Incitus Pty Ltd
ABN 55 285 448 851
PO Box 7142
Richmond
VIC 3121

T 0414 404 730
E nina.barich@incitus.com.au
W incitus.com.au

To	**Goodman**	From	**Nina Barich**
Copy		Reference	**2227**
Date	**22 March 2023**	Pages (including this page)	**15**
Subject	**Clayton Business Park Flood Modelling**		

Clayton Business Park is a 31 ha parcel of industrial development located between Westall Road, Rayhur Street, Kombi Road, and Centre Road in Clayton. The site is traversed by Melbourne Water's Westall Main Drain. This consists of 2 x 1750 mm diameter pipes along Rayhur Street, before converting to a 3650 mm x 1825 mm box culvert as the drain traverses the lower portion of the site from west to east towards Westall Road. The drain crosses Westall Road in a 3600 mm x 1800 mm box culvert prior to discharging into an open channel on the east side of the road reserve.

1 Peak Design Flows

Westall Main Drain has a 273 ha catchment contributing at Westall Road. This includes:

- The site
- 26.7 ha from north of the site, conveyed along Westall Road to the culvert crossing
- 156.9 ha from west and north west of the site conveyed along Rayhur Street
- 44.4 ha crossing the railway line from the south approximately 70 m east of Kombi Road via a 1425 mm diameter pipe culvert and discharging into Rayhur Street
- 9.6 ha crossing the railway line from the south approximately 250 m west of the intersection of Westall Road and Rayhur Street via a 1350 mm diameter pipe culvert and connecting directly to the Westall Main Drain

A RORB model was created to determine the peak 1% Annual Exceedance Probability (AEP) design flows for the Westall Main Drain. The model indicated the following peak 1% AEP design flows:

Table 1 – Peak Flows for Westall Main Drain

Location	Peak 1% AEP Design Flow
Corner of Rayhur St and Kombi Road	18.2 m^3/s
Rayhur Street and 1425 mm dia pipe railway crossing	23.3 m^3/s
Rayhur Street and 1350 mm dia pipe railway crossing	22.9 m^3/s
Westall Road crossing	24.9 m^3/s

Additional information for the RORB model calibration and catchment can be provided if required.

2 Capacity of Existing Infrastructure

A hydraulic analysis of the existing drainage infrastructure indicates that the Westall Main Drain has the capacity to convey approximately 10.2 m^3/s through the 2 x 1750 mm diameter pipes and approximately 13.8 m^3/s through the 3650 mm x 1825 mm box culvert. The crossing of Westall Road can convey the peak 1% AEP design flow at Westall Road with a head loss of approximately 1.56 m, which results in an upstream flood level of the culvert of approximately 51.6 m AHD.

A 5 m x 7 m pit with a pipe grille has been constructed upstream of the culvert crossing of Westall Road, and connects to the Westall Main Drain. It is believed that this pit was constructed to capture the gap flows, i.e., the difference between the 1% AEP design flow and the capacity of Westall Main Drain, for conveyance across Westall Road in the culvert crossing. Analysis of the pit indicates it has the capacity to capture the gap flows for the 1% AEP design storm prior to the crossing of Westall Road.

As the analysis indicates that the Westall Road culvert crossing has the capacity to convey the peak 1% AEP design flow if operating under pressure, and the redevelopment of the site is not intending any modifications to the land use or the average imperviousness of the site, on-site retardation is not required.

3 Requirements of Redevelopment

The site is currently subject to inundation in a 1% AEP storm event. Due to this, the redevelopment of the site must comply with the requirements for development in flood prone land. These key requirements are:

- Flood safety – protect human life and health, and provide safety from flood hazard
- Flood damage – minimise flood damage to property and associated infrastructure
- Flood impacts – maintain free passage and temporary storage of flood waters
- Waterway and floodplain protection – protect and enhance the environmental features of waterways and floodplains

Flood Safety

With respect to flood safety, it is important that the redevelopment meets the requirements for site and access safety, which for this redevelopment are:

- Flood Depth ≤ 0.5 m
- Flow Velocity ≤ 2.0 m/s
- Depth x Velocity ≤ 0.4 m^2/s

Flood Damage

With respect to flood damage, the redevelopment of the site will need to ensure that the floor levels for the proposed warehouses and buildings are set to a minimum of 300 mm above the 1% AEP flood level.

Flood Impacts

With respect to flood impacts, the redevelopment of the site must ensure that the development does not divert flows to the detriment of adjoining properties, that the development does not result in an increase in velocities to Westall Main Drain, that there is no impact on the flood level to surrounding developments and that the flood plain storage is maintained.

Waterway and Floodplain Protection

With respect to waterway and floodplain protection, the redevelopment of the site cannot have any detrimental effects on the values associated with waterways and floodplains. As the receiving Westall Main Drain is a trapezoidal channel with little ecological value, these criteria will not apply.

4 Flood Modelling

To assess the impacts of the redevelopment of the site; a 2 Dimensional (2D) hydraulic model has been constructed of the existing site and the proposed development.

The modelled terrain was constructed from feature survey and LiDAR data. Existing and proposed buildings have been modelled as obstructions. The LiDAR data specifications are:

- Vicmap Digital LiDAR 1m DEM Data
- Vertical Accuracy: +/- 10 cm
- Horizontal Accuracy: +/- 20 cm
- Date flown: 28 November 2017 – 27 October 2018

The following assumptions were adopted for the hydraulic models:

- A 1 m x 1 m grid size was adopted
- The model was run for 3 hours to ensure that the peak flow hydrograph for Westall Main Drain is fully run through the subject area
- Time step of 30 seconds to 5 minutes was typically adopted, although the model was run using the courant condition for stability in full momentum run
- Manning's Roughness applied to the model as shown with default roughness of 0.04 to represent the site average
- Buildings have been modelled as obstructions

The model has included the culvert crossing of Westall Road and the pit capture upstream of the crossing. It has excluded the other subsurface drainage infrastructure, as the focus is on the gap flows. A gap flow hydrograph, which has removed 10 m^3/s from the peak 1% AEP flow, has been run through the model from Rayhur Street. **Figure 1** illustrates the hydraulic model for the site.

