

5.0 The project

This chapter provides a summary of the potential impacts of the project during construction and operation. A full description of the project is provided in Chapter 5 and Chapter 6 of the EIS.

5.1 Construction

Construction of the project would involve a variety of activities with potential to impact on various aspects of surface water, they include:

- Construction flooding and drainage impacts that could potentially arise from:
 - Construction sites may increase runoff volumes, peak flows and / or time of concentration following rainfall events due to an increase in impermeable surfaces
 - Bunding or spoil stored within construction compounds has the potential to interrupt or divert existing flood routes and also reduce flood storage, increasing flood risk in adjacent areas
 - Drainage infrastructure may become blocked or temporarily diverted due to construction activities. Disruption to local drainage lines may result in localised flooding upstream of the construction compounds
 - Removal of existing pavement could divert flow away from designed drainage structures and into new receiving areas. Diverting drainage lines may also create localised areas of flooding and scour.
- Water quality impacts could potentially arise from:
- Earthworks and exposed soil, followed by wind or rain has the potential to mobilise sediments that could be discharged to local watercourses
- Spills of chemicals or construction materials during construction
- Construction activities adjacent to or within waterways could introduce foreign contaminants such as oil or greases, and disturb contaminated sediments, potentially having an adverse impact on water quality
- The project would increase the impervious surfaces in the road corridor. Consequently, pollutant loads building up on the road surfaces would increase, and greater loads of pollutants may be washed off and discharged to receiving environments
- Contaminated sediments mobilised by works in and around Alexandra Canal
- Discharge of groundwater and construction water extracted during construction.
- Leachate - contaminated runoff during works in the landfill.
- Geomorphology impacts could potentially arise from:
 - Construction activities adjacent to or within watercourses could impact channel bed and bank conditions
 - Water discharged from the construction groundwater water treatment plants may lead to localised erosion within the receiving waters
 - Water discharged from the groundwater water treatment plants may increase the baseflows experienced in receiving waterways, reducing the capacity for the watercourses to convey storm flows
 - Mobilised sediment could build up in the streams
 - Impermeable surfaces created by the project would lead to increases in the volume and rate of runoff, which could cause erosion.

The Construction Environmental Management Plan(s) (CEMP) for the project would include controls and design features to minimise impacts to surface water that could arise from these activities including:

- Construction compounds located within the 20 year Average Recurrence Interval (ARI) flood extent
- Water treatment facilities
- Temporary bunding, drainage and diversion
- Appropriate treatment of contaminated soils and Acid Sulfate Soils (ASS).

5.2 Operation

Operation of the project could impact on various aspects of surface water, these include:

- Localised flooding and drainage impacts could potentially arise from:
 - Increased runoff volumes, peak flows and / or time of concentration following rainfall events due to an increase in impermeable surfaces
 - New built development in flood risk areas would have the potential to interrupt or divert existing overland flow routes.
 - Drainage infrastructure may not have sufficient capacity to accommodate increased inflow rates
- Water quality impacts could potentially arise from:
 - Increased stormwater discharge due to larger and new pavement surface areas
 - Accidental spills and general motor vehicle discretions
 - Discharge of operational wastewater sources, including for maintenance, cleaning and fire deluge systems
 - Discharge of groundwater
 - Discharge of inadequately treated water from the water treatment plants. This includes treated groundwater and leachate captured at the St Peters interchange
 - Contaminated sediments mobilised by scour caused by new infrastructure installed in and around Alexandra Canal.
- Geomorphology impacts could potentially arise from:
 - Impermeable surfaces created by the project would lead to increases in the volume and rate of runoff, which could cause scour
 - Water discharged from treatment plants could change the bed profile and sediment processes.

The project would include controls and design features to minimise impacts that could arise from operational activities including:

- Drainage designs targeted at high levels of flood immunity
- Treatment of pavement drainage and intercepted groundwater before discharge into the receiving waterways
- Upgrades to existing transverse drainage structures
- Armouring in watercourses where the potential for scour is identified.

6.0 Impact assessment – construction

Construction of the project would involve a range of activities at sites of both permanent and temporary occupancy. Activities with the potential to impact surface water include:

- Clearing of vegetation, removal of existing pavement, excavation and stockpiling of spoil prior to reuse or removal from site. These activities could expose underlying soils that could cause erosion, landform instability, sedimentation and reduction in water quality.
- Upgrades to transverse drainage would involve removal of some existing drainage services, during which time the exposed soils may be highly susceptible to erosion and flow paths may be interrupted or diverted.
- Potential spills or leaks of fuels and / or oils can come from maintenance or re-fuelling of construction plant and equipment or vehicle / truck incidents.
- Rinse water from plant washing and concrete slurries may contain polluting contaminants.
- Discharge of treated groundwater from tunnel construction work. The volumes of groundwater and treatment requirements differ depending on the depth of the tunnel to be constructed, and the geological units through which it passes. Groundwater encountered by tunnelling activities would be discharged to either, an existing local drainage network, or, a local watercourse as surface water. The discharge of groundwater has the potential to impact the receiving environment by:
 - Increasing volume and velocity of flows.
 - Causing erosion and potentially modifying channel geometry at the outlet location and downstream.
 - Reducing water quality.
 - Introducing increased sediments, altering channel geometry and potential habitat loss and channel geometry alterations.
 - May result in algal blooms, increase risk to human health and reduction in visual amenity.
- Temporary construction facilities located within flood risk areas, potentially resulting in altered flood storage or conveyance.
- Water used in construction of the project, for activities such as dewatering and dust suppression, has the potential to generate polluted runoff.

