6.8 Flooding

The flooding supplementary technical memorandum is provided in **Appendix H** and a summary is provided below. This section should be read in conjunction with Section 7.8 of the EIS and the flooding assessment report provided in Appendix L of the EIS.

6.8.1 Assessment methodology

The methodology for the supplementary flooding assessment is described in this section and involved the following:

- Review of flooding assessment carried out on the project as described in the EIS against the amended project
  - Confirm qualitatively the likely impact to the flooding conditions from the geometric design changes
- TUFLOW flood modelling of the amended project
  - With project conditions under 5 year, 20 year, 50 year and 100 year average recurrence interval (ARI) events and probable maximum flood (PMF) for the study area where change of impact is likely to occur (refer to first dot point above)
  - Modelling is described in detail in **Section 6.8.1.1**, below
- Update of flood immunity and hydraulic impact predictions for the amended project
- Identification of changes to the impacts documented in the EIS
- Identification of any updates to existing management measures presented in the EIS, or additional management measures required to address impacts resulting from the amended project.

6.8.1.1 Modelling

The project as described in the EIS was assessed using both hydrological and hydraulic modelling. The hydrological characteristics of the catchments surrounding the project were described in Section 7.8 of the EIS. These would not change as a result of the amended project. As such, the supplementary assessment focused on the hydraulic analysis for the amended project using the TUFLOW modelling developed for the EIS. The approach as described in Section 7.8.2 of the EIS was adopted to undertake the hydraulic supplementary assessment.

The outputs from the EIS flood model and the amended project flood model were compared to identify any additional impacts. The comparison of hydraulic assessment outputs included flood levels, flood depth, flood velocities and afflux. This review identified one area where the amended project would result in a noticeable change to the flooding results for the project as described in the EIS.

The change would occur at Badgerys Creek in the area of Elizabeth Drive to the north of the Western Sydney International Airport. The other changes were found to be minimal and/or contained within the amended project construction and operational footprints.

Other flooding impacts anticipated to result from the amended project are considered to be consistent with those described in the EIS and have therefore not been discussed further.

6.8.1.2 Study area

The study area as described in Section 7.8.2 of the EIS covered five key areas where the project would influence, or be influenced by, flooding including:

- Cosgroves Creek
- Badgerys Creek
  - The EIS flood model only included the area where the main M12 Motorway carriageway would intersect the creek
  - The area where Elizabeth Drive crosses Badgerys Creek was not included in the EIS flood model
- South Creek
- Kemps Creek
- The minor waterway next to Luddenham Road that would be bridged by the project.

The amended project would extend further into the Badgerys Creek floodplain than the project as described in the EIS. The study area has therefore been extended east into the Badgerys Creek floodplain in the vicinity of Elizabeth Drive to assess any potential flood impact as a result of the amended project (see **Figure 6-49**).

