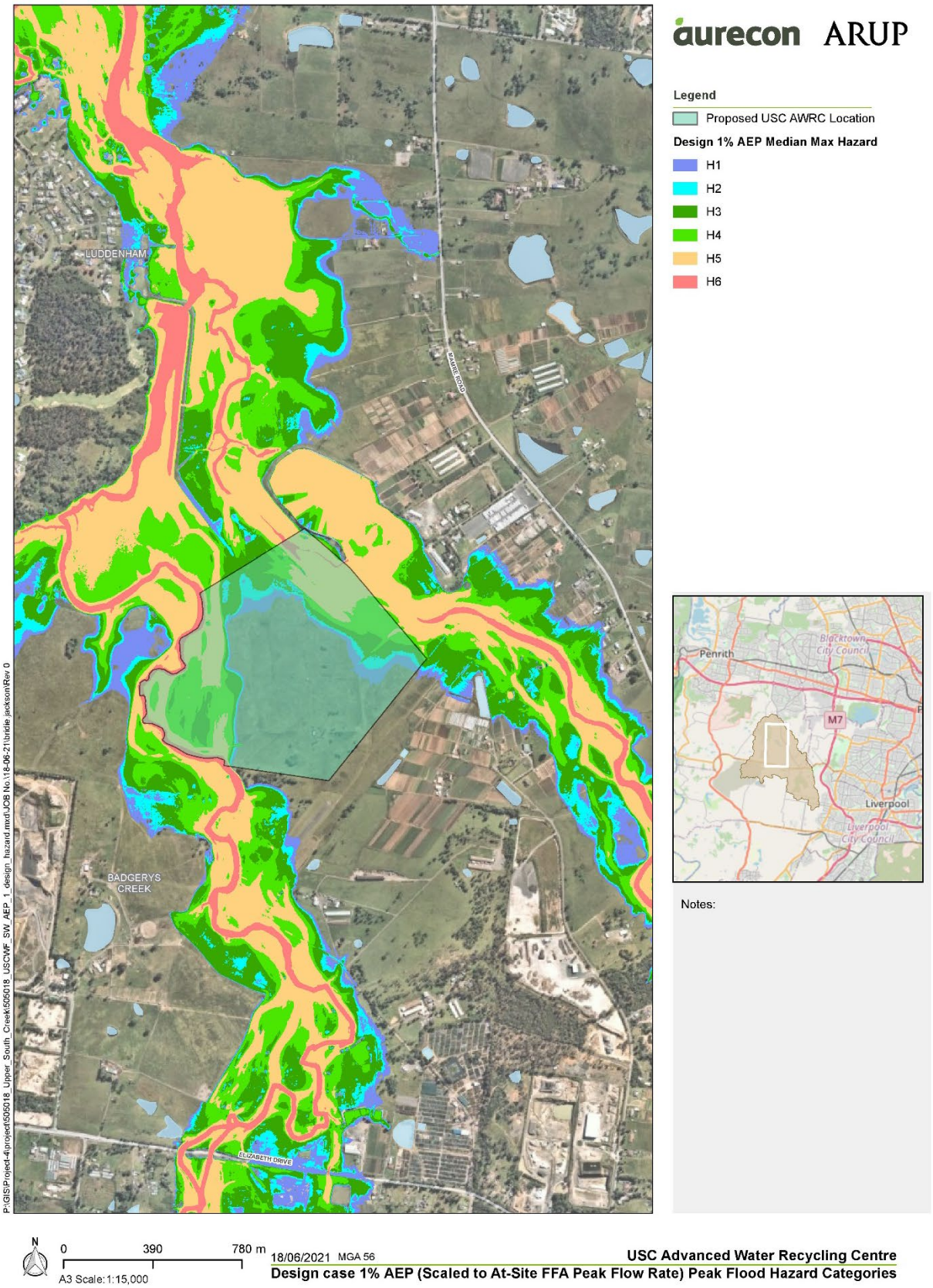


Figure 6-53 Design case 1% AEP FFA flood hazard categories

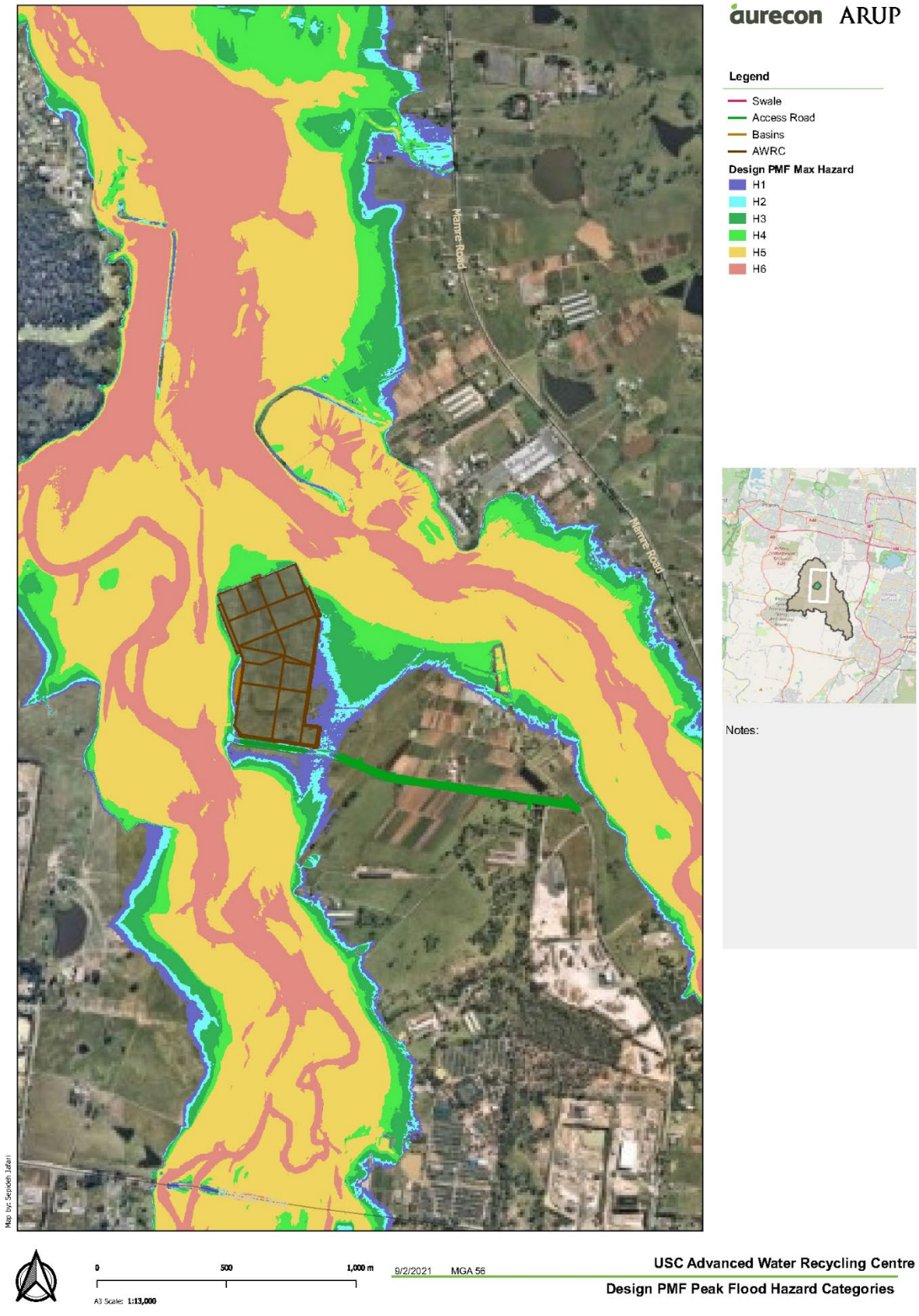


Figure 6-54 Design case PMF flood hazard categories

7 Impact Assessment and Mitigation Measures

7.1 Construction Phase

A number of construction activities can potentially impact flooding conditions. These include any temporary earthworks as part of the construction activities (e.g. stockpiles), temporary buildings and site sheds, construction plant or storage facilities that are located within flow paths and have the potential to impact flooding conditions by altering flow depths, velocities or flow paths.

Where it is required to build temporary works in the floodplain (e.g. waterway crossings) during the construction phase, these could also potentially alter flooding conditions. Portable buildings and large unsecured construction objects have the greatest potential to affect flooding. They can be carried away by deep floodwaters and worsen local flood conditions by blocking bridges, culverts and flood control structures downstream.

Construction phase flood impacts have not been quantitatively modelled as part of the current assessment as construction activities are temporary and highly dynamic and can be designed to accommodate local flood risk.

As part of the reference design for the USC AWRC and the brine, treated water and environmental flows pipeline, some indicative locations were identified for placement of construction compounds during the planned 3-year construction phase.

Where the size of the catchment upstream of a compound site is less than 15ha, it is assumed that the risk of flooding will be insignificant and general precautionary and preventive measures discussed above will adequately minimise flood impacts. For the compound locations identified to be at significant flooding risks, the extent of the 1% flood was used as the basis of flood impact assessment. The likelihood of experiencing a 1% AEP flood event during a 3-year construction period is relatively low:

$$P = 1 - \left(1 - \frac{1}{100}\right)^3 = 0.029 \cong 3\%$$

However, to minimise the risk of adverse impacts on local flooding conditions during construction, the susceptibility of the designated construction compound locations to flooding was assessed qualitatively to determine the likelihood and magnitude of flooding risks. Further recommendations were made for the compound locations identified to be at a greater flooding risk.

7.1.1 USC Advanced Water Recycling Centre site construction compounds

The location of the USC AWRC site is at a topographically high location above the modelled 1% AEP flood level. However, the indicative construction compound area partially falls in the South Creek floodplain. If the extent of the USC AWRC construction compound is limited to areas above the 1% AEP flood level, impacts on flooding are likely to be minor at this site. General precautionary and preventive measures discussed above are expected to sufficiently minimise the risks of flood impacts.

7.1.2 River Discharge Structures

During the construction of discharge structures at the Nepean River, South Creek and Warragamba River sites, silt curtains and temporary cofferdams will be installed to segregate the construction zone from the low flow zones of the waterways and minimise the generation of sediment. This is indicatively shown in **Figure 7-1**.

The expected duration of the cofferdam construction activities is six months. During dry weather, impacts of the construction activities are expected to be negligible. Overtopping of the coffer dams would occur during bank full discharge in the waterway, which has the potential to generate additional sediment loads to the waterway. Considering the small footprint of the works area within the cofferdams, the volume of sediment released will have a minor impact on turbidity and silt loads in the waterway. The likelihood of a release will be further mitigated through scheduling the construction of these structures during seasons when bank full discharges are less likely.

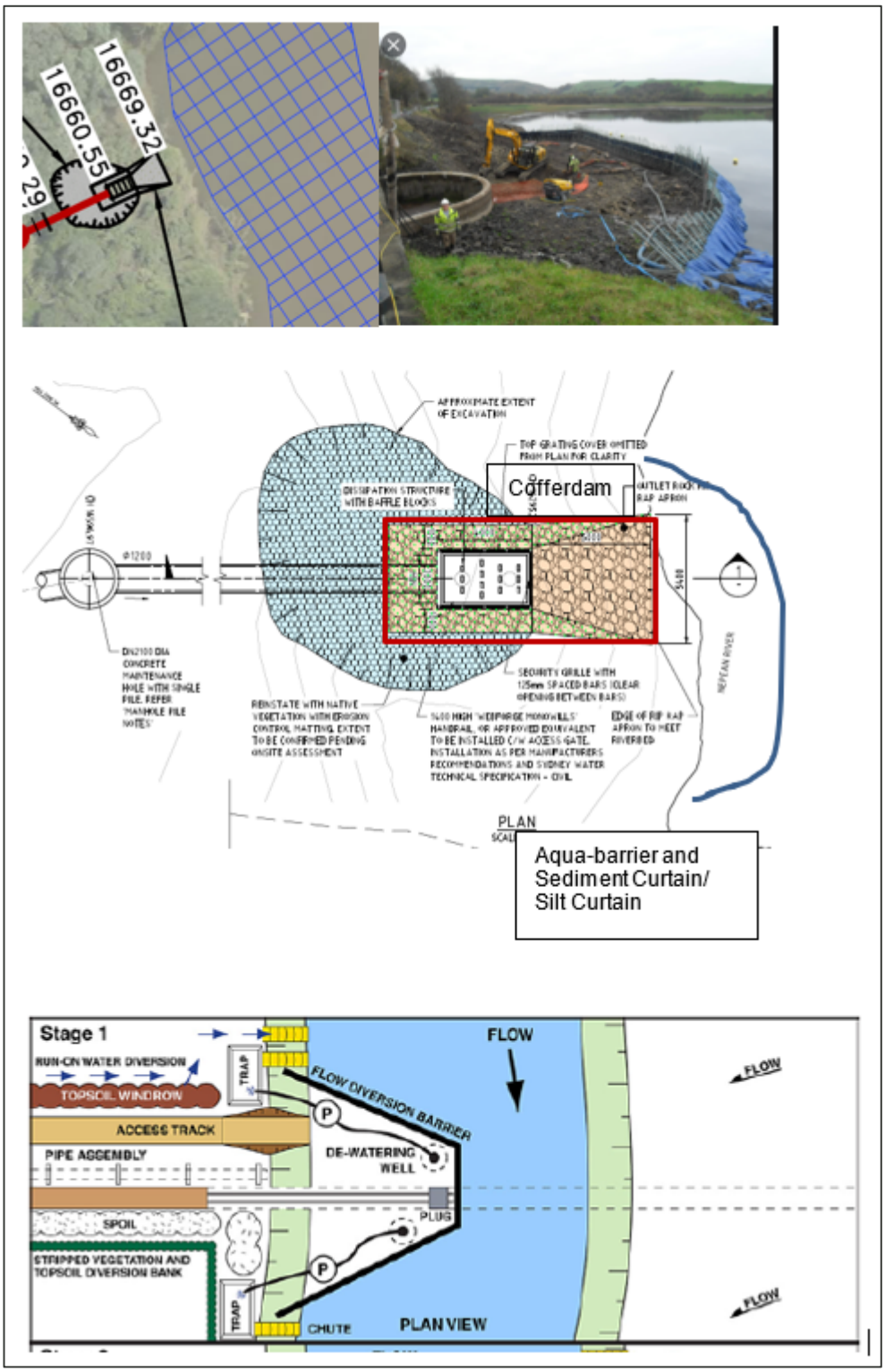


Figure 7-1 Indicative diagrams of construction activities for the waterway discharge structures

7.1.3 Treated Water Pipeline and Brine Pipeline Construction Compounds

The indicative locations of construction compounds for the treated water pipeline and brine pipeline are presented in **Figure 7-2** and listed in **Table 7-1**.