A list of construction compound sites and their respective areas facilities and activities is shown in Table 20. There are a number of receiving environments where surface water could be impacted: Wolli Creek, the Cooks River, Alexandra Canal and the Eastern Channel. Each is described in turn.

6.1 Water extraction / use

Water would be used in construction of the project for the following purposes:

- Tunnelling activities such as cooling water and dust suppression
- Surface works such as compaction of pavement materials and dust suppression
- Concrete batching
- Site office and ablutions
- Commissioning of the fire and life safety deluge systems within the tunnels.

Details of water sources and use at each of the construction compounds are outlined in Table 19. Most of the water used would be sourced from the Sydney Water potable supply network. Rainwater would be collected from compound roofs where practical. Treated groundwater would be used on those sites where it is produced, to the extent practical.

Table 19 Total water use during construction period

Compound	Potable water supply from Sydney Water mains (megalitres)	Non-potable water supply (megalitres)		Total (ML)
		Collected rainwater	Treated groundwater	
Kingsgrove North construction compound (C1)	440	1.6	55	497
Kingsgrove South construction compound (C2)	20	-	55	75
Bexley Road construction compounds (C4, C5 and C6)	301	6.8	60	368
Arncliffe construction compound (C7)	480	5.7	100	586
Canal Road construction compound (C8)	340	3.0	70	413
Campbell Road construction compound (C9)	420	0.7	-	421
Euston Road construction compound (C10)	35	0.4	-	35
Burrows Road construction compound (C11)	30	0.1	-	30
Gardeners Road bridge construction compound (C12)	30	-	-	30
Total	2,096	18.3	340	2,455

**subject to confirmation during detailed design*

6.2 Flooding and drainage

Flooding during construction of the project could impact areas within and near construction sites. The construction phase footprint is shown in Figure 14 to Figure 16. Flood related impacts during construction phase could include:

- Damage to construction plant or machinery caused by inundation from floodwaters.
- Risk to personal safety of construction workers.
- Increased flooding of adjacent areas due to temporary loss of floodplain storage or conveyance of floodwaters.
- Reduced flood residence times caused by altered hydrologic / hydraulic conditions.

6.2.1 Mainstream flooding

The construction footprint and construction compounds are shown against the 20 year ARI and 100 year ARI flooding extents in Figure 14 to Figure 16. The flooding extents are based on Technical Working Paper: Flooding (Lyll and Associates, 2015).

The construction compounds and associated construction activities, the likelihood for flooding and a summary of the potential impacts is provided in Table 20. These are based on preliminary construction plans and indicative layouts that would be refined in future as the detailed design and site construction planning is further developed.

Tunnelling would occur through temporary shafts at a number of construction compounds (C1, C3, C4, C5, C7 and C8). In addition to this, the western and eastern portals for the project would be formed using cut and cover. Ingress of floodwater into the shafts or portals would pose significant risk to personal safety to those working in the tunnel. Where these facilities occur within the floodplain, protection such as bunding would be provided to ensure floodwaters do not enter shafts or portals. A detailed risk assessment would be undertaken to inform the flood protection measures put in place, prior to construction. The flood immunity that would be adopted would need to take into consideration the duration of construction, magnitude of inflows, including local overland flows, and potential risks. The flood mitigation measures adopted to protect shafts and portals would be designed in a way that would not worsen flooding to adjacent property.

Other mainstream flooding impacts during construction are generally minor in nature. These are readily mitigated by adjusting specific aspects of the compound designs and site planning in a way that recognises the identified flooding conditions in order to minimise the potential for off-site flooding impacts. Typical mitigation measures that would be employed are outlined in Section 8.1.1.

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Figure 15 Modelled flood extents - Arncliffe construction compound