Figure 1 – Clayton Business Park Hydraulic Model Setup

Existing Conditions

An existing conditions model was created for use in comparison with the proposed redevelopment. **Figure 2** illustrates the 1% AEP flood levels extracted from the flood model for the current site conditions.

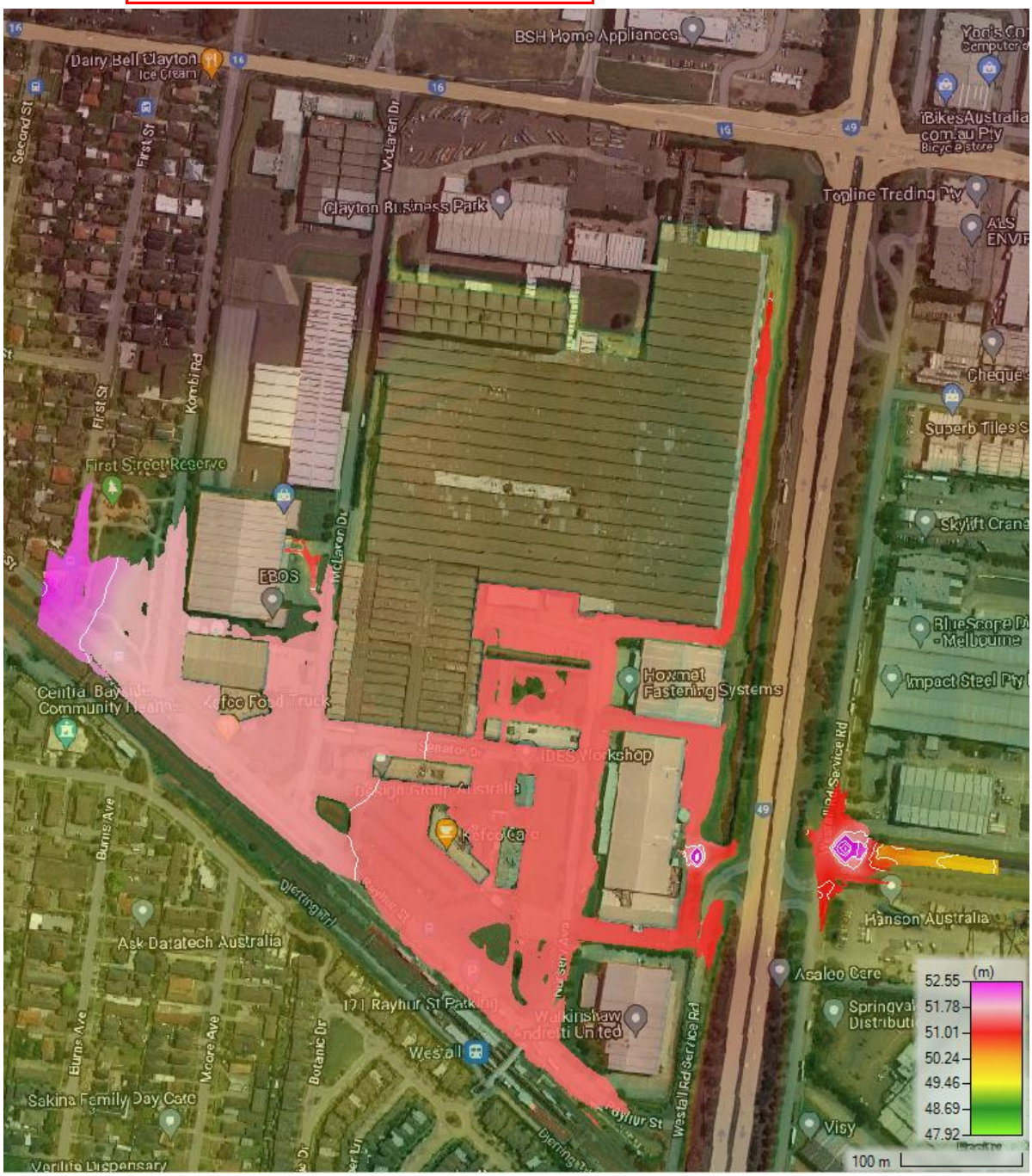

Figure 2 – Existing 1% AEP Flood Elevations

Figure 3 illustrates the existing 1% AEP flood depth through the site.