Based on the NSW SES datasets accessed on 25/05/2021, the construction compounds C1 to C4 of the treated water pipeline may be affected by the 1% AEP floodwaters of the Hawkesbury- Nepean River System.

The C9 compound sites of the brine pipeline are in proximity of Hinchinbrook Creek channel in the undeveloped area west of the Westlink M7 Motorway and may be subject to flooding in a 1%AEP event. No flood information was available for Hinchinbrook Creek to identify the extent of floods at this location. However, examination of local topography indicated that they are close enough to the Hinchinbrook Creek main channel to be affected by floodwaters.

Based on the flood data available for the Prospect Creek, the construction compound C14 is in vicinity of the main waterway channel and may be flooded in a 1% AEP event.

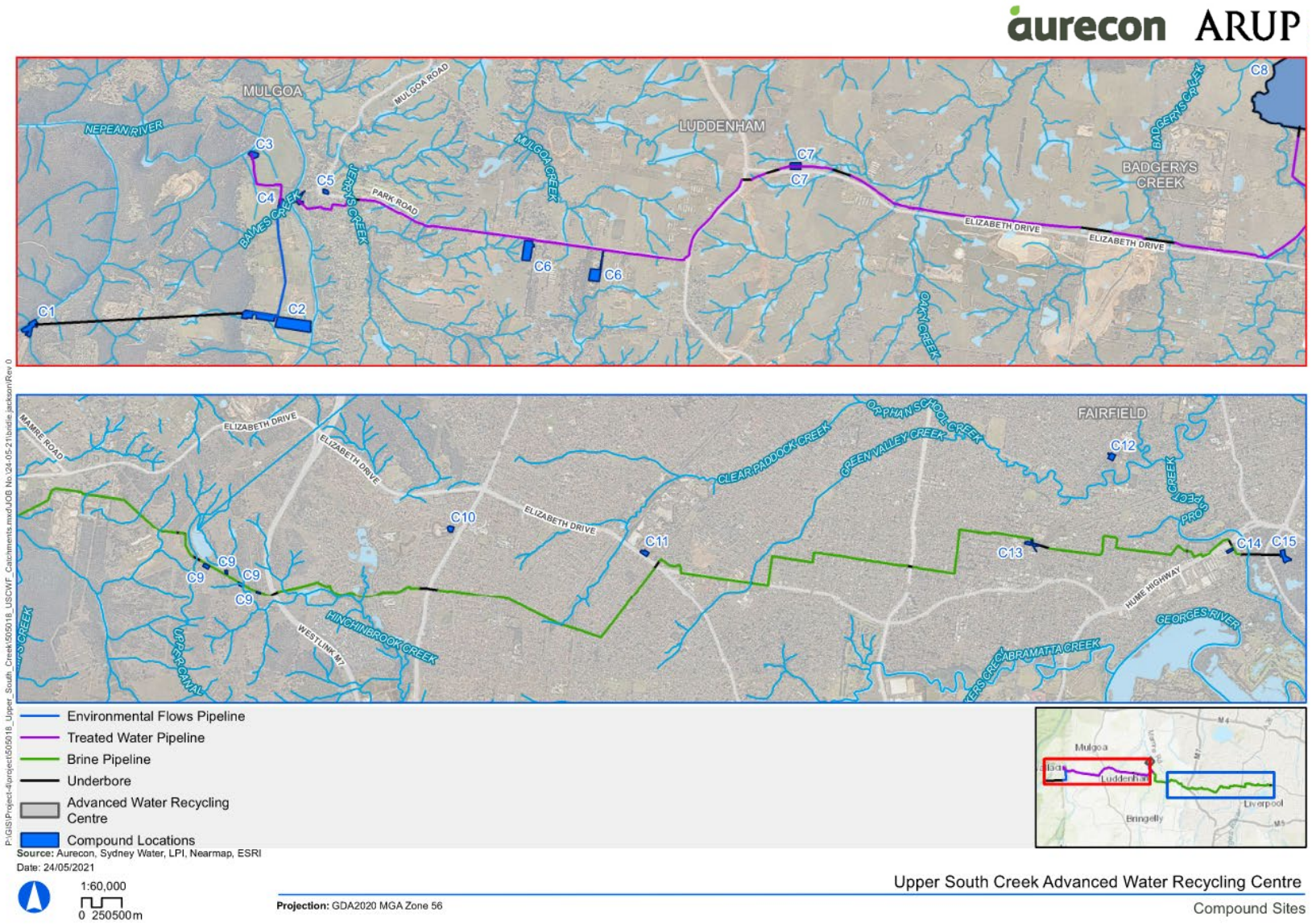


Figure 7-2 Indicative locations of construction compound sites and waterway crossings

Table 7-1 Indicative construction compounds for treated water and brine pipelines

ID	Waterway (catchment)	Is flood risk significant	Remarks
Treated water pipeline			
C1	Warragamba River	Yes	Based on the information provided by WaterNSW, this site is within the Warragamba River 1% AEP floodplain.
C2	Nepean River	Yes	Based on the flood maps available from the NSW SES web portal (accessed on 25 May 2021), this compound site is within Nepean River 1% AEP floodplain.
C3	Nepean River	Yes	Based on the flood maps available from the NSW SES web portal (accessed on 25 May 2021), this compound site is within Nepean River 1% AEP floodplain.
C4	Nepean River	Yes	Based on the flood maps available from the NSW SES web portal (accessed on 25 May 2021), this compound site is within Nepean River 1% AEP floodplain.
C5	Nepean River	No	Based on the flood maps available from the NSW SES web portal (accessed on 25 May 2021), this compound site is not within Nepean River 1% AEP floodplain.
C6	Jerrys Creek (Nepean River)	No	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), these compound sites are not within the 1% AEP floodplain.
C7	Cosgroves Creek (Hawkesbury River)	No	Based on the results of the current flood modelling, this compound site is not within the South Creek 1% AEP floodplain.
Brine pipeline			
C9	Hinchinbrook Creek (Georges River)	Likely	No existing flood data was available for Hinchinbrook Creek. However, due to proximity of this site to Hinchinbrook Creek main channel, and the size of the upstream catchment (approximately 160ha) it is likely that some or all of the sites are affected by floodwaters.
C10	Hinchinbrook Creek (Georges River)	Unlikely	Based on the topographic information this site is in a locally elevated area and is unlikely to be affected by floodwaters.
C11	Clear Paddock Creek (Georges River)	No	Based on the flood maps provided in the Flood Study for Orphan School Creek, Green Valley Creek and Clear Paddock Creek (SKM, 2008), this site is not within the 1% floodplain of Clear Paddock Creek or Green Valley Creek.
C12	Orphan School Creek (Georges River)	No	Based on the flood maps provided in the Prospect Floodplain Management Plan Review (Bewsher Consulting, 2010), this site is outside the 1% AEP flood level of Orphan School Creek.
C13	Orphan School Creek (Georges River)	No	Based on the flood maps provided in the Prospect Floodplain Management Plan Review (Bewsher Consulting, 2010), this site is outside the 1% AEP flood level of Orphan School Creek.

ID	Waterway (catchment)	Is flood risk significant	Remarks
C14	Prospect Creek (Georges River)	Yes	Based on the flood maps provided in the Prospect Floodplain Management Plan Review (Bewsher Consulting, 2010), this site is subject to flooding in a 1% AEP event.
C15	Prospect Creek (Georges River)	No	Based on the flood maps provided in the Prospect Floodplain Management Plan Review (Bewsher Consulting, 2010), this site is not subject to flooding in a 1% AEP event.

7.1.4 Access roads and waterway crossings

As far as is practicable, access roads will be designed to minimise flood hazard to vehicles during 1% AEP flood conditions. There will be access roads along the pipeline corridors at the trenched segments of the pipelines, and there will be boring launch sites at both ends of the trenchless pipeline segments at waterway crossings.

Based on the Nepean River flood maps accessed from the NSW SES web portal and current flood modelling, the access road for the treated water and environmental flow pipelines may be subject to flooding in a 1% AEP events at a number of waterway crossings including South Creek, Badgerys Creek, Oaky Creek, Cosgroves Creek, Nepean River, Baines Creek and Megarritys Creek.

The brine pipeline access road may also be subject to flooding at a number of waterway crossings including Kemps Creek and its tributaries, Hinchinbrook Creek and its tributaries, Clear Paddock Creek, Green Valley Creek and Prospect Creek.

Different construction methods are proposed along the pipeline routes for waterway crossings, which are summarised in **Table 7-2** for waterways of 2nd order or higher. In general, the watercourses will be crossed using standard trenching methods, unless there are particular constraints including existing underground infrastructure, which is common in more developed areas that the brine pipeline traverses.

Trenched crossings are generally shallower, with less probability of sub-surface related impacts, such as disruption of surface water and groundwater connectivity. Whereas deeper trenchless crossings avert potential impacts associated with direct in-stream works.

Table 7-2 Proposed construction methodology for crossing watercourses

ID	Waterway (catchment)	Is flood risk significant	Remarks
Treated water pipeline			
T1	South Creek south of AWRC (Hawkesbury-Nepean)	No	Based on the results of the current flood modelling, this site is not within the South Creek 1% AEP floodplain.
T2	Unnamed tributary to South Creek near Elizabeth Drive (Hawkesbury-Nepean)	Yes	Based on the results of the current flood modelling for South Creek, the micro tunnelling launch sites may be flooded in a 1% AEP event.
T3	Badgerys Creek near Elizabeth Drive (Hawkesbury-Nepean)	Yes	Based on the results of the current flood modelling for South Creek, the micro tunnelling launch sites may be flooded in a 1% AEP event.

ID	Waterway (catchment)	Is flood risk significant	Remarks
T4	Unnamed tributary to Badgerys's Creek near Elizabeth Drive (Hawkesbury-Nepean)	Yes	Based on the results of the current flood modelling, the micro tunnelling launch sites may be flooded in a 1% AEP event.
T5	Farm dams u/s of Badgerys Creek tributary near Elizabeth (Hawkesbury-Nepean)	No	Based on the results of the current flood modelling, the micro tunnelling launch sites are not within the South Creek 1% AEP floodplain.
T6	Unnamed tributary to Cosgroves Creek (Hawkesbury-Nepean)	No	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), this crossing is not subject to flooding in a 1% AEP event.
T7	Oaky Creek near Elizabeth Drive (Hawkesbury-Nepean)	No	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), this crossing is not subject to flooding in a 1% AEP event.
T8	Cosgrove Creek near Elizabeth Drive (Hawkesbury-Nepean)	No	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), this crossing is not subject to flooding in a 1% AEP event.
T9	Farm dam & unnamed tributary to Cosgroves Creek (Hawkesbury-Nepean)	No	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), the micro tunnelling launch sites are not subject to flooding in a 1% AEP event.
T10	Jerrys Creek near Park Road (Hawkesbury-Nepean)	Yes	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), the micro tunnelling launch sites are subject to flooding in a 1% AEP event.
T11	Nepean River near Wallacia (Hawkesbury-Nepean)	Yes	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), the micro tunnelling launch sites are subject to flooding in a 1% AEP event.
T12	Baines Creek (Hawkesbury-Nepean)	Yes	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), the micro tunnelling launch sites are subject to flooding in a 1% AEP event.
Brine pipeline			
B1	Unnamed tributary to Kemps Creek near Cross Street (Georges River)	No	Based on the results of the current flood modelling, this site is not within the Kemps Creek 1% AEP floodplain.
B2	Kemps Creek near Cross Street (Georges River)	Yes	Based on the results of the current flood modelling, this site may be flooded in a 1% AEP event.
B3	Hinchinbrook Creek near C9 Western Sydney Parklands (Georges River)	Yes	No publicly available flood data was found for Hinchinbrook Creek. However, due to proximity of this site to the Creek main channel, it is likely that the site is affected by floodwaters.

ID	Waterway (catchment)	Is flood risk significant	Remarks
B4	Unnamed tributary to Hinchinbrook Creek Near M7 Westlink (Georges River)	Yes	No publicly available flood data was found for Hinchinbrook Creek. However, due to proximity of this site to the Creek main channel, it is likely that the site is affected by floodwaters.
B5	Green Valley Creek near Cabramatta Road (Georges River)	Yes	No publicly available flood data was found for Green Valley Creek. However, due to proximity of this site to the creek main channel, it is likely that the site is affected by floodwaters.
B6	Prospect Creek near Compound C14 (Georges River)	Yes	Based on the flood maps provided in the Prospect Floodplain Management Plan Review (Bewsher Consulting, 2010), this site is subject to flooding in a 1% AEP flood event.
Environmental flows pipeline			
E1	Baines Creek near Bents Basin Road (Hawkesbury-Nepean)	Yes	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), this site is subject to flooding in a 1% AEP event.
E2	Megarritys Creek (Hawkesbury-Nepean)	No	Based on the flood maps available from the NSW SES web portal (accessed on 24 Nov 2020), this site is not subject to flooding in a 1% AEP event.