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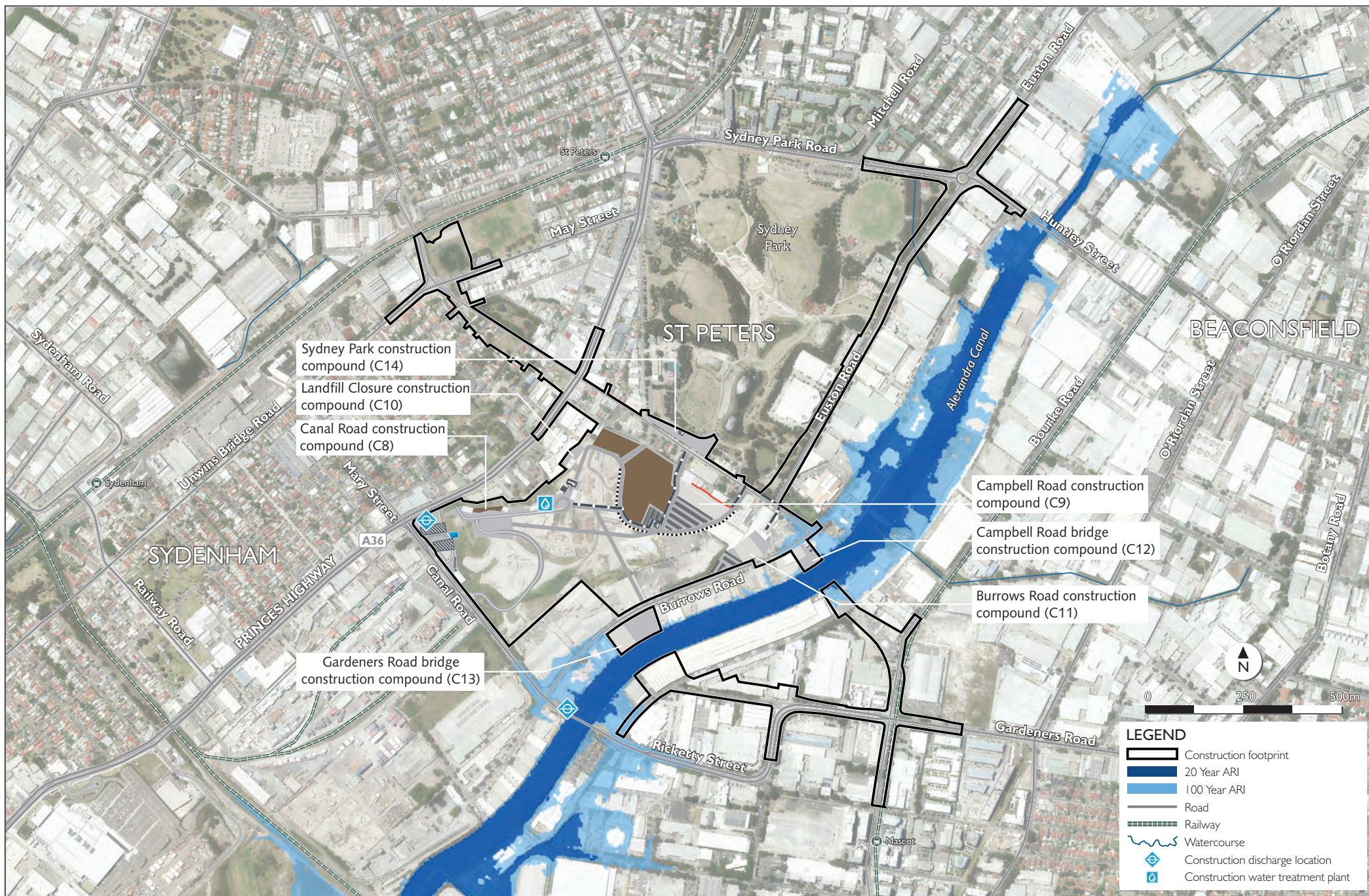


Figure 16 Modelled flood extents - St Peters interchange and local road upgrades

Table 20 Construction compounds and flooding

Compound	Size (ha)	Facilities	Activities	Existing Flooding Conditions	Potential Impacts of activities for 20 year ARI Flooding
Kingsgrove North construction compound C1	2.43	- Site offices - Staff amenities - Parking - Laydown area - Spoil management - Workshop and maintenance - Tunnelling launch and support - Construction water treatment plant	- Demolition of existing structures, including buildings and noise barriers - Establishment of site offices, amenities and temporary infrastructure including noise barriers - Stockpiling of fill and pavement materials as well as materials generated from excavation activities prior to off-site removal - Construction of the cut and cover structure at the eastbound main alignment tunnel entry portal, including piling, concrete works, excavation of structures and installation of a precast concrete roof - Construction and sinking of a shaft for tunnelling works and assembly of an acoustic shed - Excavation of the eastbound main alignment tunnel using a roadheader and associated construction activities, including stockpiling of material and spoil haulage - Installation of mechanical and electrical services within the eastbound main alignment tunnel and fit-out of the tunnel with additional infrastructure (eg signage) - Laydown and storage of materials, including precast concrete - Delivery of materials, plant and equipment.	- Outside of the 20 year ARI flood extent. - Partially within the 100 year ARI flood extent. 100 year flooding predominantly confined to carpark and laydown area. - Tunnel dive shaft outside of PMF.	None anticipated