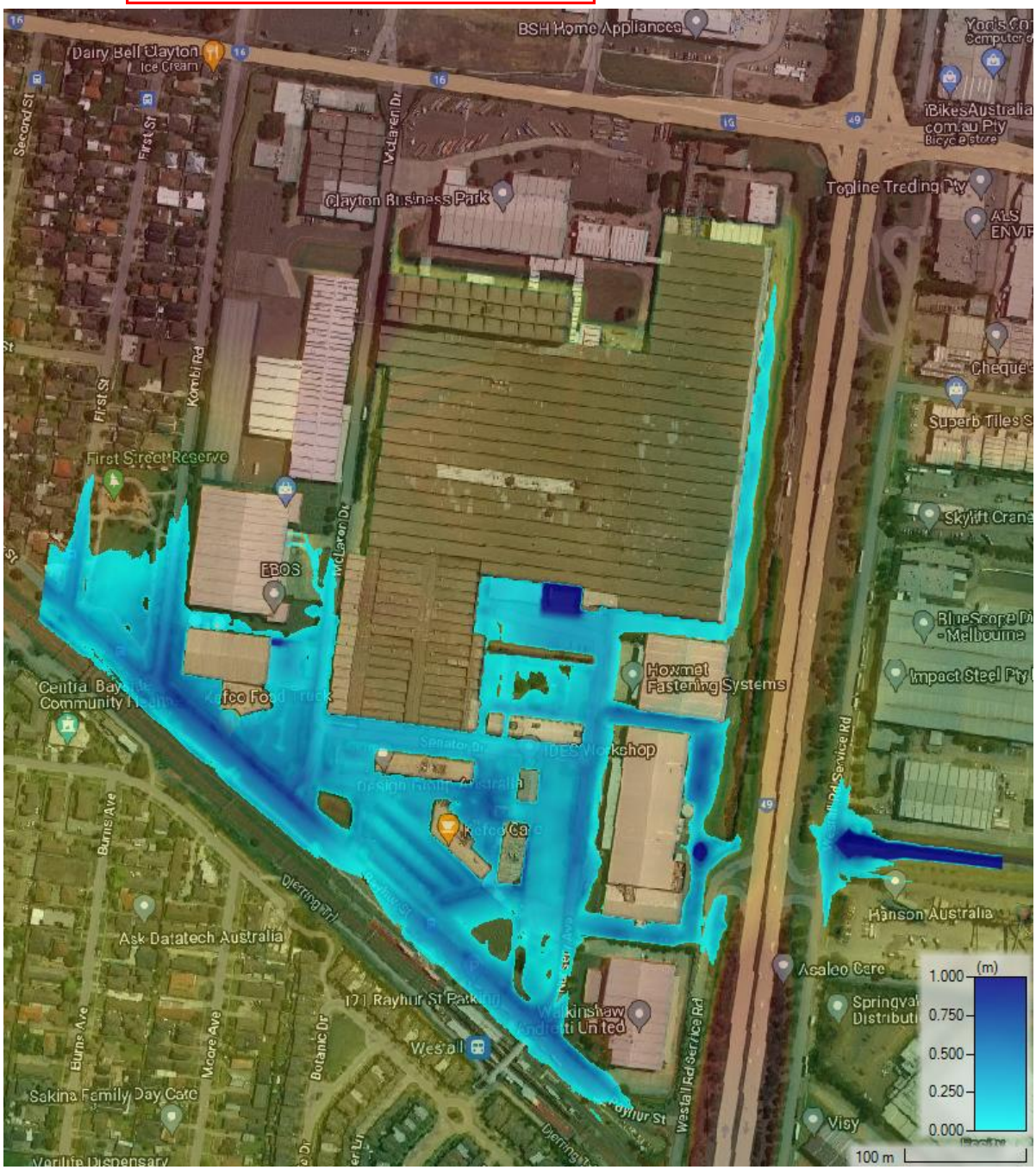

Figure 3 – Existing 1% AEP Flood Depth

Figure 4 illustrates the flood hazard (velocity x flood depth) for the current site development.

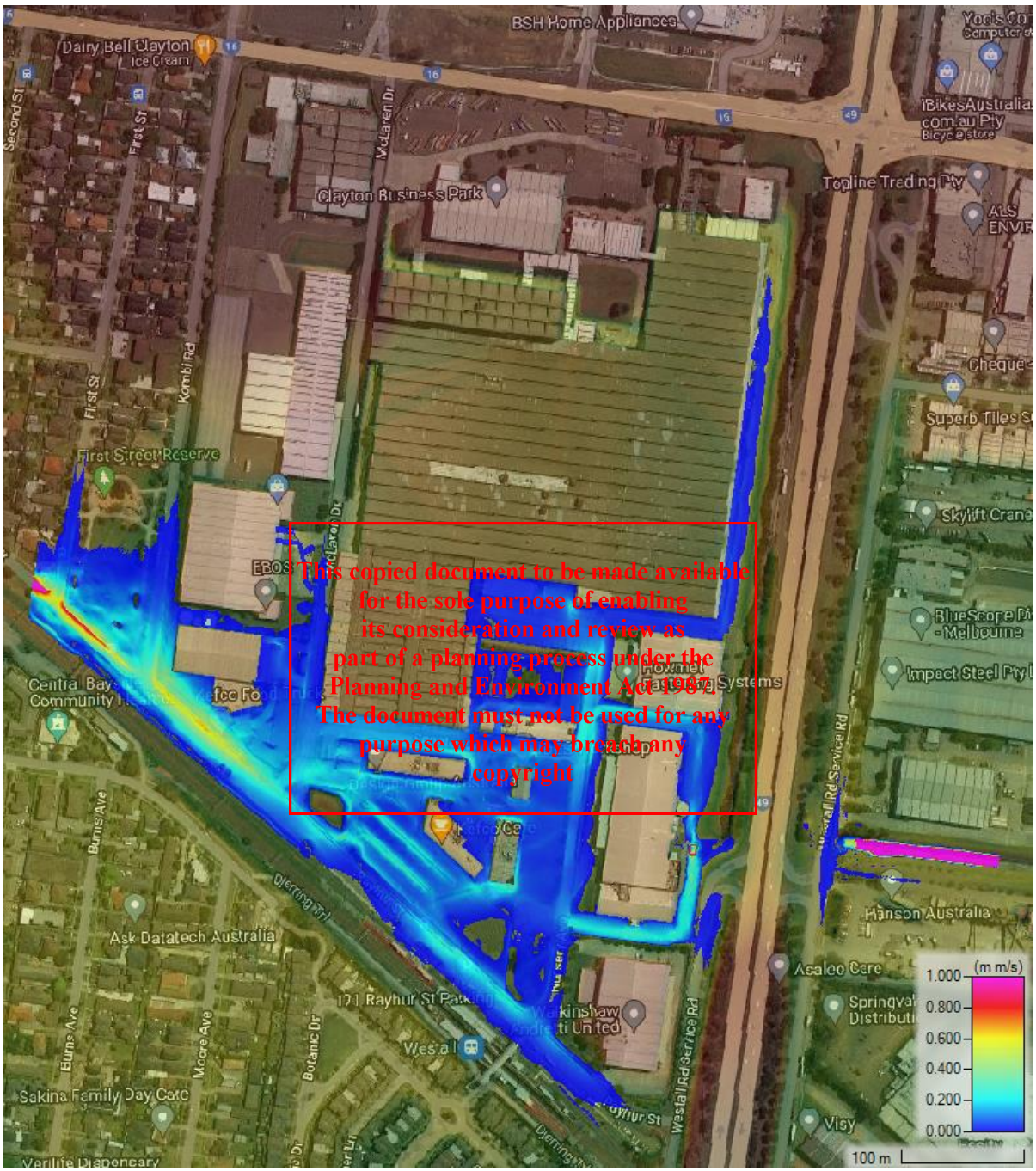

Figure 4 – Existing 1% AEP Flood Hazard

Proposed Conditions

The terrain in the model was updated to reflect the proposed new building locations for the site. It should be noted that no updates have been undertaken to the surrounding pavements as this design work has not been completed, and additional flood modelling will be required when it is done.