7.1.5 Discussion and Summary of Impacts

A qualitative review of construction activities shows that flood risk is limited to several sites located within mapped flood extents or in proximity of watercourses with large catchments. Where data does not exist, Contractors must quantify flood risk at construction sites and depot sites to inform the location of site operations. The residual flooding risks at those sites can be mitigated during the construction period, by implementing and document the following measures:

- To the extent practicable, locate compounds, site sheds, stockpiles and laydown areas outside of the 1% AEP flood-prone areas. This will eliminate the risk of influencing floodwaters through obstruction of overland flow path or loss of floodplain storage.
- Where compounds are located on flood prone lands, elevate site sheds above flood waters on sturdy foundations that allow the passage of floodwater beneath structures.
- Avoid placement of stockpiles, fuels, contaminating material and loose equipment within the construction compounds or sites affected by 1% AEP floodwaters or as far as is practical.
- To the extent practicable, the ground surface slopes and imperviousness at the construction sites are maintained close to their existing conditions. This will minimise the risk of increased runoff volumes and subsequent elevated velocities and flood hazards.
- Through detailed construction planning, develop appropriate construction site layouts and staging of construction activities to identify the flood risks and avoid or minimise the storage of stockpiles and potential obstruction of overland flow paths and limit the extent and duration of flow diversions required.

It is not practicable to provide construction access roads that are immune from flooding during all stages of a 1% AEP flood event. As such a Flood Emergency Response and Evacuation Plan (or equivalent) would be prepared by the contractor and implemented during the construction period to allow safe evacuation of the construction sites and securing of facilities, equipment and material in advance of flooding. A summary of potential impacts in construction phase and recommended mitigation measures are presented in **Table 7-3**.

Table 7-3 Impact assessment outcomes and mitigation measures (Construction phase)

Potential Impact	Reference/project location/ID	Impact significance	Mitigation measures
Changes in flooding conditions caused by temporary construction compounds, stockpiles, temporary buildings and site sheds, construction plant or storage facilities at the USC AWRC site	Temporary construction compounds at the USC AWRC site	Significance: Moderate Given that the USC AWRC is located outside the 1%AEP flood extent, if the construction components are also located above 1%AEP flood event, impacts on flooding from the construction phase at this site is expected to be minor.	• The contractor shall undertake a flood impact assessment to quantify the flood risk to their operations and determine the flood impact of their temporary works and/or operations during the construction phase. • To the extent practicable, construction compounds, site sheds, stockpiles and laydown areas should be located outside the 1% AEP flood-prone areas. • The timing and duration of the construction activities in vicinity of waterways shall be planned to occur in times of year when the chance of a 1%AEP flood event is low. • Where construction compounds are located on flood prone lands, and adverse flood impacts are not acceptable, elevate site sheds above flood waters on sturdy foundations that allow the passage of floodwater beneath the structures.
Changes in flooding conditions caused by temporary construction compounds, stockpiles, temporary buildings and site sheds, construction plant or storage facilities along the treated water and environmental flow pipelines	Temporary construction compounds along the treated water pipeline and environmental flow pipeline (C1 to C4)	Significance: Moderate Based on the NSW SES dataset, these construction compounds are located on Warragamba River and Nepean River 1% AEP floodplains and are likely to impact 1% AEP flooding conditions or be impacted by floodwaters.	
	Temporary construction compounds along the treated water pipeline (C5 to C7)	Significance: Low According to the NSW SES datasets, the construction compounds of the treated water pipeline are not within the 1% AEP floodplain of local waterways and no significant flood impacts are expected.	
Changes in flooding conditions caused by temporary construction compounds, stockpiles, temporary buildings and site sheds, construction plant or storage facilities along the brine pipelines	Temporary construction compounds along the brine pipeline (C9)	Significance: Moderate This construction compound is in close proximity to Hinchinbrook Creek and is likely to be affected by floodwaters in a 1% AEP flood event.	
	Temporary construction compounds along the brine pipeline (C10)	Significance: Low This construction compound site is in a locally elevated area and is not likely to be impacted by floodwaters.	

Potential Impact	Reference/project location/ID	Impact significance	Mitigation measures
	Temporary construction compounds along the brine pipeline (C11 to C15)	Significance: Low These construction compounds are outside the 1% AEP floodplain of local waterways and not expected to be impacted by floods .	• Placement of stockpiles, fuels, contaminating material and loose equipment should be avoided within the construction compounds or sites affected by 1% AEP floodwaters or should be located as far as is practical. • To the extent practicable, the ground surface slopes and imperviousness at the construction sites should be maintained close to the existing conditions. • Minimise and manage impacts through documentation and implementation of the approved Environmental Management Plan (or similar)
Changes in flooding conditions caused by the treated water pipeline access roads and waterway crossings	The treated water pipeline crossings (T1, T5 to T9)	Significance: Low These crossings are not subject to flooding in a 1% AEP event and are not expected to impact flood conditions.	
	The treated water pipeline crossings (T2 to T4, T10 to T12)	Significance: Moderate These crossings may be flooded in a 1% AEP event and are likely to impact flood conditions.	
Changes in flooding conditions caused by the brine pipeline access roads and waterway crossings	The brine pipeline crossings (B1)	Significance: Low The crossing is not within the 1%AEP floodplain and no significant flood impact is expected.	
	The brine pipeline crossings (B2 to B6)	Significance: Moderate These crossings may be flooded in a 1% AEP event and are likely to impact flood conditions.	
Changes in flooding conditions caused by the environmental flows pipeline access roads and waterway crossings	The environmental flows pipeline crossings (E2)	Significance: Low The crossing is not within the 1%AEP floodplain and no significant flood impact is expected.	
	The environmental flows pipeline crossings (E1)	Significance: Moderate The crossing is subject to flooding in a 1% AEP event and is expected to impact flood conditions.	

Potential Impact	Reference/project location/ID	Impact significance	Mitigation measures
Changes in flooding conditions caused by flow barriers or cofferdams utilised for the construction of discharge headwalls	The environmental flow discharge structure at Warragamba River	Significance: Low While the flow construction site at the Warragamba River discharge structure is below the 1% AEP flood level, the flow at this location is already highly turbulent and the discharge structure is unlikely to make any meaningful impacts to the flooding conditions.	
	The treated water discharge structure at Nepean River and South Creek	Significance: Moderate The construction site at the South Creek and Nepean River discharge structures may be flooded in a 1% AEP event. Coffer dams will reduce the channel capacity but will not have a significant impact on the conveyance capacity of the floodplain.	

7.2 Operational Phase

7.2.1 The Treated Water, Brine and Environmental Flows Pipelines

Because all the proposed pipelines will be installed underground, and there will be no permanent changes to ground surface resulting from these pipes, it is not expected that these pipelines influence any overland flows. On this basis, no quantitative assessment was undertaken for the pipes, because in such assessment the existing and design case flooding conditions would have become identical.

There are above ground structures along the pipelines, such as the flow split structure at Wallacia, air valves along the brine pipeline, scour valves and a headwall structure on the treated water pipeline that may have localised flood impacts but would have negligible impact on adjacent properties, if any.

The Environmental Flow Discharge Structure will not make any changes to the flood prone land, flood planning area, hydraulic categorisation and flood hazard, as described in the Floodplain Development Manual (NSW Government 2005); neither they will affect the existing local community emergency management arrangements for flooding

7.2.2 The Environmental Flows Discharge Structure

To investigate the potential impact of the environmental flows discharging to the Warragamba River and associated structures, the flow rates and water level of the Warragamba River downstream of the Warragamba Dam were sought from WaterNSW. **Table 7-4** presents the data provided from WaterNSW on spillway outflows from Warragamba Dam for a range of flood events (WaterNSW, 2020).

The rate of the environmental flows varies between 0.5 m^3/s to 3 m^3/s depending on dry or wet weather conditions. It is evident from **Table 7-4** that the influence of the environmental flows on Warragamba River flows is negligible. As such, no significant impact on the existing flood conditions is expected to occur as a result of the environmental flow discharges.

Table 7-4 Order of magnitude of Warragamba Dam spillway outflows

Parameter	0.001% AEP	0.2% AEP	0.5% AEP	1% AEP	5% AEP
Warragamba Dam spillway outflow (m^3/s) - values are approximate	44,000	10,100	9,300	8,300	6,800
Maximum discharge rate from the Environmental Flow pipeline (m^3/s)	3	3	3	3	3
Ratio of discharged flow to spillway outflow	0.007%	0.03%	0.03%	0.04%	0.04%

Based on this data, the 1% AEP water level in Warragamba River immediately downstream of the spillway is about 44 mAHD (excluding the waves and surface perturbations associated with the highly turbulent flow at this location). An above-ground discharge structure is proposed at the end of the Environmental Flow Pipeline, which has an invert level of 27.7 m AHD, as shown in **Figure 7-3**. This means that the environmental flows discharge structure and the adjacent infrastructure, including the access road, are located below the 1% AEP Warragamba River flood levels. However, the loss in channel cross section area and conveyance capacity due to the discharge structure and access road is relatively small.

Being located downstream of the Warragamba Dam wall, major floods in this location are associated with highly turbulent flows that are not expected to be flowing at a uniform depth with a steady, consistent energy gradient. Due to the highly dynamic and turbulent flow conditions associated with flood events flowing through the Dam spillway, no measurable flood impact is expected from the loss of channel cross sectional area and the flood impacts associated with the structure are considered to be negligible.

The Environmental Flow Discharge Structure will not make any changes to the flood prone land, flood planning area, hydraulic categorisation and flood hazard, as described in the Floodplain Development Manual (NSW Government 2005); neither will affect the existing local community emergency management arrangements for flooding.

7.2.3 The Nepean River Primary Discharge Structure

The discharge flow rates from the pipeline at Wallacia Weir, Nepean River, are very small (approximately 0.5 m^3/s to 3 m^3/s in dry and wet weather conditions respectively) compared to magnitude of Nepean River flood flows at this location. The Nepean River Flood Study (WorleyParsons, 2015) reports the Nepean River flood at the location of this structure as presented in **Table 7-5**.

Table 7-5 Nepean River modelled peak discharge rates at Wallacia Weir (WorleyParsons, 2015)

Parameter	PMF	0.2% AEP	0.5% AEP	1% AEP	5% AEP	20% AEP	50% AEP
Nepean River peak flow rate (m^3/s)	18,421	11,048	9,469	8,314	5,220	2,447	1,074
Maximum discharge rate from Treated Water pipeline (m^3/s)	3	3	3	3	3	3	3
Ratio of discharged flow to Nepean River flow	0.02%	0.03%	0.03%	0.04%	0.06%	0.12%	0.28%

As presented in the last row of the table, the magnitude of discharged flows from the pipeline are negligible compared to the Nepean River flows, suggesting that the Treated Water discharge rate will be drown out by the Nepean River flows.

In terms of impact of the discharge structure on flood conveyance, as shown in **Figure 7-4,** the configuration of the discharge structure will not alter the cross sectional area or flood conveyance capacity of the Nepean River in a significant way. This structure will be partly recessed into the channel wall and will not protrude into the river in such a way that would alter conveyance, flood storage or flood levels in the vicinity of the structure or downstream. As such, it does not result in channel constriction and does not represent a change in flooding conditions.

Based on these factors, and while the structure will be inundated in a 1% AEP event, the impacts to Nepean River flood levels are expected to be negligible. The Nepean River Discharge Structure will not make any changes to the flood prone land, flood planning area, hydraulic categorisation and flood hazard, as described in the Floodplain Development Manual (NSW Government 2005); neither it will affect the existing local community emergency management arrangements for flooding.

The Treated Water Pipeline Discharge Structure will not make any changes to the flood prone land, flood planning area, hydraulic categorisation and flood hazard, as described in the Floodplain Development Manual (NSW Government 2005); neither will affect the existing local community emergency management arrangements for flooding.