Compound	Size (ha)	Facilities	Activities	Existing Flooding Conditions	Potential Impacts of activities for 20 year ARI Flooding
Kingsgrove South construction compound C2	3.31	- Site offices - Staff amenities - Parking - Laydown area - Spoil management - Workshop and maintenance	- Demolition of structures, including buildings and noise barriers - Stockpiling of materials, including spoil generated during tunnelling and surface works - Stockpiling of fill and pavement materials as well as materials generated from excavation activities prior to off-site removal - Laydown and storage of materials to be incorporated into permanent works - Construction of the Kingsgrove South motorway operations complex (MOC1) - Demobilisation - Rehabilitation and landscaping.	- Marginally within 20 year and 100 year ARI flood extents along boundaries bordering Wolli Creek. - Due to the local topography the 20 and 100 year ARI flood extents within the compound boundaries are very similar.	None anticipated
Commercial Road construction compound C3	0.59	- Tunnelling launch and support - Construction water treatment plant	- Demolition of existing structures, including buildings and noise barriers - Site establishment, including site offices, amenities, water treatment plant and acoustic shed installation - Construction and sinking of a shaft for tunnelling works - Excavation of the westbound main alignment tunnel using a roadheader and associated construction activities, including stockpiling of material and spoil haulage - Installation of mechanical and electrical services within the westbound tunnel and fit-out of the tunnel with additional infrastructure (eg signage).	Completely within 20 year and 100 year ARI flood extents.	All activities would be impacted by 20 year ARI flood. The acoustic shed and flood protection measures to protect against ingress of floodwaters into the compound would have the potential to impact flood conveyance and/or storage. Temporary compensatory drainage works would be implemented to minimise impacts adjacent to existing development as far as practicable.

Compound	Size (ha)	Facilities	Activities	Existing Flooding Conditions	Potential Impacts of activities for 20 year ARI Flooding
Bexley Road North construction compound C4	0.43	- Staff amenities - Laydown area - Spoil management - Workshop and maintenance - Tunnelling launch and support	- Site establishment - Construction of an acoustic shed - Construction and sinking of a shaft for tunnelling works - Decline and tunnel excavation of the eastbound and westbound main alignment tunnels using roadheaders, as well as stockpiling of excavated material and spoil haulage - Installation of mechanical and electrical services within the westbound main alignment tunnel and fit-out of the tunnel with additional infrastructure (eg signage) - Finishing works including landscaping asphaltting, line marking and signage installation - Demobilisation.	Completely within 20 year and 100 year ARI flood extents.	All activities would be impacted by 20 year ARI flood. The acoustic shed and flood protection measures to protect against ingress of floodwaters into the compound would have the potential to impact flood conveyance and/or storage. However these impacts are unlikely to impact existing development.
Bexley Road South construction compound C5	0.52	- Staff amenities - Parking - Laydown area - Spoil management - Workshop and maintenance - Tunnelling launch and support - Construction water treatment plant	- Site establishment - Construction of an acoustic shed - Construction and sinking of a shaft for tunnelling works - Decline and tunnel excavation of the eastbound and westbound main alignment tunnels using roadheaders, as well as stockpiling of material and spoil haulage - Construction of the Bexley Road South motorway operations complex (MOC2), including a permanent emergency smoke extraction facility and operational ancillary infrastructure - Installation of mechanical and electrical services within the westbound tunnel and fit-out of the tunnel with additional infrastructure (eg signage) - Commissioning of operational ancillary infrastructure (the Bexley motorway operations complex (MOC2)) - Finishing works, including landscaping, asphaltting, line marking and signage installation - Demobilisation.	Partially within 20 year and 100 year ARI flood extents, which are similar in outline at this location.	The acoustic shed and flood protection measures to protect against ingress of floodwaters into the compound would have the potential to impact flood conveyance and/or storage. However these impacts are unlikely to impact existing development.

Compound	Size (ha)	Facilities	Activities	Existing Flooding Conditions	Potential Impacts of activities for 20 year ARI Flooding
Bexley Road East Construction Compound C6	0.58	- Noise barriers / hoarding - Parking - Site offices - Crib rooms - Ablutions block	- Site establishment, including car parking and site offices - M&E installation - Commissioning - Finishing works including landscaping asphaltting, line marking and signage installation - Demobilisation	Completely outside of 100 year ARI flood extent.	None anticipated
Arncliffe Construction Compound C7	4.92	- Site offices - Staff amenities - Parking - Laydown area - Spoil management - Workshop and maintenance - Tunnelling launch and support - Construction water treatment plant	- Site establishment, including clearing, levelling and earthworks - Construction of site offices, amenities, laydown, material storage, water treatment plant and acoustic shed - Construction and excavation of two shafts; one for temporary tunnel access and one for the permanent smoke extraction facility - Decline and tunnel excavation with roadheaders and associated construction activities, including stockpiling of material and spoil haulage - Installation of mechanical and electrical services within the tunnels and fit-out - Construction and commissioning of the Arncliffe motorway operations complex (MOC3), including the emergency smoke extraction facility and operational water treatment plant - Finishing works, including landscaping, asphaltting, line marking and signage installation - Demobilisation.	Predominantly within 20 year and 100 year ARI flood extent. Tunnel dive shaft outside of PMF.	The majority of activities would be impacted by flooding although the stockpile and acoustic shed are outside of 20 year ARI. Flood protection measures to protect against ingress of floodwaters into the compound would have the potential to impact flood conveyance and/or storage. Design of these measures would give consideration to minimising adverse flooding impacts adjacent to existing development north of Marsh Street as far as practicable.