The model was run without any mitigation to the existing gap flows to assess the impacts. The results indicated that the proposed redevelopment would result in an increase in flood levels adjacent to the site along Rayhur Street of up to 200 mm and Kombi Road of up to 100 mm. The increase to flood elevation has occurred through the significant reduction in the flow path within the site adjacent to

Rayhur Street. No increase to the existing flood levels is acceptable. Therefore, the site must adopt some mitigation measures to prevent the increase.

Mitigation measures may include creating an unobstructed flow path through the site or capturing and piping some additional gap flow through the site. Creating an unobstructed flow path through the site does not match the proposed development plan, and therefore the option of capturing an piping additional gap flows through the site has been considered.

The model was run progressively extracting additional gap flow until no increase in flood level was experienced. This requires the capture and conveyance of up to an additional 5.5 m^3/s of gap flow. This option still requires the safe conveyance of approximately 7.7 m^3/s overland through the site.

Figure 5 illustrates the difference in flood elevation between the existing conditions and the proposed redevelopment with the piping of an additional 5 m^3/s.

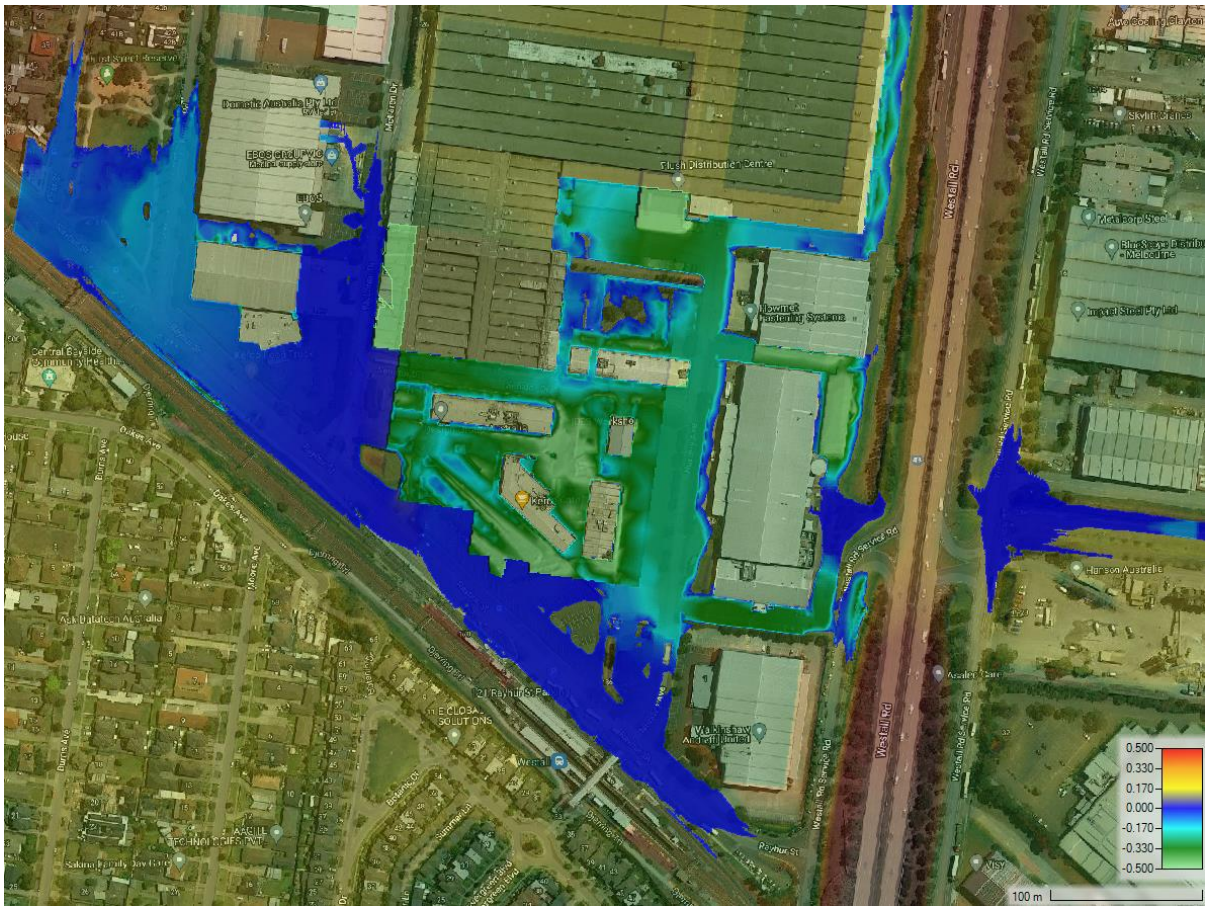

Figure 5 –1% AEP Flood Elevation Difference

Figure 6 illustrates the 1% AEP flood elevation for the proposed redevelopment with the mitigation measure of piping an additional 5.5 m^3/s of overland flow.