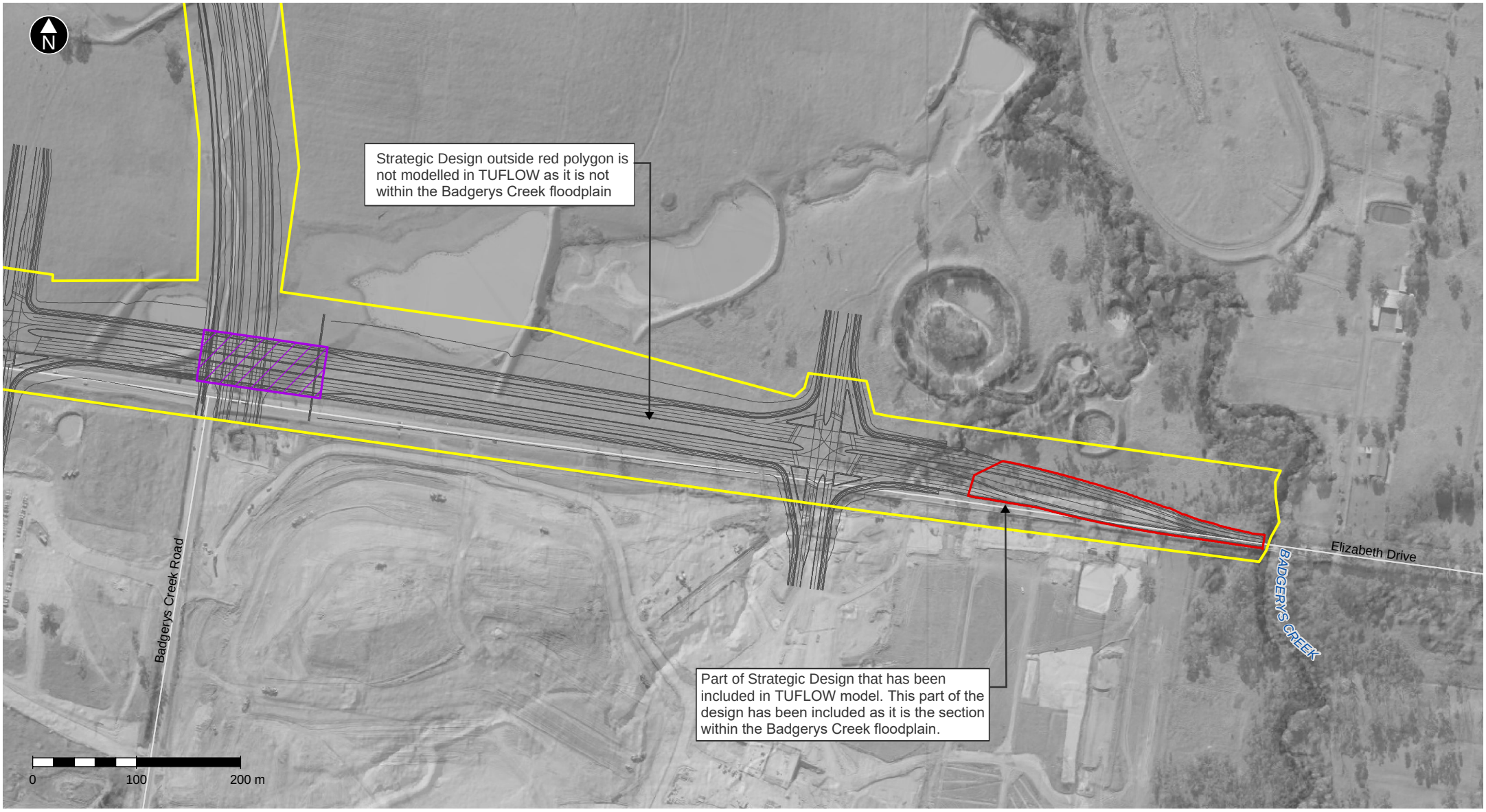
6.8.2 Existing flooding conditions

Section 7.8.3 of the EIS provides a detailed description of the existing flooding conditions of the EIS study area, which are shown in Attachment A of **Appendix H**.

The supplementary assessment has focused on the existing environment of the additional project area at Badgerys Creek in the vicinity of Elizabeth Drive, to the north of the Western Sydney International Airport. At this location, Elizabeth Drive currently bridges over Badgerys Creek. The creek flows south-to-north under Elizabeth Drive and then pass under the main M12 Motorway carriageway at the proposed bridge (Bridge 05) as shown in **Figure 3-2** further north before joining South Creek. West of the Elizabeth Drive bridge over Badgerys Creek, there is a tributary to Badgerys Creek that crosses Elizabeth Drive via a box culvert.

Upstream of Elizabeth Drive (south of the road) the combined Badgerys Creek and tributary floodplains flow overland towards Elizabeth Drive. Under existing conditions, Elizabeth Drive is shown to be inundated in events smaller than the 20 year ARI flood event. The floodwaters in the floodplain of the tributary and Badgerys Creek overtop an existing low point in the road.

The draft for public exhibition Floodplain Risk Management Study and Plan for South Creek (Penrith City Council, September 2019), also indicates overtopping of the road in the 20 year ARI flood event (five per cent annual exceedance probability (AEP) flood).



The amended project

The amended project operational footprint

Bridge

Extent of the amended project modelled in TUFLOW

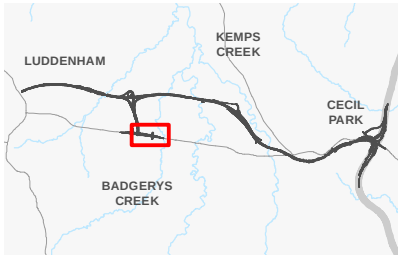


Figure 6-49 Amended study area (TUFLOW Modelling Area)

6.8.3 Assessment of potential impacts

6.8.3.1 Construction impacts

Section 7.8.4 of the EIS identified a number of flooding impacts that may occur during construction. This section focuses on the additional impacts that are likely to occur as a result of the amended project when compared to the project described in the EIS. These impacts include:

- Earthworks
- Stockpile and ancillary facilities.

These impacts are discussed in the following sections.

The EIS also identifies impacts associated with temporary creek crossings. Temporary creek crossings would not change, however, from those described in the EIS. As a result, no change to flood conditions is anticipated as a result of temporary creek crossings.