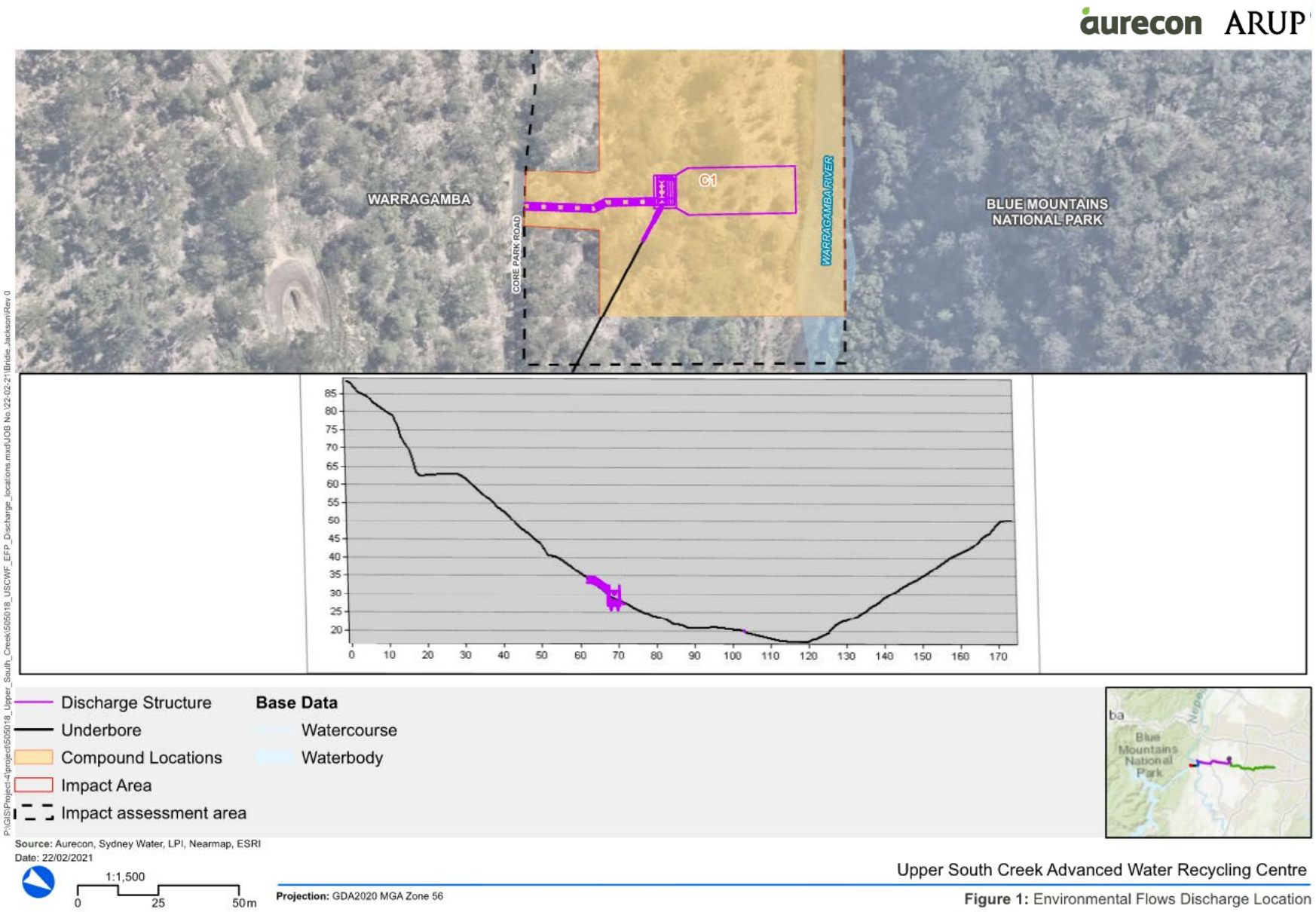


Figure 7-3 The environmental flows discharge location at Warragamba River

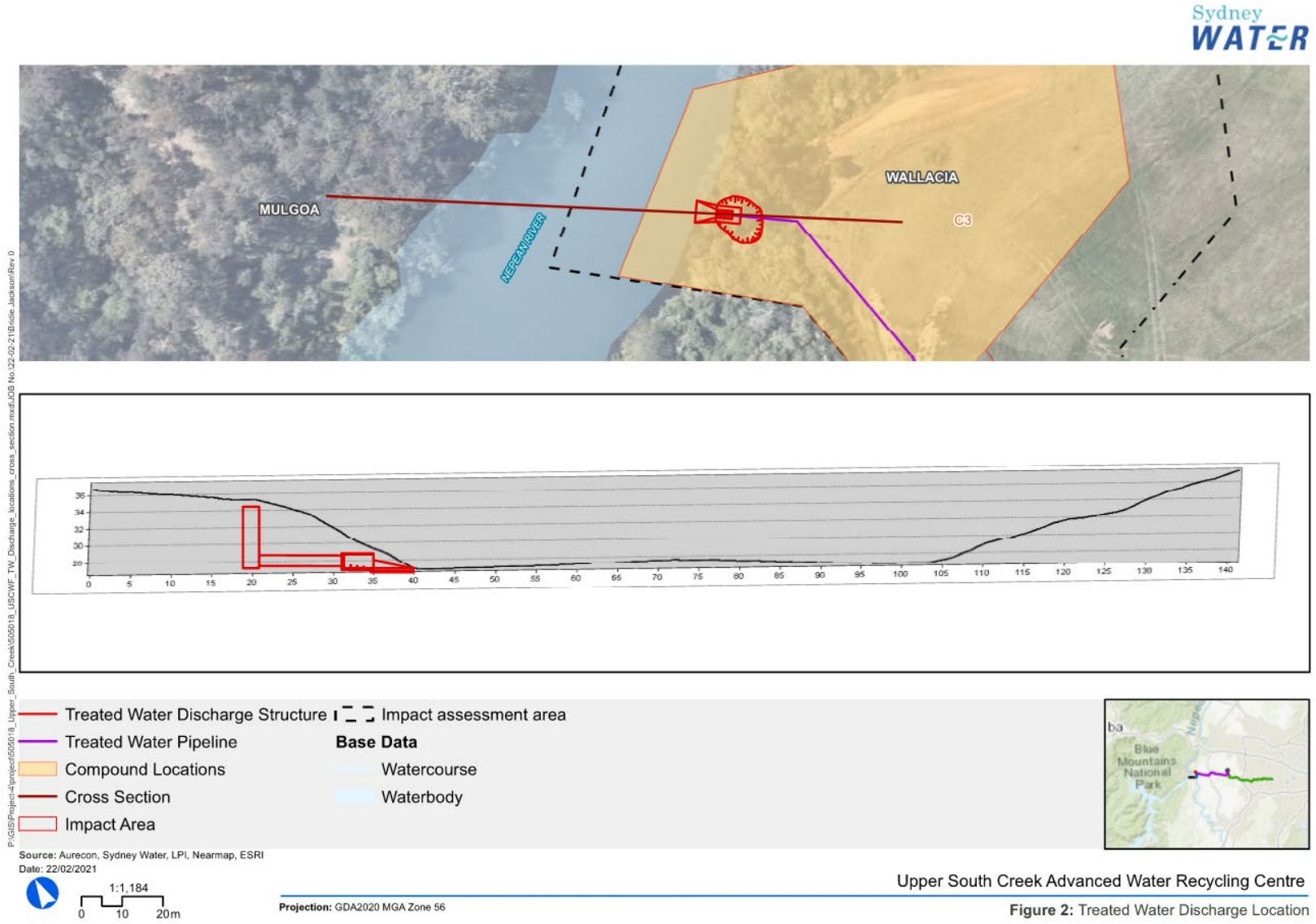


Figure 7-4 The Nepean River Discharge Structure

7.2.4 The Upper South Creek Advanced Water Recycling Centre

7.2.4.1 Impact on flood flow rates

The project reference design provides three On-Site Detention basins (OSD): North A, North B and South, as shown in **Figure** 7-5. The basins have been included to ensure that sufficient land take and earthworks are provided for in the case that detention basins are prescribed for the Western Sydney Aerotropolis precincts.

Modelled peak discharge rates from these OSDs are estimated in Appendix B of the Surface Water Impact Assessment. **Table 7-6** presents a summary of the modelled peak discharge flowrates as well as the modelled flowrate in South Creek at the discharge location for 50%, 5% and 1% AEP events. It is evident from the table that the site discharge flow rates into South Creek are negligible compared to the 1% AEP flood flows and therefore would not make any meaningful impact.

Table 7-6 Modelled 1% AEP OSD peak discharge rates (m³/s)

Parameter	Unit	North OSDs	South OSD
Peak Discharge Rate from OSDs	m³/s	0.94	0.57
South Creek Discharge Rate	m³/s	530	296
Post-development Flow to South Creek Flow Ratio	-	0.2%	0.2%

[1] Peak discharge rate refers to the maximum median flowrate simulated across all storm durations

7.2.4.1.1 Wet weather flow

Based on the same study, the peak Wet Weather discharge rate from the site are expected to be 2.5m³/s, which includes stormwater runoff from the catchment that would otherwise be in South Creek.

The modelled 10% and 1% AEP flood flows in South Creek immediately downstream of USC AWRC are 193m³/s and 530m³/s, respectively. The wet weather flows are less than or about 1% of the South Creek flood flow rates for these events and therefore its impacts are deemed to be insignificant.

Table 7-7 Contribution of wet weather discharge from the AWRC and flows during plant shutdown

Parameter	Unit	10% AEP	1% AEP
South Creek Discharge Rate	m³/s	193	530
Wet weather discharge	m³/s	2.5	2.5
Percentage change	-	1%	0.5%
Plant shut down	m³/s	3.4	3.4
Percentage change	-	1.7%	0.6%

7.2.4.1.2 Plant shutdown overflow

In case of the USC AWRC plant shutdown, the wastewater inflow will be discharged into South Creek via the overflow channel at a rate of 3.4 m³/s which will comprise some wastewater and stormwater runoff from the South Creek catchment that has entered the trunk sewer rather than the waterway.

This flow rate is less than 2% of the South Creek 10% AEP flow (193 m³/s) and less than 1% of the 1% AEP flow (530 m³/s). On this basis, the impacts of the wastewater overflow to South Creek flood flows are considered negligible.

7.2.4.2 Impact on flood hydraulics

The results of the hydrology and hydraulic modelling were used to identify the locations, extents and level of the USC AWRC flood impacts on the South Creek and Kemps Creek existing flooding conditions. Peak water levels at the proposal area for the modelled design events were determined from the flood modelling results.

The flood modelling showed that the development of the USC AWRC site, using cut and fill construction methods, and being above the FPL, would not have any significant effects on the pattern of flood flows or on flood levels for a range of modelled flows from very frequent (10% AEP) to rare (0.2% AEP). However, there will be some impacts under the extreme PMF conditions as described in the sections below.

7.2.4.3 The 10% AEP (approximately 1 in 10-year ARI) event

Figure 7-6 shows the changes in flood level for 10% AEP event. In this event the USC AWRC site remains completely above the flood level and therefore it will not impact the flooding conditions except some drop in flood levels on the west side of the site, which are resulting from the improved flood storage in that area.

7.2.4.4 The 1% AEP (1 in 100-year ARI) event

The 1% AEP afflux (change in flood level) map is shown in **Figure 7-7**. As the USC AWRC site still remains completely above the flood levels, there are no areas with increased flood level outside of the site boundary. Modelling shows a small area showing difference is the west side of the site with reduction of flood levels from 10 mm to 30 mm due to the increased floodplain storage of the swale and wetland. Otherwise, the project does not result in any adverse impact to the baseline flooding conditions on surrounding properties or infrastructure.

7.2.4.5 The 0.5% AEP (1 in 200-year ARI) event

The afflux map for the 0.5% AEP event is shown in **Figure 7-8**. The USC AWRC site is still completely above the flood level and no increase to flood levels is expected to occur due to the project, except some reduction of flood levels on the west side of the site for the same reason mentioned above.

7.2.4.6 The 0.2% AEP (1 in 500-year ARI) event

In a 0.2% AEP event and as presented in **Figure 7-9**, the USC AWRC site is still above the water level and the extent of changes to flooding conditions is still limited to decreased flood levels at the downstream west side of the site.

7.2.4.7 The PMF event

As shown in **Figure 7-11**, under the PMF event, the elevated site pad encroaches into the PMF floodplain, resulting in a blockage of flow and loss of flood storage. This leads to an afflux in Kemps Creek along the east boundary in the order of 100 mm. However, the flood level increases are localised and do not impact on any significant infrastructure or emergency evacuation routes. Peak flood levels in South Creek decrease along the west side, which is due to the increased floodplain storage because of the swale and wetland.

A summary of potential impacts in operational phase and recommended mitigation measures are presented in **Table 7-8**.

Based on the model results, the USC AWRC will not result in any changes to flood prone land, flood planning area, hydraulic categorisation and flood hazard, as described in the Floodplain Development Manual (NSW Government 2005) for modelled events up to and including 0.2% AEP; neither it will affect the existing local community emergency management arrangements for flooding.

Under the modelled PMF event and as shown in **Figure 7-11**, there are changes to flooding conditions of Kemps Creek, resulting in an extended flood prone land immediately upstream of the site.

7.2.4.8 The 1% AEP FFA flow event

Under the 1% AEP FFA event, the works near the South Creek channel and elevated site pad result in a minor localised change to flow patterns but no overall impact on flood conveyance or flood levels outside of the AWRC site. This leads to a small localised extent where the water level is reduced by up to 100mm in one area and increased by up to 30mm immediately adjacent to the AWRC site in Kemps Creek along the eastern boundary but within the AWRC site. Similar to the 1% AEP event, the peak flood levels in South Creek mostly decrease between 10 to 30 mm due to the increased floodplain storage created by channel works in the floodplain to the west of the AWRC shown in **Figure 7-5** below.