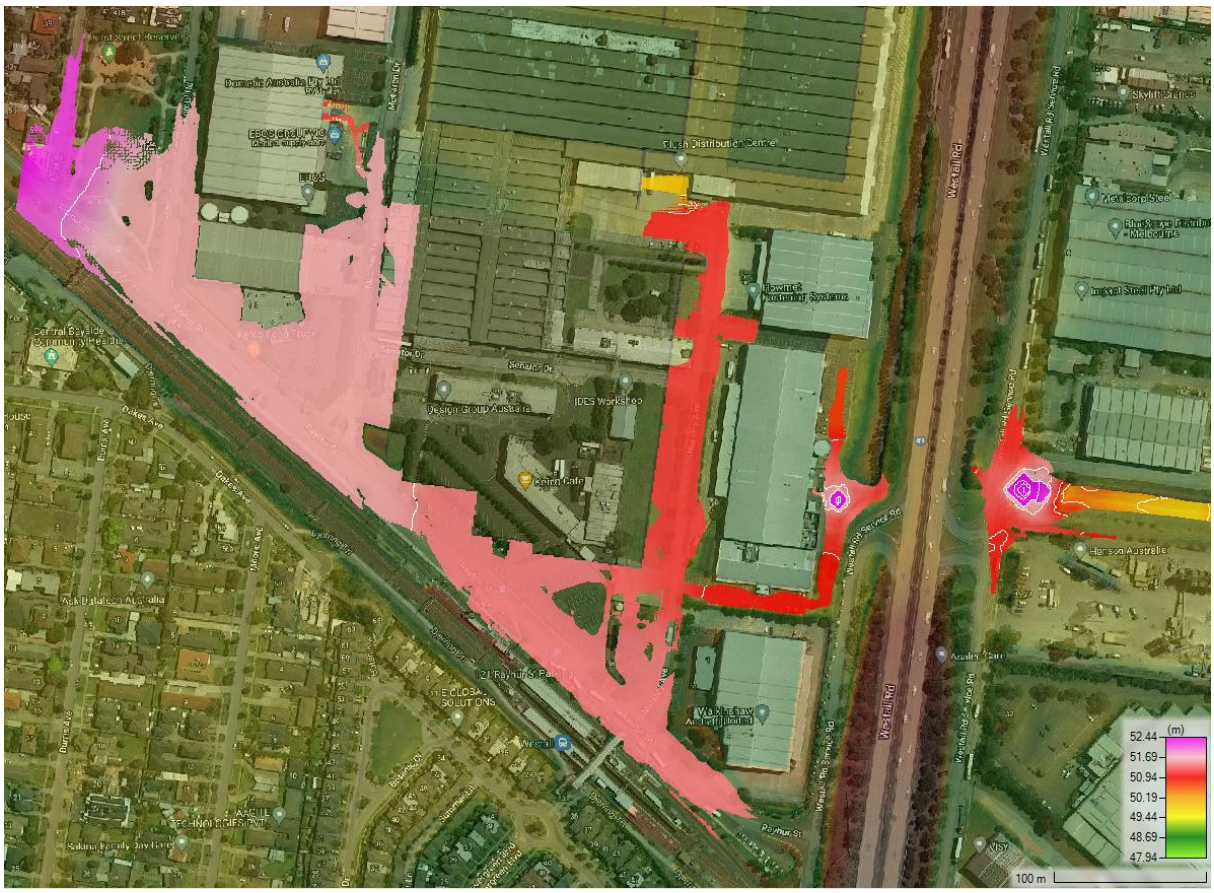

Figure 6 –Proposed 1% AEP Flood Elevation with Mitigation Measures

Figure 7 illustrates the 1% AEP flood depths for the proposed redevelopment with the mitigation measure of piping an additional 5.5 m^3/s of overland flow.

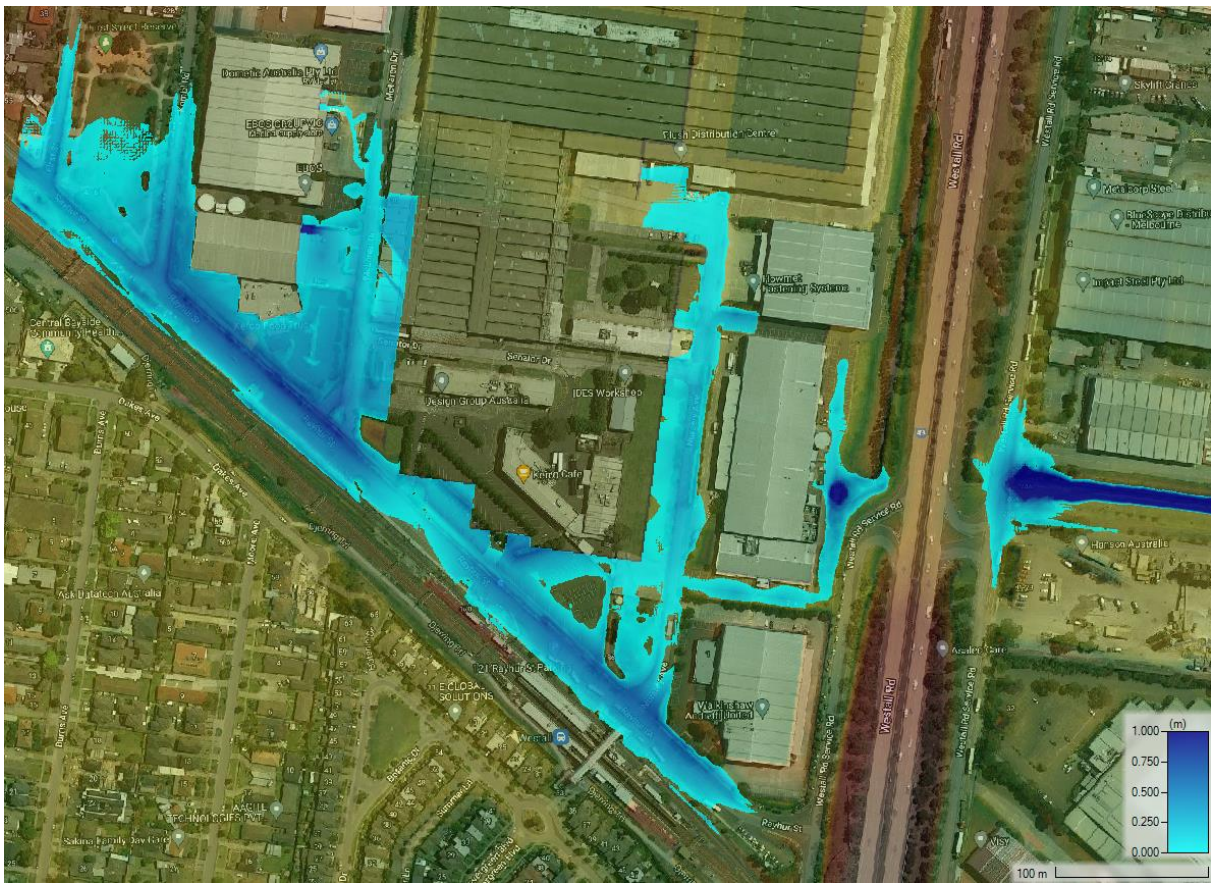

Figure 7 –Proposed 1% AEP Flood Depth with Mitigation Measures

Figure 8 illustrates the 1% AEP flood velocity for the proposed redevelopment with the mitigation measure of piping an additional 5.5 m^3/s of overland flow.