Compound	Size (ha)	Facilities	Activities	Existing Flooding Conditions	Potential Impacts of activities for 20 year ARI Flooding
Canal Road construction compound C8	2.30	- Site offices - Staff amenities - Parking - Laydown area - Spoil management - Workshop and maintenance - Tunnelling launch and support - Construction water treatment plant	- Site establishment for construction activities associated with eastern portals - Demolition of buildings - Construction of the cut and cover structure at the eastern portals - Installation of piles for the on and off ramps connecting the main alignment tunnels to the St Peters interchange - Construction and commissioning of the St Peters motorway operations complex (MOC4) - Dive excavation for tunnelling activities - Tunnelling support including spoil removal - Civil tunnel back end works (which would include pavement and drainage works) and mechanical and electrical installation - Finishing works including asphaltting, line marking, signage installation and landscaping - Demobilisation.	Completely outside of 100 year ARI flood extent	None anticipated
Campbell Road construction compound C9	2.53	- Site offices - Staff amenities - Parking - Laydown area - Spoil management	- Site establishment for construction activities associated with St Peters interchange - Demolition of existing buildings - Construction of the on and off ramps and bridge structures at the St Peters, local road upgrades and shared paths - Construction of carriageways - Tie in with existing roads onto Campbell Road - Finishing works, including asphaltting, linemarking, signage installation and landscaping - Demobilisation.	Completely outside of 100 year ARI flood extent	None anticipated

Compound	Size (ha)	Facilities	Activities	Existing Flooding Conditions	Potential Impacts of activities for 20 year ARI Flooding
Landfill Closure construction compound C10	0.15	- Site offices - Staff amenities - Parking - Laydown area - Spoil management	- Site establishment for construction activities associated with the landfill closure works - Installation of access roads, site fencing and barriers - Demolition of buildings - Relocation of utilities - Enabling works - Landfill closure works, including earthworks, foundation treatments and capping - Demobilisation and landscaping.	Completely outside of PMF flood extent	None anticipated
Burrows Road construction compound C11	0.71	- Site offices - Parking - Laydown area - Spoil management	- Site establishment to support construction activities associated with the St Peters interchange and local road upgrades - Demolition of buildings - Construction of hardstand for overflow car parking - Creation of a laydown area and storage of materials for local road upgrades - Construction of the motorway control centre.	Completely outside of 100 year ARI flood extent	None anticipated
Campbell Road bridge construction compound C12	0.32	- Staff amenities - Parking - Laydown area - Spoil management	- Site establishment for the construction activities associated with the new bridge across the Alexandra Canal - Demolition of buildings - Stockpiling of materials for construction works - Utilities relocation - Support for construction of a new bridge across Alexandra Canal - Works to enable tie in with Campbell Road upgrade works - Laydown and storage area for plant and equipment, and permanent materials for bridge works, including precast concrete - Finishing works including landscaping asphaltting, line marking and signage installation - Demobilisation.	Partially within the 20 year ARI flood extent. Completely within 100 year ARI flood extent	Potential minor impacts to activities on the immediate banks of canal. No measureable impact on flood storage or conveyance anticipated during a flood event.

Compound	Size (ha)	Facilities	Activities	Existing Flooding Conditions	Potential Impacts of activities for 20 year ARI Flooding
Gardeners Road Bridge construction compound C13	0.82	- Site offices - Staff amenities - Parking - Laydown area - Spoil management	- Site establishment for construction activities associated with the Gardeners Road bridge - Demolition and reinstatement of buildings - Relocation of utilities - Tie-in of the Gardeners Road bridge with the local road upgrades - Storage of bridge construction plant and equipment - Stockpiling of construction materials - Laydown and storage of bridge materials, such as precast concrete - Storage of temporary access platforms for bridge works (western side of the Alexandra Canal) - Pre-assembly of segments, heavy lifts and associated bridge and local road upgrade construction works - Finishing works, including landscaping, asphaltting, line marking and signage - Demobilisation.	Only marginally affected by the 20 year ARI flood extent. Partially within 100 year ARI flood extent.	None anticipated
Sydney Park construction compound C14	0.65	- Site offices - Staff amenities - Parking - Laydown area	- Site establishment activities - Construction activities associated with the pedestrian and cycle bridge over Campbell Road - Construction of the bridge over Campbell Road - Construction of a shared pedestrian and cycle path in Sydney Park - Plant and equipment laydown and storage area - Demobilisation.	Completely outside of PMF flood extent	None anticipated

**subject to confirmation during detailed design*

6.2.2 Localised flooding and drainage

All construction works would have the potential to impact local overland flows and existing minor drainage paths. Disruption of existing flow mechanisms, both of constructed drainage systems or those of overland flow paths, could be worsened by the various construction activities and facilities. Specific causes of these impacts could include:

- Disruption of existing drainage networks during decommissioning, upgrade or replacement of drainage pits and pipes.
- Interruption of overland flow paths by installation of temporary construction ancillary facilities.
- Blocking of drainage assets by increased solid loading of surface water.