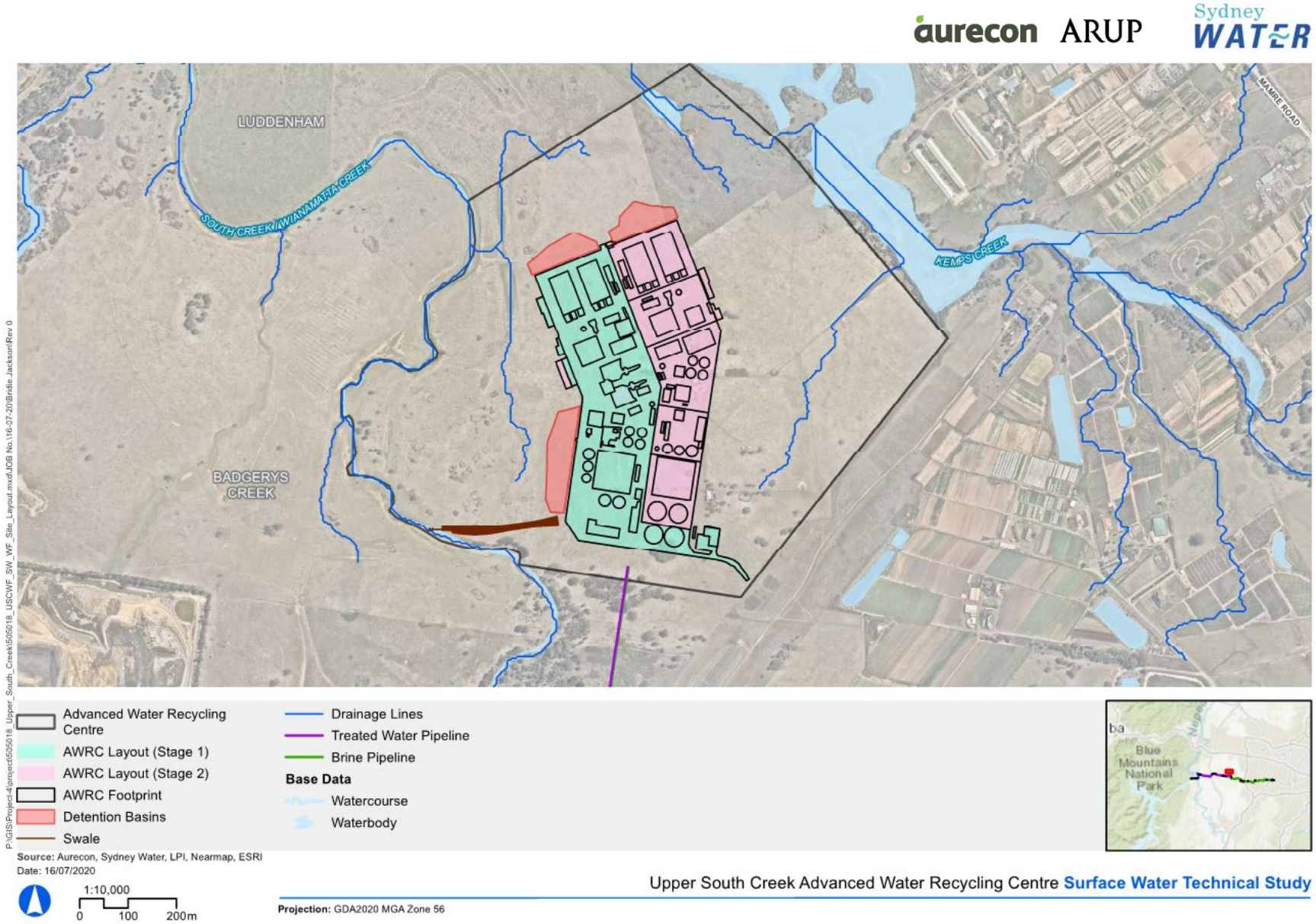


Figure 7-5 The AWRC layout including the On-Site Detention (OSD) Tanks

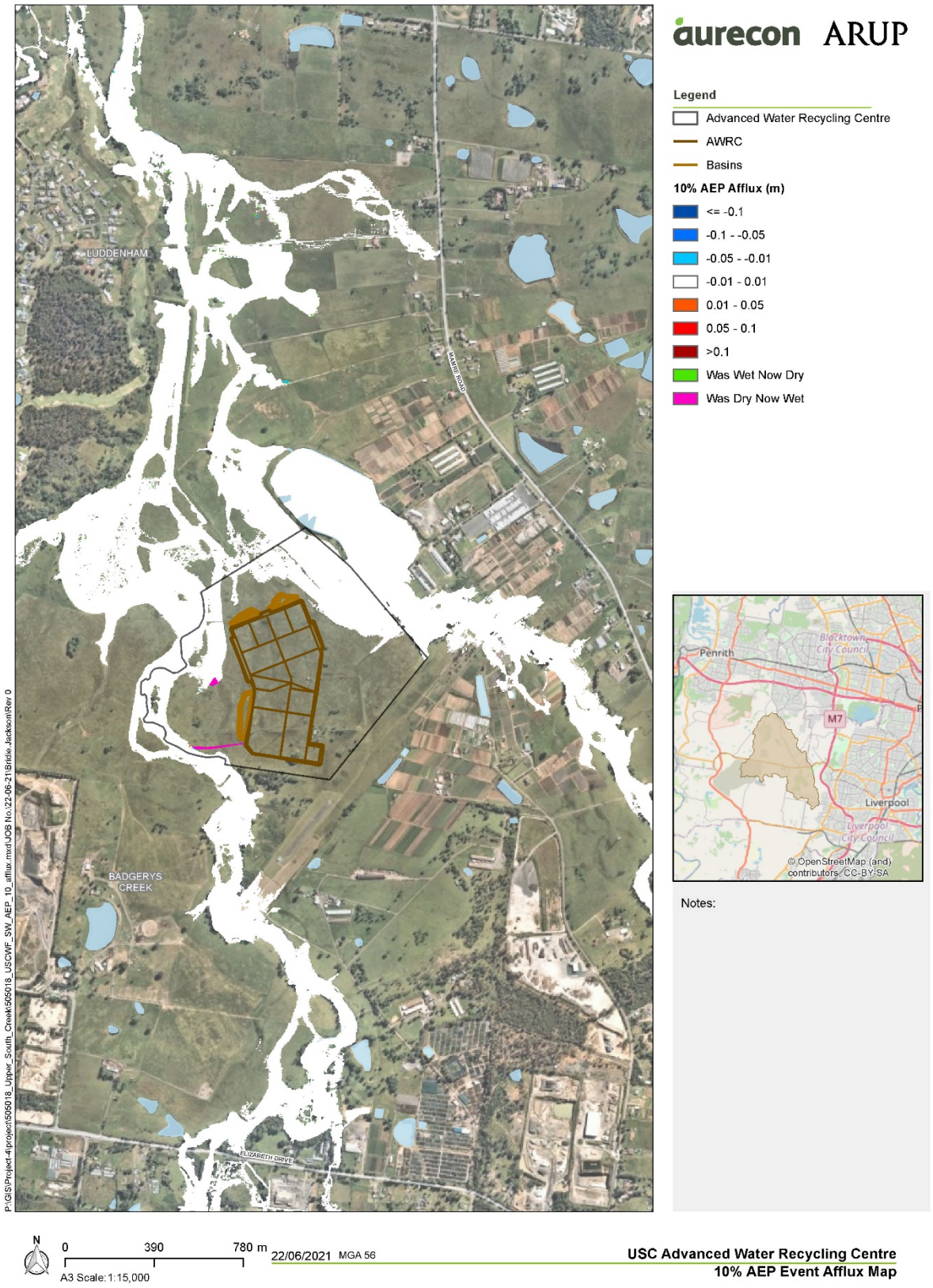


Figure 7-6 The 10% AEP Event Afflux Map

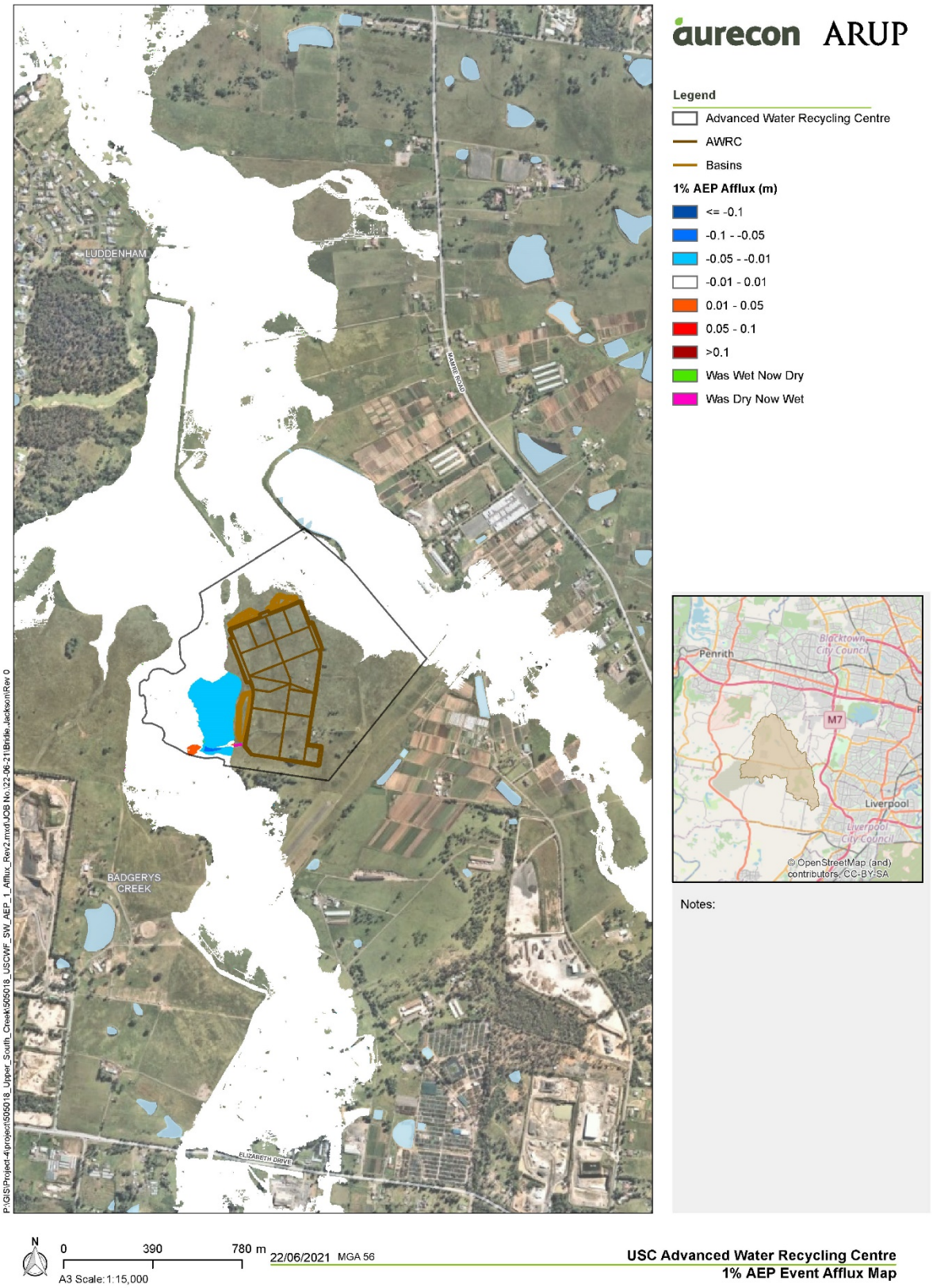


Figure 7-7 The 1% AEP Event Afflux Map

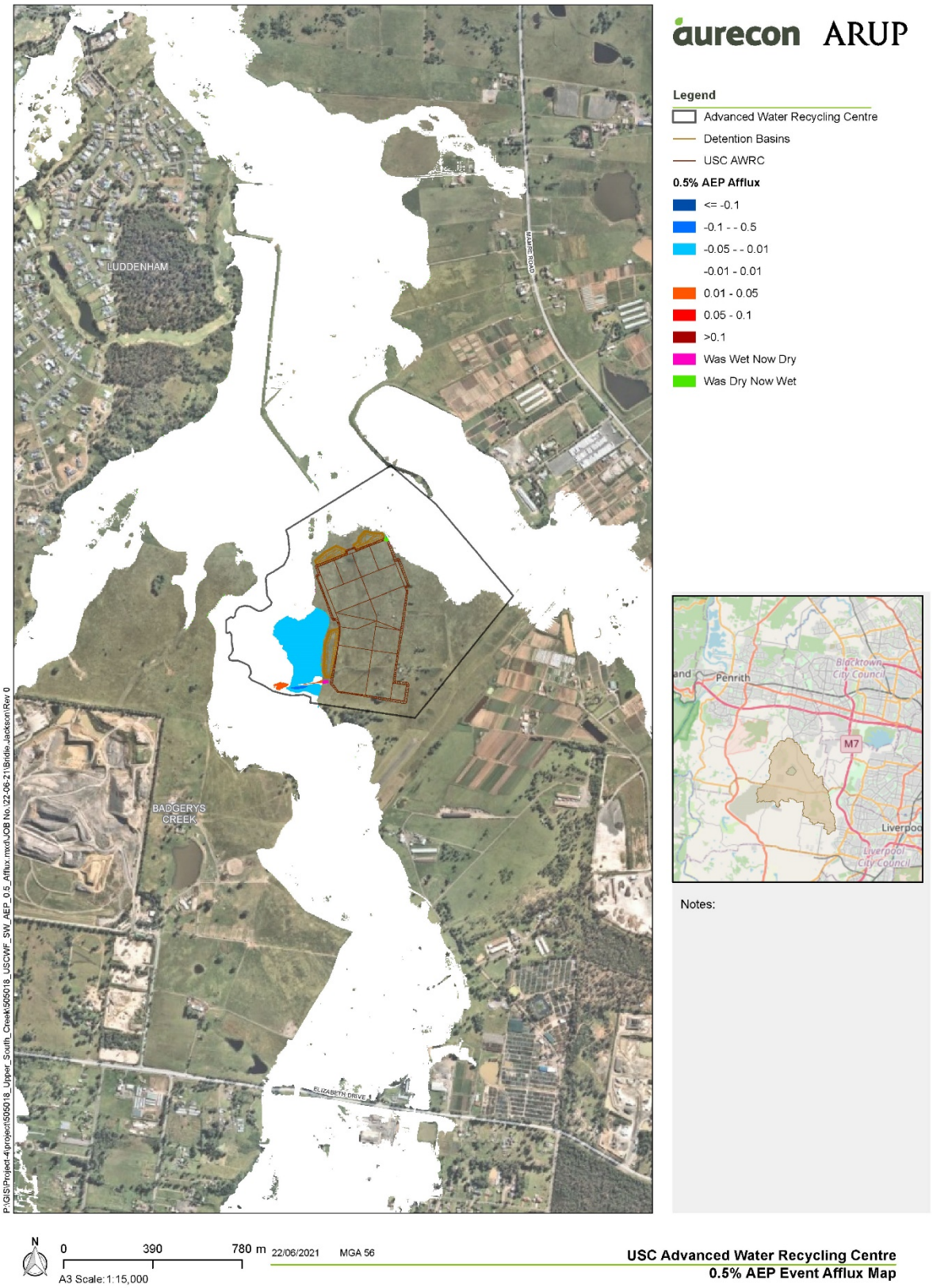


Figure 7-8 The 0.5% AEP Event Afflux Map

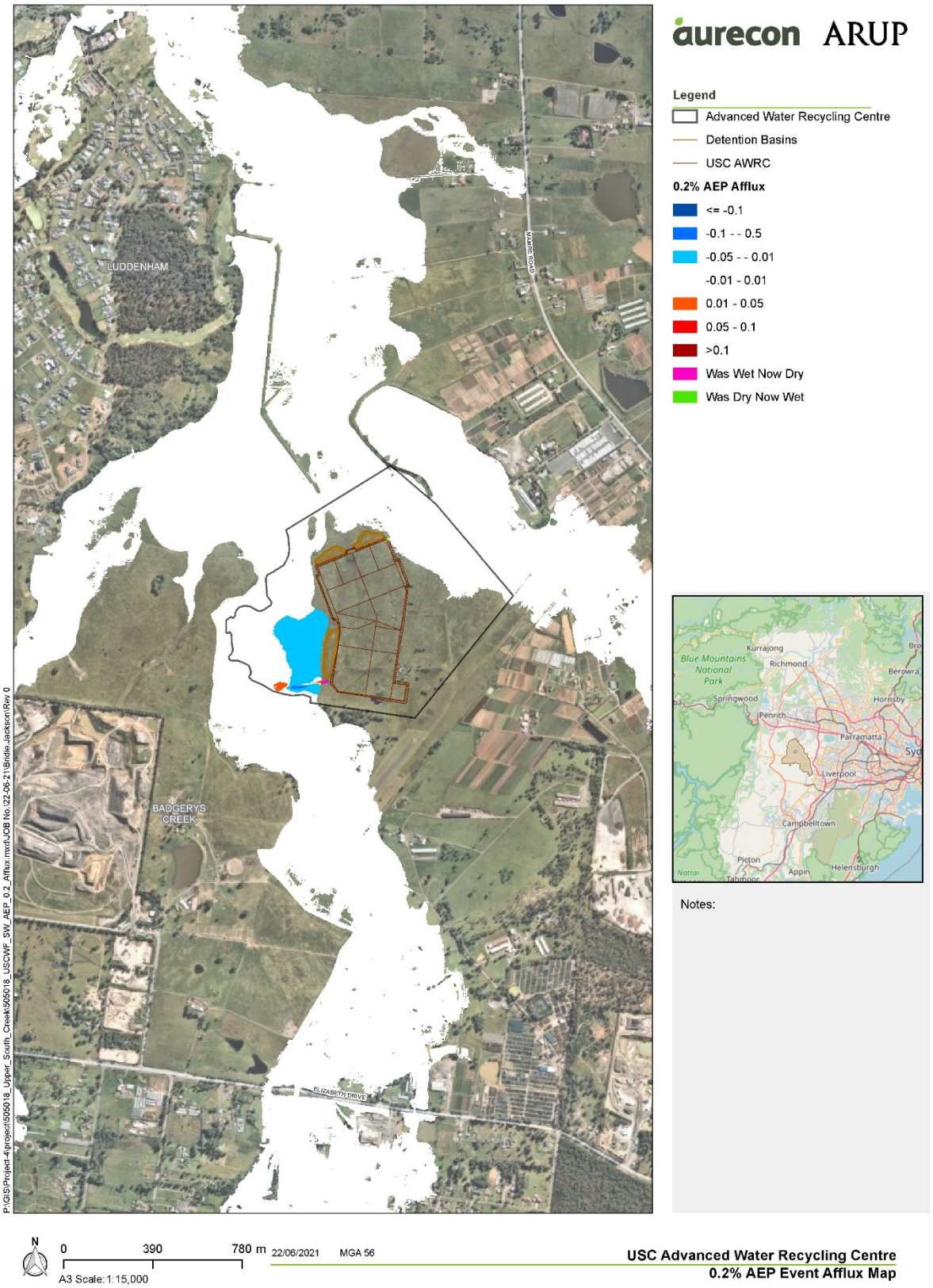


Figure 7-9 The 0.2% AEP Event Afflux Map

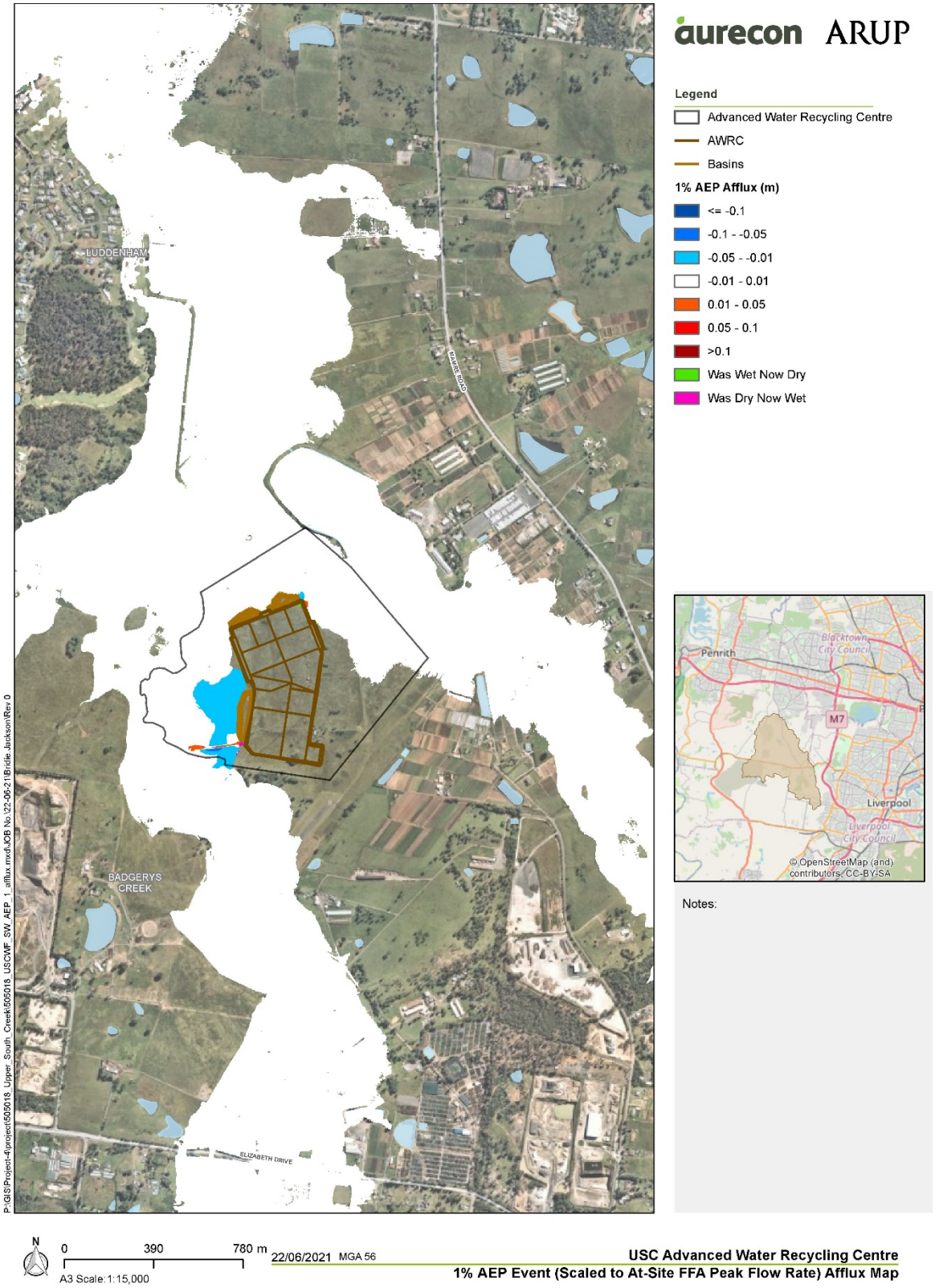


Figure 7-10 The 1% AEP FFA Event Afflux Map

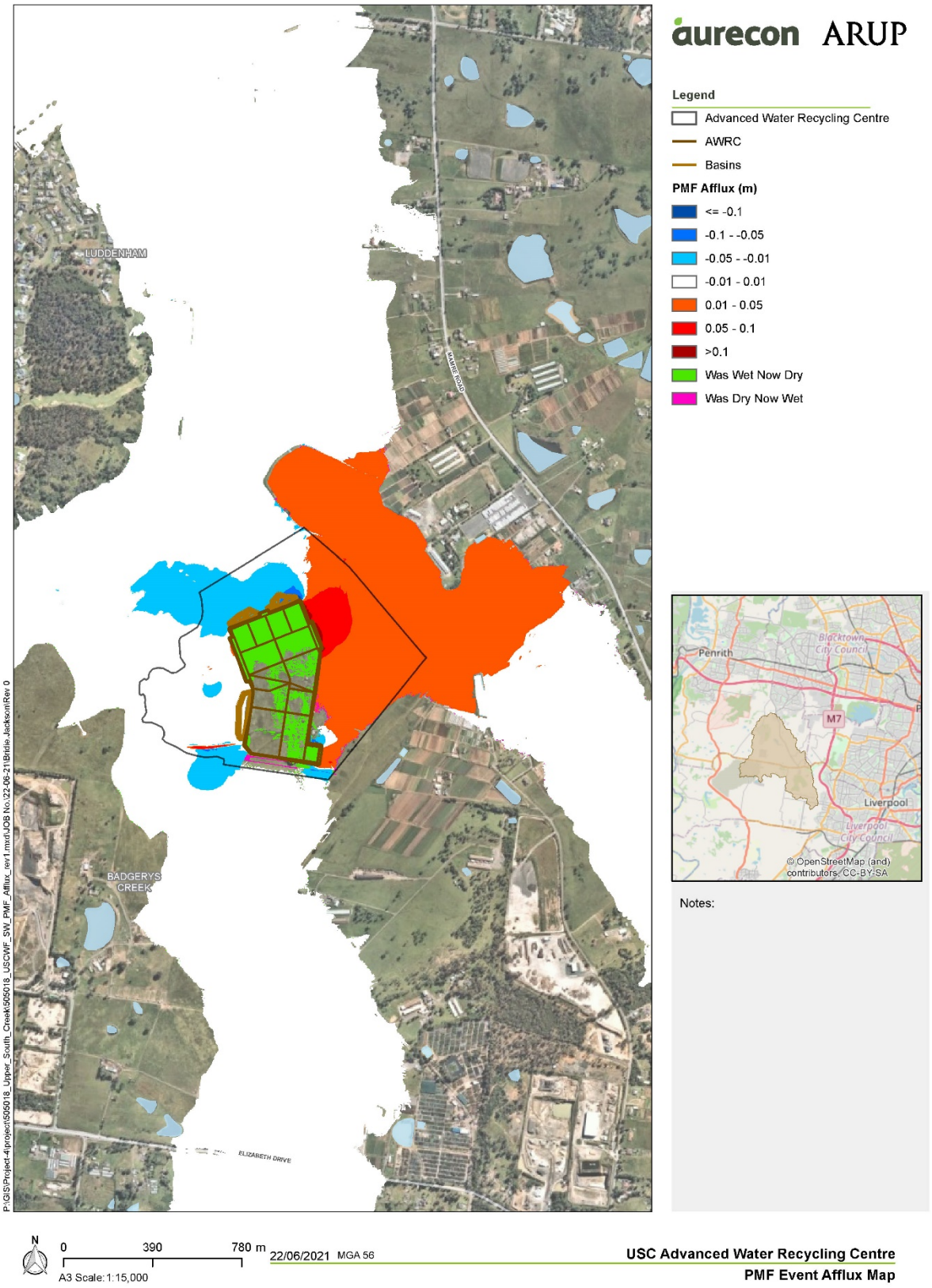


Figure 7-11 The PMF Event Afflux Map

7.2.5 Discussion and Summary of Impacts

AWRC

A quantitative assessment of the AWRC reference design demonstrates that the proposed earthworks and flow management measures will have an acceptable impact on flooding in terms of:

- Having negligible impact on flood levels and existing flood prone land in events up to the PMF event
- Contributing a negligible amount of additional discharge (wet and dry weather flows) to peak flow rates at the South Creek discharge location
- Not altering the local flood planning area, not resulting in a loss of floodplain storage and not altering floodplain conveyance up the 1% AEP event
- Having negligible impact on existing floodways and flood storage areas up to the 1% AEP event
- Being a compatible land use in the context of the local hydraulic category and flood hazard.

Treated Water Discharge Structure

A qualitative assessment of the Treated Water discharge structure and notional wet and dry weather discharges to the Nepean River have an acceptable impact on flooding in terms of:

- Having negligible impact on flood conveyance, and therefore not impacting existing flood levels and flood prone land in events up to and including the PMF event
- Contributing a negligible amount of additional discharge (wet and dry weather flows) to peak flow rates in the Nepean River
- Not resulting in a loss of floodplain storage and not altering floodplain conveyance up the 1% AEP event
- Having negligible impact on existing floodways and flood storage areas up to the 1% AEP event
- Being a compatible land use in the context of the local hydraulic category and flood hazard.