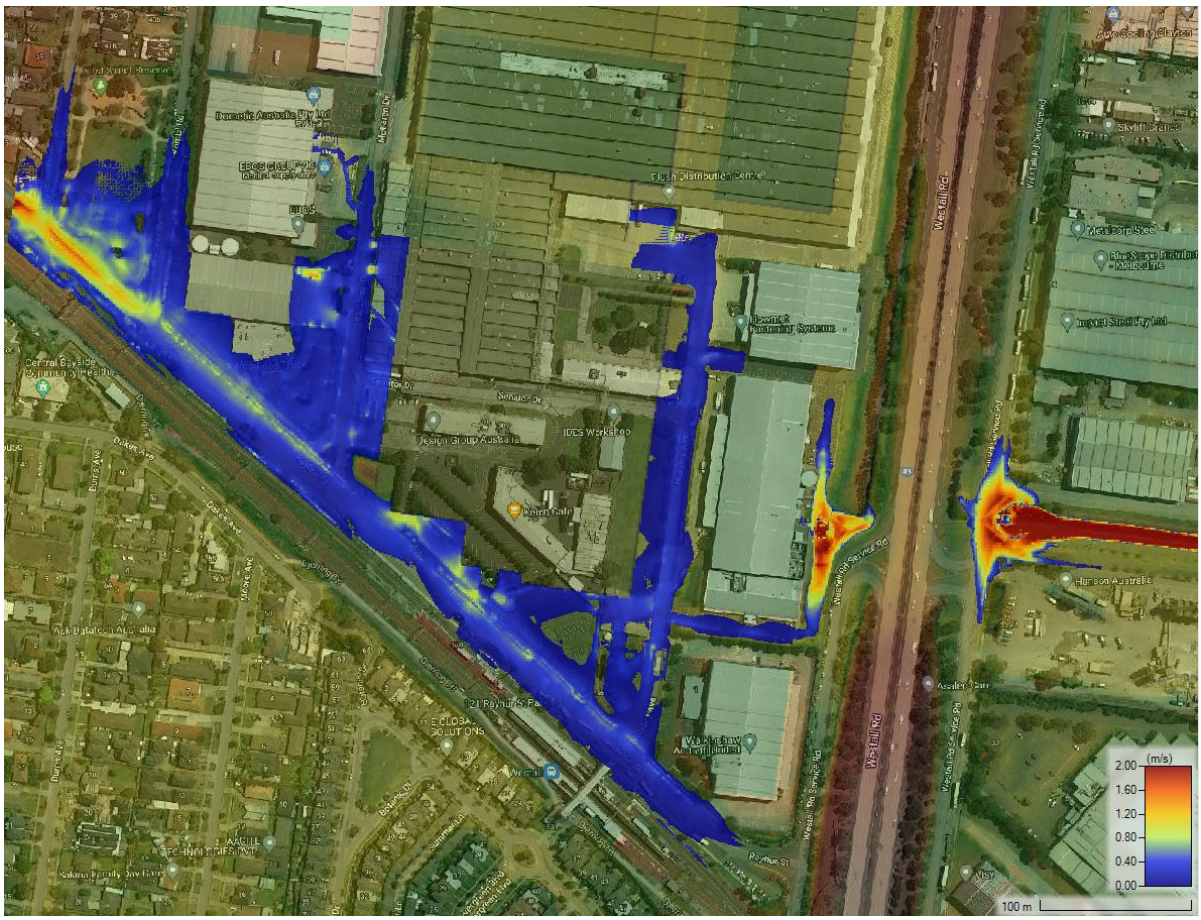

Figure 8 –Proposed 1% AEP Flood Velocity with Mitigation Measures

Figure 9 illustrates the 1% AEP flood hazard (depth x velocity) for the proposed redevelopment with the mitigation measure of piping an additional 5.5 m^3/s of overland flow.