These would require consideration during future detailed design and construction planning, along with the typical mitigation measures described in Section 8.1.1.

6.2.3 Maintenance of natural flow variability

The discharge of treated ground / construction water would have a minor increase in flow rates of receiving water courses. Alexandra Canal and the Cooks River flow variability is dominated by tides within the study area, hence the project discharges would not impact natural flow variability. Discharge to Wolli Creek would be to the concrete lined section upstream of Bexley Road. Between Bexley Road and the fish weir at Turrella – the discharge would contribute up to 13.1 litres per second to a highly altered reach of creek, affected by both upstream lining and downstream hydraulic controls. This small amount of discharge would not have the potential to impact what was the natural flow variability in the creek.

6.3 Water quality

Potential impacts on surface water quality during construction of the project are considered manageable with the application of standard mitigation measures.

Exposed soils may be eroded by wind or rain, and the eroded soils may lead to water quality issues such as sedimentation in the receiving waters downstream. Soils transported into local waterways can impact water quality through increased turbidity, lowered dissolved oxygen levels, and increased nutrients (nitrogen, phosphorus). The sedimentation may smother aquatic ecosystems and increases in nutrients may contribute to eutrophication.

Drainage works also have the potential to concentrate flows, which may exacerbate erosion. These construction activities pose the greatest risk where they occur near waterways; on steep slopes or on land subject to flow or flooding.

Erosion and sediment loads would gradually diminish with completion of construction activities as the disturbed areas are stabilised and the vegetation of batters start to establish and hold the soils in place.

The key objective during construction would be to minimise erosion of disturbed earthworks areas and to contain any sediments on-site. A preliminary erosion and sedimentation assessment was undertaken for the project in accordance with the *Erosion and Sedimentation Risk Assessment Procedure* (RTA, 2004) – *Appendix 1a & 1b for Concept Designs*. This identified the project works to be high risk, with reference to:

- Slopes in parts of the surface water study area with greater than ten per cent grade.
- An R factor (rainfall erosivity) of 3000-3500 for this area of Sydney.

As this presents a high erosion hazard, an Erosion and Sedimentation Management Plan would need to be prepared as outlined in *Erosion and Sedimentation Risk Assessment Procedure* (RTA, 2004).

Disturbance of contaminated soils or Acid Sulfate Soils (ASS) could affect water quality by liberating acids. There is a high potential for ASS at the Arncliffe construction compound and local road upgrades as well as in sediments in Alexandra Canal. Further contamination investigation would be conducted in areas with medium or high ASS potential. Recommended mitigation and management measures for ASS are provided in Chapter 8.

The following section discusses the potential impacts to water quality by the following key activities and locations:

- Construction water treatment plant discharges
- The western surface works located in proximity to Wolli Creek
- The Arncliffe surface works within the Cooks River catchment
- St Peters interchange and local road works within the Alexandra Canal sub-catchment
- Local road works within the Eastern Channel sub-catchment.

6.3.1 Construction water treatment plants

During construction, tunnelling works would result in significant volumes of wastewater from groundwater ingress and construction activities which would require treatment and disposal. Other sources of wastewater during construction include:

- Water used in dust suppression
- Wash down runoff
- Sewage / grey water from construction compound sites.

Water (including wastewater) volumes generated during the construction of the project would vary based on construction activities that are taking place, the level of groundwater inflow into the tunnel and the length of tunnel that has been excavated.

Groundwater and process water captured during construction would be contaminated with total suspended solids and increased pH levels due to tunnelling and concreting activities. An estimated quality of groundwater influent based on that of the existing M5 East Motorway water treatment plant is shown in Table 21. Estimated quality of existing M5 East Motorway groundwater influent, categorised for contaminated or uncontaminated groundwater is provided in Table 22. These were obtained from *Geotechnical, Hydrological and Contamination Interpretive Report*, (Golder Associates) and the current influent operation data from the M5 East Motorway water treatment plant (M5 East Water Quality Records).

Groundwater collected during construction would also have varying levels of salinity. In some parts, particularly under the estuarine reaches of Wolli Creek, the Cooks River and Alexandra Canal, salinity levels would potentially be high.

Table 21 Groundwater influent water quality measured from M5 East Motorway water treatment plant at Turrella.

	Iron (mg/L)	TSS (mg/L)	Turbidity (NTU)	O&G (mg/L)	pH
Median	16.5	38.5	32.2	0	5.8 (min)
Maximum	91.0	440	211	14	8.1

Table 22 Expected groundwater influent concentrations

Parameter	Contaminated groundwater		Groundwater	
	Average	Peak	Average	Peak
Flow (kL/day)		700		1,037
Flow (L/s)		8.1		12
Ammonia load (kg/d)	19.8	76	0	0
TDs load (kg/d)	472	1,228	145	415
Cyanide load (kg/d)	0.009		0	0
Iron Load (kg/d)	11.5	63.7	17	94
TPH (kg/d)	0.06	0.9	0	0
Phenols (kg/d)	0.0003	0.014	0	0

During construction, water captured from both surface flows and groundwater would be collected in sumps and pumped to holding tanks, which would be pumped to the construction water treatment plants located at each of the four main construction compounds as shown in Figure 17 and Figure 18, and as listed in Table 23.