Environmental Flows Discharge Structure

A qualitative assessment of the Environmental Flow discharge structure and notional wet and dry weather discharges to the Warragamba River have an acceptable impact on flooding in terms of:

- Having negligible impact on flood conveyance, and therefore not impacting existing flood levels and flood prone land in events up to and including the PMF event
- Contributing a negligible amount of additional discharge (wet and dry weather flows) to peak flow rates in the Warragamba River
- Not resulting in a loss of floodplain storage and not altering floodplain conveyance up the 1% AEP event
- Having negligible impact on existing floodways and flood storage areas up to the 1% AEP event
- Being a compatible land use in the context of the local hydraulic category and flood hazard.

Summary

A summary of potential operation phase impacts are presented in **Table 7-8**.

Table 7-8 Impact assessment outcomes and mitigation measures (Operational phase)

Potential Impact	Reference/project location/ID	Impact significance	Mitigation measures
Changes in flooding conditions due to the completed AWRC	The USC AWRC site and South Creek	Significance: Low Negligible impact on floodways, flood conveyance or flood storage zones up to the modelled FFA event. No altering of the local flood planning area Negligible impact on existing and flood storage areas up to the 1% AEP event Compatible land use in the context of the local hydraulic category and flood hazard.	Impact significance low without mitigation.
Changes in flooding conditions caused by wet weather discharges from the AWRC to South Creek	The USC AWRC site and South Creek	Significance: Low Negligible increase in peak discharge to South Creek.	Impact significance low without mitigation.
Changes in flooding conditions due to the Nepean River Treated Water discharge structure	The Treated Water discharge structure in the Nepean River	Significance: Low Negligible impact on floodways, flood conveyance or flood storage zones up to the PMF event No altering of the local flood planning area Negligible impact on existing and flood storage areas up to the 1% AEP event Compatible land use in the context of the local hydraulic category and flood hazard.	Impact significance low without mitigation.
Changes in flooding conditions caused by wet weather discharges to the Nepean River	The Treated Water discharge structure in the Nepean River	Significance: Low Negligible increase in peak discharge to the Nepean River.	Impact significance low without mitigation.

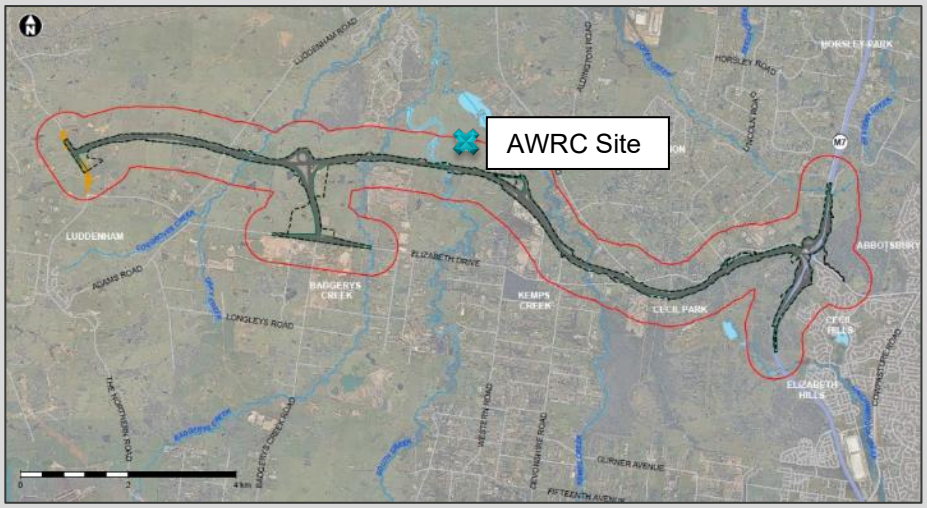
Potential Impact	Reference/project location/ID	Impact significance	Mitigation measures
Changes in flooding conditions due to the Warragamba River Environmental Flow discharge structure	The Environmental Discharge structure in the Warragamba River	Significance: Low Negligible impact on floodways, flood conveyance or flood storage zones up to the PMF event No altering of the local flood planning area, Negligible impact on existing and flood storage areas up to the 1% AEP event Compatible land use in the context of the local hydraulic category and flood hazard.	Impact significance low without mitigation.
Changes in flooding conditions caused by wet weather discharges from the Environmental Flow discharge structure	The Environmental Discharge structure in the Warragamba River	Significance: Low Negligible increase in peak discharge to Warragamba River.	Impact significance low without mitigation.

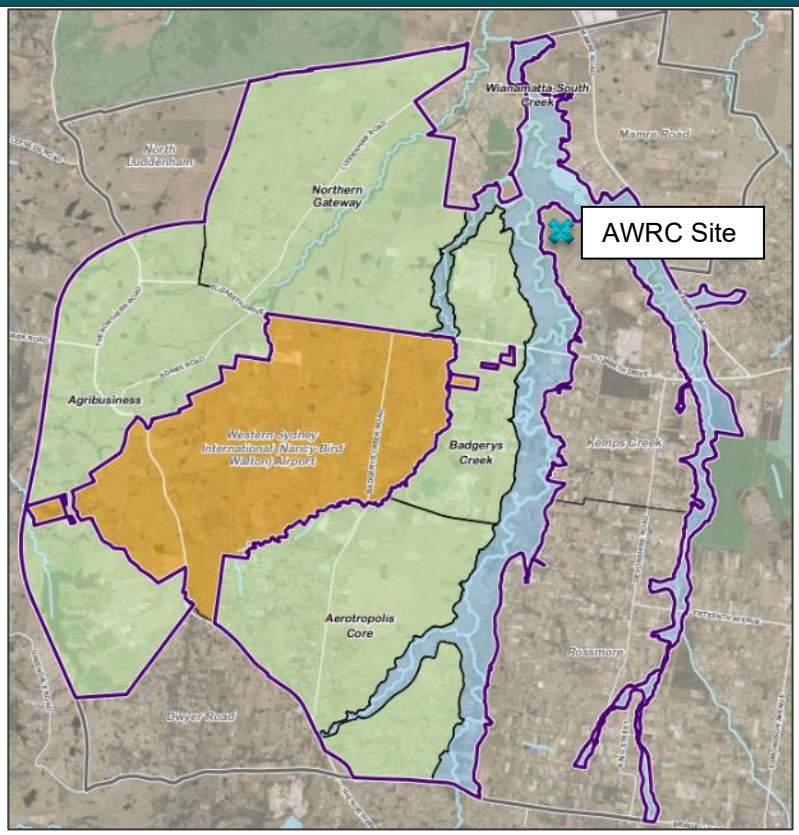
7.3 Cumulative impacts

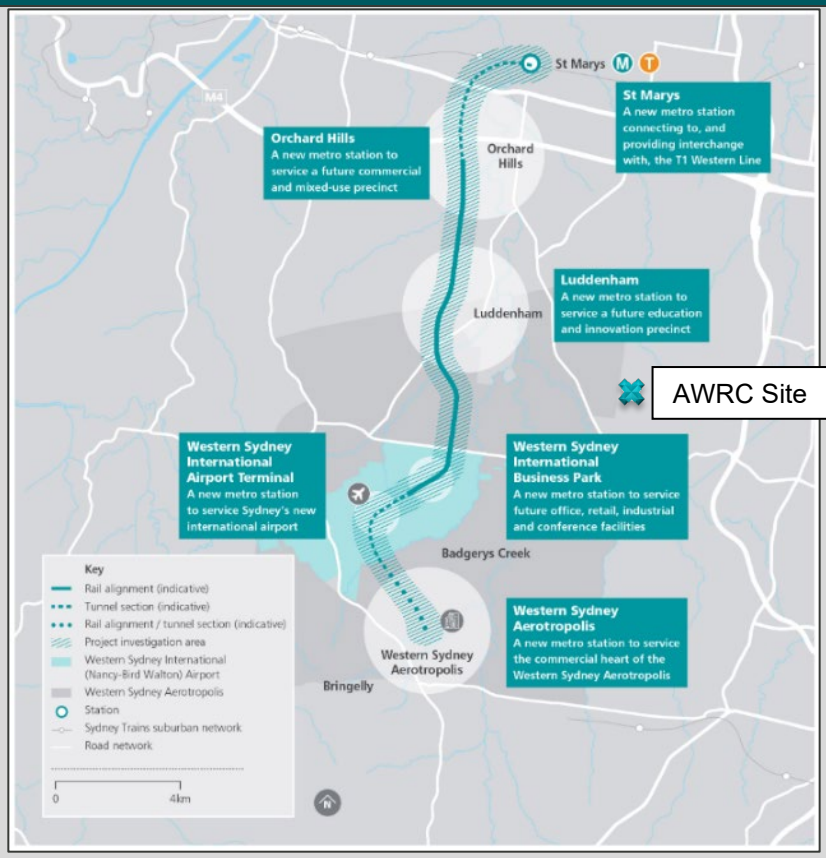
When considered in isolation, any identified project impacts on baseline flooding conditions may be considered insignificant. These insignificant impacts may, however, be compounded, when the cumulative impacts of multiple projects on flooding conditions are considered. As such, the identified impacts on flooding regime need to be considered alongside recently completed, ongoing and proposed projects. The major projects currently being proposed within close proximity to the study areas are indicated in **Table 7-5**.

Table 7-5 Proposed major projects in close proximity to AWRC study areas

Project	Project description, relation to current proposed AWRC project and expected residual impacts
Western Sydney Airport	The proposed Western Sydney Airport (WSA) site will be located approximately 3.2 km south-west of the USC AWRC site, south of Elizabeth Drive. The site is primarily drained by Badgerys Creek and Cosgrove Creek. Construction at the WSA site has already commenced. The Western Sydney Airport EIS surface water hydrology and geomorphology assessment (GHD, 2016) concluded that: • Construction of the proposed WSA would result in major changes to the surface water runoff generated and removal of a large number of watercourses and farm dams. The effects of these changes are mitigated by the inclusion in the design of several detention basins. • The assessment considers the potential for the cumulative impacts of climate change to exacerbate the environmental impacts of the proposed airport and also to increase susceptibility of the airport infrastructure to flooding. • During construction, a detailed surface water management plan would be developed and would need to consider the impacts of flooding on-site over the course of the construction period. • During the operational phase, the proposed detention basin strategy would be effective at limiting the downstream impacts such that any increases in flood level would not worsen flooding to surrounding roads and dwellings. • Some localised minor changes in water level is predicted immediately downstream of the airport site Any increase in surface runoff downstream of the WSA site will result in cumulative impacts on flood levels upstream of the USC AWRC site, which may already experience elevated flood levels resulting from the construction of the project. As the current assessment suggests that flood levels upstream of the site resulting from the construction of the USC AWRC project will not change significantly, the cumulative impacts on flood levels around Elizabeth Drive due to combined construction of the WSA and USC AWRC are expected to be minor.

Project	Project description, relation to current proposed AWRC project and expected residual impacts
M12 Motorway	The proposed M12 Motorway will run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres and would be opened to traffic prior to opening of the Western Sydney Airport. The AWRC site itself is located within the extents of the M12 surface and hydrology study area. The discharge pipelines will follow a similar alignment to the M12 along portions of their routes.  Because any potential changes to the baseline flooding conditions resulting from the M12 project will likely be in form of afflux south of the Motorway, it is not expected that there are any significant cumulative impacts resulting from the USC AWRC and M12 projects.
Western Sydney Aerotropolis	The Western Sydney Planning Partnership (WSPP) is rezoning new areas of land release. These precincts all directly border the WSA site, they include: the Aerotropolis Core, Badgerys Creek, Northern Gateway, Agribusiness and adjoining areas of Wianamatta-South Creek as indicated below. These precincts are primarily located within the South Creek catchment as the discharge pipelines will transect several of them.

Project	Project description, relation to current proposed AWRC project and expected residual impacts
	 Integrated water management and flood management strategies are being developed to targeting low and high flow storm events respectively. One outcome of this work is to determine flood detention requirements and flow management requirements that will ensure no increase in flood risk to downstream development under cumulative development.
Sydney Metro – Western Sydney Airport	The proposed new railway will link St Marys to the new airport and the Western Sydney Aerotropolis, alignment indicated below (Sydney Metro, 2020).

Project	Project description, relation to current proposed AWRC project and expected residual impacts
	 The Project footprint is primarily located within the South Creek catchment (or its tributaries). The scoping document reiterates the degraded water quality within the area and references a water management system associated with the Western Sydney International Stage 1 which is expected to effectively mitigate potential flooding and water quality impacts. The EIS (Sydney Metro, 2020b) was published in October 2020, indicating that the potential impacts from the operation of the project may further degrade the water quality if not properly managed, as well as the potential for minor but localised changes to the catchment and watercourse health. Several mitigation measures, such as the incorporation of operational detention basins (designed to Penrith Council requirements), and WSUD features at stations to treat stormwater runoff, will be incorporated to mitigate impacts and achieve the stated project performance outcomes.
The Northern Road Upgrade – Glenmore Road to Bringelly	The project will upgrade around 35 kilometres of The Northern Road between The Old Northern Road at Narellan and Jamison Road at South Penrith. The project will see The Northern Road upgraded to a minimum four-lane divided road, and up to an eight-lane divided road with dedicated bus lanes. The treated water pipeline will run alongside the Northern Road for a stretch of approximately 1.4 km. Construction works within this area could likely overlap. As no flood impacts are expected to be associated with the pipelines, any cumulative impacts are negligible.