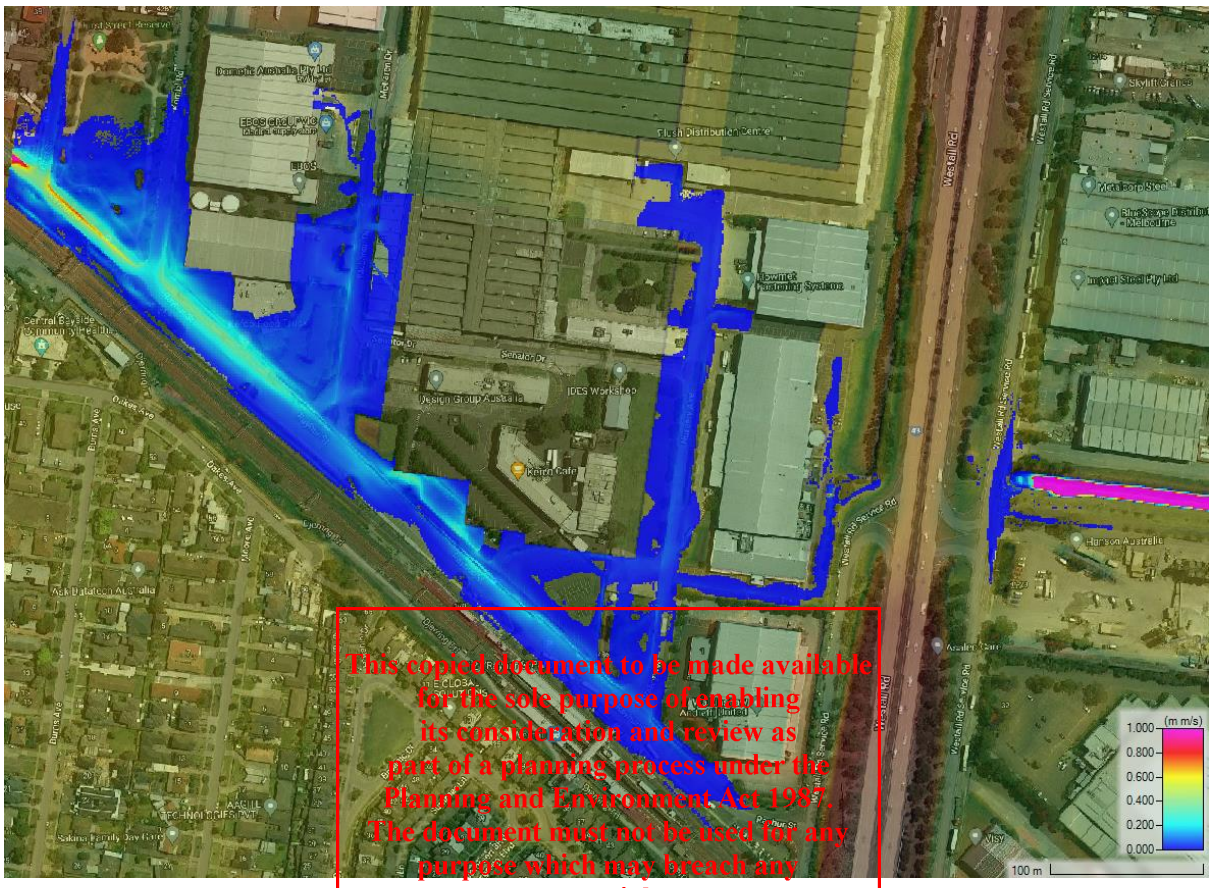

Figure 9 –Proposed 1% AEP Flood Hazard with Mitigation Measures

5 Flood Mitigation Works

The redevelopment of the site must capture and convey an additional 5 m^3/s in a subsurface system to ensure no increase to flood elevations to surrounding properties. Alternatively, an additional offset to the built form from Rayhur Street is required together with some piping of gap flows.

The additional gap flows will need to be captured in a grated pit around Kombi Road, or McLaren Drive. The pit will need to be depressed to capture the flow. Selecting the ideal location for the capture pit is difficult due to level constraints to match into the existing large pit located on Westall Road. It is proposed to pipe the 5.5 m^3/s between the capture pit and connect it to the existing large pit on Westall Road.

Locating the capture pit around Kombi Road would require negotiations with Council as the pit would likely be located outside of the site on Council land. Locating the pit in Council land would ensure no afflux due to the future joining of the warehouses on Kombi Road.

Locating the pit at McLaren Drive would keep control of the additional drainage works within the development. This would also enable a better longitudinal grade for the proposed pipeline. The exact location of the pit and the future pipe is subject to a functional design, based on survey of the exact location of the Westall Main Drain and the location of the proposed works within the site at MGA coordinates base.

A 3 m x 3 m grated pit located with the finished surface depressed 550 mm below the surrounding ground levels is required to capture the additional gap flow for subsurface piping. This accounts for

blockage of the inlet. A large increase in the pit size is required to reduce the depth of flow required over the top to capture the flow.

A 2400 mm diameter pipe is required through the site to capture and convey the additional gap flows. It is preferred to align this additional pipe adjacent to the existing Westall Main Drain. Melbourne Water's requirements is for a 1.5 m minimum clearance from the outside diameter of the existing drain to the proposed new drain. A preliminary investigation indicates that there is a possibility of meeting this requirement and aligning the new drain parallel to the existing Westall Main Drain.

The proposed building at 2 McLaren Drive is approximately 3 m away from the property boundary at the pinch point. The proposed drain may need to be partially located within the road reserve to achieve an adequate clearance from this proposed building, or the building footprint marginally reduced adjacent to Rayhur Street to facilitate the new drain adjacent to the Westall Main Drain.

Alternatively, the new drain will need to be constructed north along McLaren Drive, east through the proposed east – west internal road and south along Westall Road.

It is proposed to connect the new 2400 mm diameter pipe into the existing 5 m x 7 m pit located in Westall Road. The new pipeline will have a longitudinal grade of between 1 in 1500 and 1 in 2000, subject to detailed design.

6 Addressing Development in Flood Prone Land

The site can address the requirements of development in flood prone land for the redevelopment through the following.

Flood Safety

Preliminary modelling with the additional piping of 5.5 m3/s results in the maximum flood depth within the site should be than 0.5 m, dependent upon the revised civil design for the site, and is therefore okay. The location of the proposed additional entrance from Rayhur Street has a flood depth of less than 0.5 m in Rayhur Street and will be okay.

The peak 1% AEP velocities for the gap flow through the site is less than 2 m/s and is therefore okay.

The flood hazard for the gap flows through the site is less than 0.4 m^2/s and is therefore okay.

The proposed redevelopment will be situated on land with a low overall hazard and is therefore okay.

The proposed redevelopment cannot contain hazardous materials within the area that is subject to inundation in a 1% AEP storm event.

The proposed redevelopment is for industrial purposes and therefore is not deemed to be for vulnerable persons or for services needed to function continuously.

Flood Damage

The floor levels for the proposed redevelopment need to be set a minimum of 300 mm above the 1% AEP flood level. The following is the proposed minimum floor levels for the redevelopment, subject to further refinement with the design of the pavement surrounding the proposed buildings.

Table 2 – Proposed Minimum Finished Floor Levels

Location	Peak 1% AEP Flood Elevation (m AHD)	Proposed Finished Floor Level (m AHD)
1 McLaren Drive & 3 McLaren Drive	51.61	51.91
2 – 8 McLaren Drive	51.60	51.94
1 - 5 Nursery Avenue	51.42	51.72
7 Nursery Avenue	51.14	51.44
2 Nursery Avenue	51.42	51.72
4 Nursery Avenue	51.52	51.82
6 Nursery Avenue	50.86	51.16
8 Nursery Avenue	51.08	51.38
9, 10 & 11 Nursery Avenue	51.18	51.48

The proposed buildings affected by flooding should be constructed from flood resistant materials. The essential building services through the site to the proposed buildings within the land subject to inundation will need to be flood proofed.