Table 23 Expected treatment plant discharge volumes

Location	Receiving watercourse	Discharge daily flow L/s (ML/d)
Kingsgrove North construction compound (C1)	Wolli Creek	2.8 (0.09)
Kingsgrove South construction compound (C2)	Wolli Creek	2.8 (0.24)
Bexley Road construction compounds (C4-C6)	Wolli Creek	7.6 (0.66)
Arncliffe construction compound (C7)	Cooks River	11.6 (1.00)
St Peters interchange	Alexandra Canal	7.2 (0.62)

**subject to confirmation during detailed design*

Each water treatment plant would comprise a series of modular water-tight tanks with automated probes and dosing units designed to test and treat the water to the required standard. Water treatment would typically need to involve:

- Flocculation to remove total suspended solids
- Reverse osmosis to reduce salinity and dissolved solids
- Correction of pH level through the addition of lime or acid
- Treatment of elevated levels of iron and manganese
- Treatment of salinity and other contaminants such as ammonia, where necessary.

The treatment train adopted for each plant would vary depending on the origin of water being treated at each plant. However, the construction water treatment plants would be designed to a minimum standard that would meet the water quality reference criteria (AECOM, 2015) (refer to Appendix A).

Treated wastewater would be reused where possible, such as dust suppression. However it is anticipated that there would be an excess of wastewater from the water treatment plants. The water treatment plants would discharge treated water to the existing stormwater drainage systems, which would eventually discharge into the Cooks River via its tributaries including Wolli Creek.

The waterways that would receive discharges during construction are highly disturbed ecosystems, as described in Section 4.6. The water quality reference criteria have been developed to improve water quality of these receiving environments. As such, provided the criteria are met, there would be a low risk of adverse impacts of treated water discharges on the water quality of the receiving environment.

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Figure 17 Location of construction water treatment plants and discharge locations - Kingsgrove and Bexley Road construction compounds

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Figure 18 Location of construction water treatment plants and discharge locations - Arncliffe and St Peters interchange

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6.3.2 Wolli Creek

Construction of the project would involve extensive works within the Wolli Creek catchment. The extent of works includes the western surface works, the Kingsgrove surface works and Bexley Road surface works, and includes construction compounds. These activities have the potential to impact surface water within the study area and an assessment of these impacts has led to the following:

- Stockpiling of spoil and construction materials could present a risk to water quality. However, this would predominantly occur within the acoustic sheds. The sheds would minimise the potential for transport of spoil sediments by both wind and rain.
- Runoff from these construction compounds would drain to the concrete lined tributary of Wolli Creek and the main arm of Wolli Creek. Runoff could impact these environments by delivering sediments and pollutants to Wolli Creek. Wolli Creek is a highly disturbed environment, where the water quality is known to be highly turbid, with elevated nutrient and heavy metal concentrations (refer to Section 4.6). Unmitigated runoff from the project during the construction phase would place increasing pressure on this already stressed environment. Mitigation measures would be required to reduce the potential for environmental impacts arising during construction. Provided that appropriate controls are implemented during construction, short term impacts are expected to be manageable and expected to have no material impact on receiving water quality.
- During construction, an existing water quality wetland would be removed with a replacement wet basin constructed. The basin currently treats pavement runoff from a catchment of 2.21 hectares of the existing M5 East Motorway. The decommissioning of the wetland would not occur until replacement water quality devices are in operation.

6.3.3 Cooks River

The Arncliffe surface works would include the establishment and use of the Arncliffe construction compound (C7) as outlined in Table 20.

Runoff from these construction compounds would drain to the Cooks River, which is a heavily polluted waterway with poor water quality and contaminated sediments (refer to Section 4.6). The location of this compound is very close to the mouth of the Cooks River and Botany Bay. Botany Bay and its estuaries are associated with significant biodiversity and other environmental values as well as significant community, environmental and social values.

Runoff from construction areas could impact this environment by delivering sediments and pollutants to the river. Spoil and other construction materials would also be stockpiled at the site. As discussed earlier, there is also a high risk of ASS. Unmitigated runoff from the project during the construction phase would place increasing pressure on the already-stressed Cooks River, and could endanger the ecological health of Botany Bay. Mitigation measures would be required to reduce the potential for environmental impacts arising during construction.

One sensitive environment in particularly close proximity to construction is the RTA ponds that provide breeding habitat for Green and Golden Bell Frog near Marsh Street, Arncliffe. The species also utilise most of the Kogarah Golf Course for foraging, sheltering and occasionally breeding. Certain golf course ponds located within the construction footprint would be decommissioned. The golf course ponds are expected to have poor water quality due to nutrient runoff associated with golf course management activities.