Project	Project description, relation to current proposed AWRC project and expected residual impacts
Warragamba Dam Raising	Warragamba Dam Raising is a project to provide temporary storage capacity for large inflow events into Lake Burragorang to facilitate downstream flood mitigation and includes infrastructure to enable environmental flows. The EIS for this project is still being developed and thus potential impacts have not been assessed and published as yet. Cumulative impacts are expected to be minimal as the dam is located upstream of the environmental flows discharge location, and the raising is aimed at storing major flood events rather than retaining more water on a regular basis.

Generally major projects are designed and delivered in accordance with current environmental legislation and incorporate sufficient control measures to mitigate associated impacts.These proposed major projects along with the general expected future urban development in the area will be required to implement similar flood controls as outlined for the USC AWRC which will preserve existing peak flows and flood levels in the Wianamatta - South Creek floodplain. The same controls will be applied to the numerous small-scale developments, mitigating impacts from these smaller developments.

Where all developments implement the same controls, then it is unlikely that current watercourse geomorphology will be exacerbated by the construction and operation of the USC AWRC and the discharge pipelines.

7.4 Evacuation Routes

AWRC

Due to the proximity of the AWRC to the confluence of South Creek and Kemps Creek, the flooding fringe surrounds the Project and the access roads into the site would be affected by several of the design flood events. Consequently, early evacuation of the site would need to be considered to ensure workers are not isolated and required to shelter in place.

Access to the site is via Clifton Avenue which, based on the results of the flood modelling in this assessment, is regarded as the safest site egress route. Model results suggest that the site and access road from Clifton Avenue will remain flood-free for events up to 1% AEP. However, under PMF event the new portion of the access road connecting the site to the existing Clifton Avenue may become partially flooded.

During the 10% flood event, the safest and most direct evacuation route would be to exit the site, continue along Clifton Avenue to the south, then turn left onto Elizabeth Drive and continue to the east to join the northbound lane of Westlink M7 Motorway. As there are fewer waterway crossings on Elizabeth Drive between Clifton Avenue and Westlink M7 Motorway, this would be the lowest flood risk route for evacuation. This route is shown in **Figure 7-12**.

A secondary but less safe route which should only be used in the event of an unforeseen event or accident that prohibits turning left on Elizabeth Drive, would be to travel west on Elizabeth Drive to join the Northern Road. While there are many waterway crossings on Elizabeth Drive between Clifton Avenue and the Northern Road, the modelling suggests this route will remain almost flood-free during the 10% AEP flood event, with some minor (about 50 mm) inundation of Elizabeth Drive road surface after Adams Road at the Cosgrove Creek crossing.

During the 1% AEP flood event and based on the model results, Elizabeth Drive will remain flood-free between Clifton Avenue and Westlink M7 Motorway, so it is still safest to use the above route for evacuation, i.e. exit the site, continue Clifton Avenue to the south, then turn left onto Elizabeth Drive and continue to the east to join the northbound lane of Westlink M7 Motorway. In such an event, the road overtopping at the Cosgrove Road crossing increases and the modelled floodwater is about 100 mm deep, making it unsafe to drive westbound toward the Northern Road.

During the 0.2% AEP, 0.5% AEP and PMF events, the site exit road may be partially flooded, and Elizabeth Drive will also be flooded (both eastbound and westbound), leaving no evacuation route to the east, west or even further south. Evacuation of the site prior to the access routes being inundated during flood events higher than 1% AEP would be required, in accordance with Government flood warnings and evacuation procedures.

Treated Water Discharge Structure

Construction of the proposed headwall structures may take 12 months for a construction team accessing the site off Silverdale Road, Wallacia. Construction is associated with a small workforce and small increase in traffic movements which will have no impact on evacuation of the village of Wallacia.

During operation, very infrequent maintenance operations will be necessary also requiring a small team causing negligible additional traffic movements.

The site is flood prone and early evacuation of the site can occur via Wallacia and Park Road.

Environmental Flows Discharge Structure

Construction of the proposed temporary road, excavation, trenching, structures and rock placement may take 12 months for a construction team accessing the site off Core Pare Road, Warragamba. Construction is associated with a small workforce and small increase in traffic movements which will have no impact on evacuation of the neighbouring suburbs.

During operation, very infrequent maintenance operations will be necessary also requiring a small team causing negligible additional traffic movements.

While the site is flood prone, high ground is close by and evacuation can occur via the village of Warragamba.

Flood Preparedness Plan

A Flood Preparedness Plan should be prepared for the Project based on the PMF design event, which would be incorporated into the Construction Environmental Management Plan or the Site Emergency Response Plan. This plan would include:

- Roles, responsibilities and communication procedures including emergency contacts
- Monitoring procedures for rainfall and flood warnings
- Site shutdown and flood preparedness procedures to minimise harm to persons, plant and the environment
- Actions in the lead up to the flood (such as monitoring water levels, completing erosion and sediment controls, removing hazardous materials and waste from the site, barricading, sealing tanks and containers to prevent overflows, tying down loose items)

- Actions at the time of the flood (may include further evacuation, rescue, pollution prevention, spill response, and contingency measures)
- Actions post-flood (including clean up and rectification)
- Evacuation routes and procedures
- Rescue procedures
- Procedure for resuming operations
- Reporting requirements and corrective actions

During its development, this Flood Preparedness Plan would be discussed with the NSW SES and Penrith City Council to ensure alignment with community evacuation arrangements and implemented during both construction and operational phase.

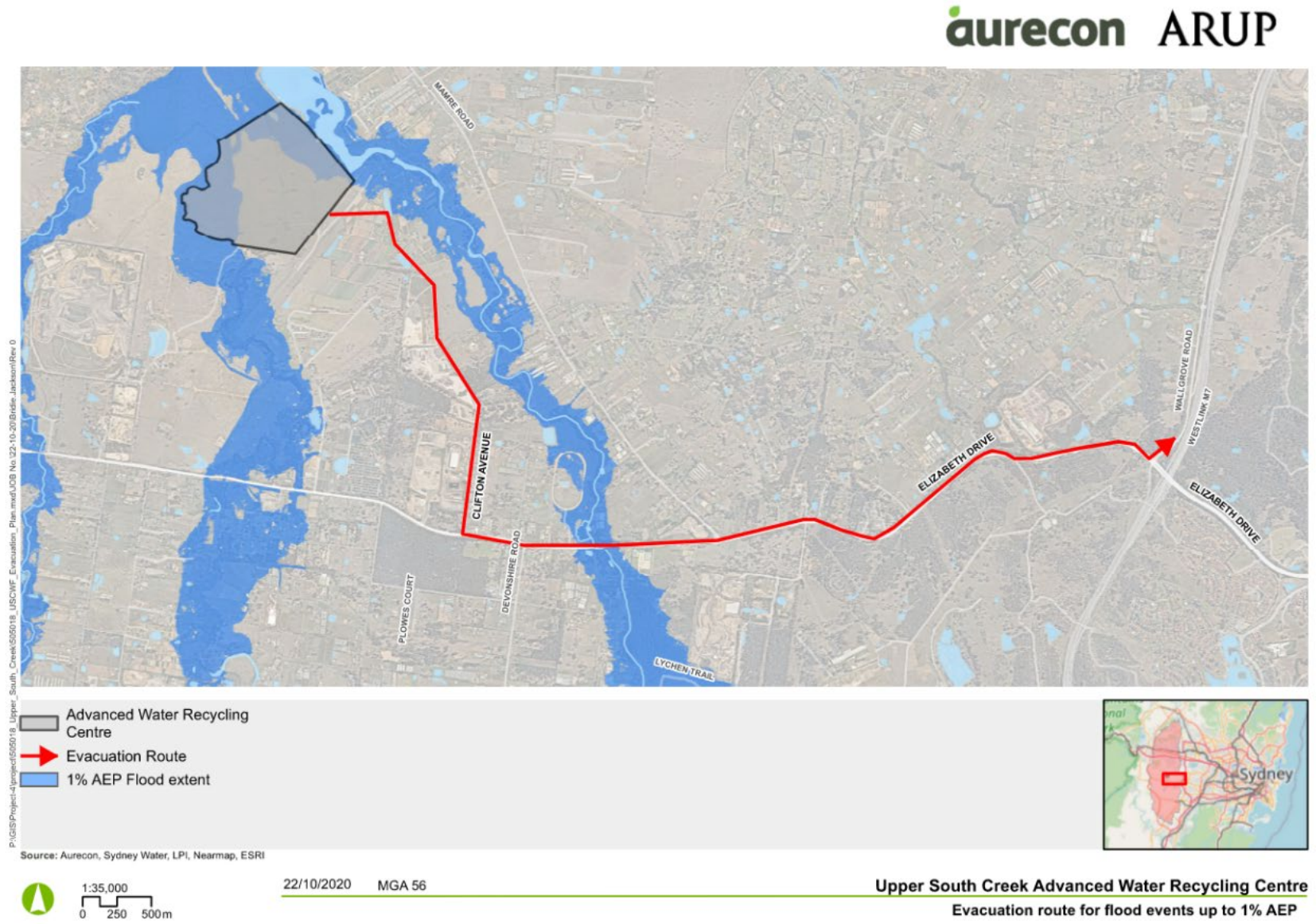


Figure 7-12 Evacuation Route for flood events up to 1% AEP

8 Conclusions and Recommendations

A flood impact assessment was carried out for to the proposed USC AWRC, Treated Water Pipeline, Environmental Flow Pipeline and Brine Pipeline.

During the construction phase the contractor should prepare and implement an approved Environmental Management Plan (or similar) to minimise the risk of flood impacts. At the identified compound locations and waterway crossings subject to flooding, special considerations apply in relation to storage of material and equipment to minimise impacts in the event of a flood.

During operations phase, the pipelines are not expected to influence floodwaters or change the flooding conditions, because they will be buried underground. The discharge rates from the Environmental Flow Pipeline and Treated Water Pipeline at Warragamba River and Nepean River are negligible compared to the waterway flood flows at the location of discharges. Therefore, they are unlikely to result in changes in flooding conditions or affecting adjacent properties.

For the USC AWRC site, both existing and the design conditions were numerically modelled for the 10%, 1%, 0.5%, 0.2% AEP design floods and the PMF. The 1% AEP event was also modelled under the climate change conditions. For the 1% AEP existing event, about 45ha of the proposed land remained outside the flood extent, covering the designated area for the USC AWRC main operational facilities. The results of the modelling for the proposed development under the 10% AEP, 1% AEP, 0.5% AEP and 0.2% AEP events were similar to those of the pre-development results with some local reduction of flood levels on the west boundary of the site due to the increased floodplain storage in that area. For modelled flood events up to 0.2% AEP, the development of the project would not impact flood behaviour, nor would it result in any detrimental changes in potential flood affection of other developments or land, consistent with the provisions in the NSW Flood Development Manual (2005). The project would not cause any redirection of flow, flow velocities, flood levels, hazards and hydraulic categories, so no adverse effect is expected to beneficial inundation of the floodplain environment, on, adjacent to, or downstream of the site, as a consequence of developing the Proposal. Under the PMF event, the elevated site pad does encroach into the PMF floodplain. This results in a blockage of flow and loss of flood storage, resulting an increase in flood levels upstream of the site along Kemps Creek in the order of 100 mm. These flood level increases are localised and do not impact on any significant infrastructure or emergency evacuation routes.

As the proposed development would not impact on local flooding behaviour up to the 0.2% AEP event, or impede access to existing road networks, the development is not expected to have any impacts on existing community emergency management arrangements for flooding. It is recommended that a meeting is held with the SES and Council prior to construction of the project to discuss proposed site evacuation routes and processes and ensure that these are compatible with or do not impede upon the Council and SES arrangements.

With the exception of the USC AWRC site under the PMF event, the proposed structures will not make any changes to the flood prone land, flood planning area, hydraulic categorisation and flood hazard, as described in the Floodplain Development Manual (NSW Government 2005); neither they will affect the existing local community emergency management arrangements for flooding. The flood modelling undertaken as part of this assessment also suggests that the development would not have any detrimental social and economic impacts on the community as a consequence of flooding.

9 References

- Advisian, 2020. Wianamatta (South) Creek Catchment Flood Study – Existing conditions
- AAJV, 2019. Western Sydney Aerotropolis, South Creek Flood Study
- Aurecon-Arup, Upper South Creek Advanced Water Recycling Centre, Surface Water Impact Assessment (2021)
- Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) 2016, Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia).
- Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia).
- Bewsher, 2010, Prospect Creek Floodplain Management Plan Review
- Bureau of Meteorology (BoM), 2003. The Estimation of Probable Maximum Precipitation in Australia: Generalised Short- Duration Method
- Department of Environment and Climate Change (DECC), 2007. Floodplain Risk Management Guideline: Practical Considerations of Climate Change.
- Department of Infrastructure, Planning and Natural Resources (DIPNR), 2005. Floodplain Development Manual
- Department of Infrastructure and Regional Development, 2015, Western Sydney Airport EIS, Surface Water Hydrology and Geomorphology
- NSW Department of Industry, 2018. Guidelines for Controlled Activities on Waterfront Land – Riparian Corridors
- SKM, 2008, Flood Study for Orphan School Creek, Green Valley Creek and Clear Paddock Creek
- WaterNSW, 2020, email received from Justine Clarke (Catchment and Asset Protection Adviser), 19/10/2020
- WMA Water, 2019, Hawkesbury-Nepean Valley Regional Flood Study
- WorleyParsons Services Pty Ltd, 2015. Updated South Creek Flood Study. prepared for Penrith City Council in association with Liverpool, Blacktown and Fairfield City Councils
- WorleyParsons Services Pty Ltd, 2015. Nepean River Flood Study. prepared for Camden City Council.
- Office of Environment and Heritage (OEH) NSW, 2015. Climate change impacts on surface runoff and recharge to groundwater study
- WMA Water (2019), Review of ARR Design Inputs for NSW
- WMA Water (2019), Upper South Creek Flood Study