Earthworks

The fill associated with the construction of the amended project would be 3,322,000 cubic metres. This is a decrease of 267,000 cubic metres from the 3,589,000 cubic metres that would be required for the project as described in the EIS. Flow constriction and loss of storage would be similar to the effects described in the EIS.

Stockpile and ancillary facilities

To support the construction of the amended project, nine additional construction ancillary facilities (AF 10 to AF 18) and an expanded AF 9 would be required. Six of the additional proposed ancillary facilities (AF 11 to AF 16) would be located outside of the major floodplains to avoid or minimise impacts from the project earthworks on flow behaviour in the floodplains. Three of the additional proposed ancillary facilities (AF 10, AF 17 and AF 18) and expanded AF 9 would be located near The Northern Road catchment in the west and Ropes Creek Catchment in the east.

Potential flood impacts of these ancillary facilities are as follows:

- A small portion of expanded AF 9 would be located within the medium risk flood precinct which is below the 100 year flood level but is not subject to a high hydraulic hazard as per the Ropes Creek Flood Planning Map (Fairfield City Council, 2014). The impact from the expanded AF 9 on the 100 year flood conditions is likely to be minimal.
- AF 17 and AF 18 would be located within the low flood risk precinct which is within the PMF extent but above the 100 year flood level as per Fairfield City Council (2014). This would not be impacted by a 100 year flood.
- AF 10 is located about 1500 metres from Blaxland Creek, the closest significant waterway. As a result, negligible impact on the main creek floodplains is expected.

These construction impacts would be managed through the implementation of the environmental management measures outlined in Section 7.8.6 of the EIS.

6.8.3.2 Operational impacts

Section 7.8.4 of the EIS identified a number of flooding impacts during operation. This section focuses on the additional impacts that are likely to occur as a result of the amended project when compared to the project as described in the EIS.

Operational impacts would not change as a result of the amended project, with the exception of the area of Badgerys Creek at Elizabeth Drive north of the Western Sydney International Airport. The potential impacts in this area would include:

- Increases in flood affectation
- Changes to peak stormwater flows, downstream velocity and scour potential
- Flood hazards
- Climate change.

These impacts are discussed in the following sections.

A number of other impacts would be consistent with the EIS. These include:

- Land use impact
- Impacts on buildings and inundation durations
- Changes in surrounding catchments
- Farm dams
- Hydraulic functions of flow conveyance
- Adverse effects to beneficial floodplain inundation
- Emergency management, evacuation and access
- Social and economic costs.

These impacts are consistent as the amended project is not anticipated to have any design features that would result in increased flooding impacts associated with these issues. These impacts have therefore not been discussed further.

Increases in flood affectation

Elizabeth Drive would be raised from the existing road surface level and the road widened as part of the amended project. Floodwaters would build up upstream of the road (to the south) before the road is overtopped. This would cause an increase in flood levels on the upstream side of the road of about 50 millimetres in the Badgerys Creek floodplain area in the 100 year ARI event.

The maximum predicted flood level in Badgerys Creek channel upstream of the existing bridge would increase by about 75 millimetres due to the amended project. Downstream of Elizabeth Drive (to the north) a decrease in flood levels of up to 25 millimetres is predicted due to the reduced overtopping of the road.

The area in the vicinity of the Badgerys Creek floodplain at Elizabeth Drive is currently agricultural land use. A 250 millimetre threshold was adopted in the EIS as a flood impact objective for this land use type. The predicted afflux from the assessment of the amended project is within the flood impact objective in the 100 year ARI flood event. The increases in flood affectation for the amended project, as compared to the existing conditions, are shown in **Table 6-47**.

Table 6-47 Elizabeth Drive increases in flood affectation and flood immunity

Flood affectation	Existing conditions	Amended Project
Flood level upstream of existing bridge (100 year ARI)	46.55 m AHD	46.63 m AHD
Flood level in floodplain (100 year ARI)	46.82 m AHD	46.87 m AHD
Afflux – Badgerys Creek (100 year ARI)	N/A	+ 75 mm
Afflux – Badgerys Creek floodplain (100 year ARI)	N/A	+ 50 mm
Afflux – downstream of Elizabeth Drive (100 year ARI)	N/A	- 25 mm
Flood immunity at area of Badgerys Creek at Elizabeth Drive north of the Western Sydney International Airport	5 year ARI flood immunity Overtopped in the 20 year ARI event by about 295 mm over road crown.	5 year ARI flood immunity Overtopped in the 20 year ARI event by about 160 mm over road crown and depths of up to 350 mm on the west-bound carriageway.