Flood Impacts

Through the capture and subsurface conveyance of an additional 5.5 m^3/s of gap flow, the development has demonstrated that there is no increase in flood level to the surrounding properties. The development is not diverting any flows to the detriment of adjoining properties. The lost flood plain storage between the existing development and the proposed redevelopment is provided in the additional subsurface pipe drainage.

7 Summary

The proposed redevelopment of Clayton Business Park must meet the requirements of development in flood prone land. As the redevelopment is proposing an increase in building footprints through the existing flood plain, the development will need to capture and convey some additional gap flows in a subsurface system through the site.

Flood modelling has indicated that the capture and subsurface conveyance of an additional 5.5 m^3/s of gap flow will not impact the surrounding land. This flow will need to be captured in a 3 m x 3 m grated pit, proposed to be located around the intersection of McLaren Drive and Rayhur Street. The pit RL will need to be set at 550 mm below the surrounding levels to capture the flow.

A 2400 mm diameter pipe is required to connect the capture pit to the large existing pit in Westall Road. The preferred alignment for this pipe is parallel to the existing Westall Main Drain. Further survey of the existing Westall Main Drain is required to ensure appropriate clearances for this drain can be achieved from the Westall Main Drain and the proposed building footprints.

Further flood modelling will be required to demonstrate that the site meets the requirements of development in flood prone land once the internal civil design is completed.

Incitus Pty Ltd
ABN 55 285 448 851
PO Box 7142
Richmond
VIC 3121

T 0414 404 730
E nina.barich@incitus.com.au
W incitus.com.au

To	**Goodman**	From	**Nina Barich**
Copy		Reference	**2227**
Date	**6 March 2024**	Pages (including this page)	**2**
Subject	**Response to Clayton Business Park Melbourne Water RFI - Stormwater**		

A Request for Further Information (RFI) has been received from Melbourne Water in relation to the redevelopment of Clayton Business Park, including some items relating to stormwater management. The following is the response to the stormwater RFI items.

1. *The updated report does not clearly specify whether the proposed 2400mm pipe is meant to replace the existing pipe or to be added as a new component alongside the Melbourne Water's existing pipe.*

   The intention is to create an additional pipe to convey some of the overland flow in the subsurface system. ~~This is because the current gap flow is not safe~~ overland and also to mitigate any afflux resulting from the redevelopment. This will be clarified in a revision of the report which will not be available until revised modelling is completed around mid-April.

2. *The assertion in the report that the redevelopment will not alter land use or average imperviousness must be supported by a comprehensive analysis of pervious and impervious areas within the site. Additionally, the impact of the proposed 2400mm pipe on the time of concentration for flood flow needs to be assessed, ensuring it does not lead to surcharging the Melbourne Water's pipe in the proposed connection area. Therefore, a hydraulic gradient analysis is necessary to validate that the proposed pipe and connection will not cause surcharging. However preference is to analyse the impact and capacity of the proposed drain via 1D/2D coupling modelling software such as Tuflow.*

   The proposal will be modelled using Tuflow. An initial HEC-RAS model was developed to determine potential stormwater mitigation measures. This will be refined with a Tuflow model for submission. It is expected that the revised modelling will be completed around mid-April.

3. *The proposal of a 3m x 3m grated pit, situated with the finished surface 550mm below surrounding ground levels to capture additional gap flow for subsurface piping, requires supporting calculations to ensure its suitability. The same scrutiny applies to the proposed connection at Westall Road. This proposed pit must be included in a hydraulic model. The proposed pit must account for blockage.*

   This will be included in the Tuflow model to be completed around mid-April.

4. *The location of connections for the proposed 2400mm pipe at downstream and upstream needs further clarification.*

   The location of the proposed system including the connection points will be included with the resubmission upon completion of the revised hydraulic modelling.

5. *More details are needed regarding the considered 5.5 m³/s gap flow and the methodology employed for modelling this flow. The deduction of gap flow from total overland flow in the updated report, used in HEC-RAS modelling (the latest submission), may oversimplify the conditions and may not accurately reflect reality, as it doesn't account for the timing of the flow and may not have considered the influence of downstream boundary conditions as well as the losses may be experience within the drainage network.*

   This will be addressed in the Tuflow model to be completed around mid-April and reflected in the revised report.

6. *The initial report by Spiire in 2019 modelled the existing condition using TUFLOW. However, the updated report and proposed 2400mm pipe has been modelled using HEC-RAS. Certain aspects of hydraulic modelling need attention before proceeding with the application, outlined as follows:*

   - *The model boundary in HEC-RAS appears too small, potentially overlooking influence of upstream and downstream flood boundary conditions.*
   - *Limitations of HEC-RAS, particularly in pit and pipe modelling, necessitate consideration. TUFLOW modelling is recommended in this case as it can account for 1D drainage network.*
   - *Inflow and outflow boundaries, as well as the representation of buildings and blocks, are missing in the report.*
   - *Essential hydraulic parameters, including roughness and building blockout, should be clearly presented. The assumption should align with Melbourne Water's guidelines. Currently, the chosen mannings' roughness value of 0.04 does not accurately represent the actual conditions of the site.*
   - *In Table 1 of the report, the peak flow at various locations has been presented. However, it is unclear which flow was used as an input for the model, and the location of the inflow boundary remains unknown.*
   - *Model results, such as those depicted in Figures 3 and 4, need to be accurately labelled and presented in the report for clarity.*

   The redevelopment and proposed mitigation measures will be remodelled in Tuflow, with an expected completion around mid-April. The modelling will be supported by a revised report which will address the issues stated above in relation to the boundaries applied, the coupling with the pipe network, the building blocks and mannings value applied and the peak flow used in the model and updated in a revised report. It is anticipated that this will be completed mid-April.

7. *Lastly, we kindly ask the applicant to submit hydrology and hydraulic models along with the result files for additional evaluation. Accompanying this submission must include a summary of the scenarios presented in the models. Also, presentation of the results and colour coding of the figures must be in line with the Guidelines for Development in Flood Affected Areas (DELWP, 2019).*

   This will be provided once the updated modelling and report have been completed around mid-April.

Asset Protection

We note Melbourne Water's requirements for Asset Protection. These requirements will be adhered to with the design and construction of any assets near the existing Melbourne Water Westall Road Main Drain.