Changes to peak stormwater flows, downstream velocity and scour potential

Under the amended project, velocities in the creek channel would remain in the order of 1.5 metres per second to 2.3 metres per second and increase by a maximum of 0.1 metres per second in the 100 year ARI flood event compared to the existing conditions. In the floodplain, velocities would remain in the order of 0.1 to 0.8 metres per second and increase by a maximum of 0.1 metres per second in the 100 year ARI flood event. The changes to velocity for the amended project, as compared to existing conditions are shown in **Table 6-48.**

Given the change in peak flows and velocity is negligible, there would no expected increase in scour potential.

Table 6-48 Elizabeth Drive changes to velocity

Flood affectation	Existing conditions (metres per second)	Amended Project (metres per second)
Velocity at existing bridge (100 year ARI)	2.2	2.3
Velocity in upstream floodplain (adjacent to road embankment) (100 year ARI)	0.7	0.8

Flood hazards

The existing Elizabeth Drive at Badgerys Creek north of the Western Sydney International Airport has a flood immunity up to and including the 5 year ARI flood event. It is overtopped on the 20 year ARI event under the existing scenario with 295 millimetres of flood depth above the crown of the road.

During operation of the amended project, Elizabeth Drive would have a flood immunity up to and including the 5 year ARI flood event. It would be overtopped in the 20 year ARI event with a flood depth of about 160 millimetres above the crown of the road and depths of up to 350 millimetres on the west-bound carriageway.

There would be no substantial change to the flood immunity at Elizabeth Drive north of the Western Sydney International Airport as a result of the amended project.

Climate change

The project as described in the EIS would be well above the 2000 year ARI (equivalent to 0.05 per cent AEP) flood levels and the impacts of climate change would have minimal impact on flooding due to the project. However, modelling of the amended project indicates that the section of the amended project along Elizabeth Drive around the Western Sydney International Airport, would be overtopped during both the 100 year ARI and the 2000 year ARI flood events. The depth of overtopping would increase by about 220 millimetres in a 2000 year ARI event compared to the 100 year ARI event. Elizabeth Drive would be overtopped both for existing conditions and, if the amended project is approved and constructed, in smaller floods than the 20 year ARI flood.

The impacts of climate change may result in an increased frequency of flooding events and the overtopping of Elizabeth Drive. As such, the road may become overtopped in smaller magnitude flood events or inundated for longer periods of time. However, the impact of climate change is not likely to substantially alter the traffic conditions of the road compared to the existing conditions when in flood, given the flood modelling undertaken for the amended project (see Annexure A of **Appendix H**).

6.8.3.3 Cumulative impacts

The cumulative flooding impacts would likely remain consistent with the qualitative assessment undertaken as part of the EIS and presented in Section 7.8.5 of the EIS.

For Badgerys Creek at Elizabeth Drive north of the Western Sydney International Airport an assumption has been made that the Western Sydney International Airport would have adequate on-site measures to mitigate any impacts outside the airport site boundary. As further details of Western Sydney Internal Airport's flood management and earthworks are developed, these will be incorporated into an updated M12 Motorway flood model for the detailed design phase of the project.

6.8.4 Environmental management measures

Flooding impacts associated with the amended project are generally consistent with impacts described in the EIS and can be managed through the implementation of the proposed management measures described in Section 7.8.6 of the EIS.

However, further flood investigations and hydrological and hydraulic modelling will be required during the detailed design stage to ensure the flood impact criteria for the amended project are met. This is already addressed in the existing environmental management measure F01. The refined modelling would be adopted to define the nature of Badgerys Creek mainstream flooding and

tributary flooding at the area where Elizabeth Drive crosses the Badgerys Creek floodplain. Two additional environmental management measures would also be required for the amended project as shown in **Table 6-49**.

Table 6-49 Revised environmental management measures (flooding)

Impact	Reference	Environmental management measure	Responsibility	Timing
Flooding impacts of bridges and culverts	**F07**	**During the detailed design phase, TfNSW will seek to refine the design of the works at Elizabeth Drive near Badgerys Creek to minimise flood affectation. Mitigation measures may include adjustment of road levels and/or flood relief culverts through the road.**	**TfNSW / Contractor**	**Detailed design**
Consultation regarding flooding impacts	**F10**	**Ongoing consultation will be carried out with Western Sydney International Airport and as further details of their flood management and earthworks are developed, these will be incorporated into an updated M12 Motorway flood model for the detailed design phase of the project.**	**TfNSW / Contractor**	**Prior to and during construction**