Dust generated by construction activity, if not properly managed, has the potential to impact the water quality of the RTA ponds and frog habitat on the golf course. The use of sheds for spoil handling, and dust suppression measures would mitigate and manage the potential for indirect impacts. Additional measures specific to the species and project are also detailed in the plan of management (Eco Logical Australia, 2015). As such, the construction activity is not expected to impact the water quality of the RTA ponds or surrounding habitat. It is a commitment in the plan of management to undertake water quality monitoring of the RTA ponds. More detail on the water quality monitoring regime including frequency, sampling locations and parameters would be provided in the Habitat Creation and Captive Breeding Plan due for completion by March 2016.

Provided that appropriate controls are implemented during construction, short term impacts are expected to be manageable and expected to have no material impact on receiving water quality.

6.3.4 Alexandra Canal

Construction of the project would involve extensive works within the Alexandra Canal catchment. The areas of construction compounds are shown previously in Table 20. These activities have the potential to impact surface water in the surface water study area. An assessment of these impacts has led to the following:

- Stockpiling of spoil and construction materials could present a risk to water quality. In some instances, stockpiling would be within sheds. Mitigation and management measures would be implemented to manage risks to water quality.
- Runoff from some construction compounds would drain to Alexandra Canal. Runoff from construction areas could impact these environments by delivering sediments and pollutants to the canal. Alexandra Canal is a heavily polluted waterway with poor water quality and contaminated sediments (refer Section 4.6). Unmitigated runoff from the project during the construction phase would place increasing pressure on this already stressed environment.
- Construction of the bridges over Alexandra Canal would not involve installation of any piers within the canal. However, works would occur in close proximity to the canal. Runoff from these activities would be managed to minimise potential impacts to water quality within the canal.
- Construction of new stormwater outlets along the canal (as outlined in 7.3.2) is likely to cause localised mobilisation of sediment, however, it is considered unlikely that sediments mobilised as a result of the impact of the new outlets would extend a significant distance from the stormwater discharge point given that the canal has a very low sediment transport capacity. More information is provided on contaminated sediments in Technical Working Paper: Contamination (AECOM, 2015).

Mitigation measures (as described in Section 8.1.2) would be required to reduce the potential for environmental impacts arising during construction. Provided that appropriate controls are implemented during construction, short term impacts are expected to be manageable and expected to have no material impact on receiving water quality.

Landfill runoff

The Alexandria landfill site would be closed in preliminary works for the St Peters interchange. This closure would involve landscaping and subsequent disruption drainage and overland paths. Leachate would continue to be captured and treated in the existing leachate treatment plant up until commissioning of the new leachate treatment plant. The plant would continue to discharge to the local sewer.

Surface runoff could potentially become contaminated at the site. Non contaminated runoff would be capture by existing drainage lines which discharge to Alexandra Canal. The quality of this runoff, including control of sediment levels would be managed by methods outlined in Managing Urban Stormwater-Soils and Construction, Volume 1 (Landcom, 2004). Where runoff has the potential to be contaminated, it would be captured and directed to the leachate treatment plant for treatment before discharge to sewer under a trade waste agreement.

6.3.5 Eastern Channel

Construction activities in the Eastern Channel catchment would occur as a result of upgrades to road and drainage structures and works at the existing water quality basin in Camdenville Park as outlined in Table 20.

Runoff from construction areas could impact the receiving environment by delivering sediments and pollutants to the channel. Water quality within the Eastern Channel is not yet known, but due to its direct connection to the Cooks River, and proximity with similar in land use to Alexandra Canal, it is expected that the water quality would be similar to these other watercourses, characterised by high turbidity, high nutrients, pathogens and toxicants (refer Section 4.6). The Eastern Channel, being concrete-lined has little habitat value per se, but is an efficient conveyance for water that would impact upon the ecosystem health of the Cooks River. Therefore, unmitigated runoff from the project during the construction phase would place increasing pressure on the already stressed environment of the Cooks River, and would undermine attempts by the surrounding community and stakeholders to improve the ecosystem health of the Cooks River.

6.4 Geomorphology

The potential impacts on the geomorphic condition (refer Figure 12) of watercourses during construction of the project are considered minor and manageable with the application of current best practice construction mitigation measures.

Direct construction activities within or adjacent to the watercourse and / or riparian zone are likely to involve the clearing of vegetation and excavation of channel bed and bank areas, including installation of bridge abutments. These direct activities are likely to disturb the existing floodplain and / or in-channel geomorphic units, exposing them to scour erosion, altering the trajectory of the channel planform.

Discharge from the outlets of the groundwater treatment system and upgrade of existing drainage infrastructure have the potential to concentrate flows, which may exacerbate erosion. Erosion can lead to channel deepening (bed incision) and channel widening (channel bank lateral expansion and / or migration), altering the trajectory of the channel planform. Locations of discharges from construction water treatment plants are shown in Figure 17.

Construction areas where soil has been exposed and / or weakened by construction activities can be eroded / mobilised by wind or runoff, have the potential to deposit sediments in receiving waterways. Sediments can fill and smother in-stream geomorphic units and habitat features such as pools and riffles. Furthermore, sediments can accumulate at in-stream barriers and constrictions, which may result in localised flooding and / or channel avulsion (a new altered flow path around an in-stream barrier).

Erosion and sediment loads would gradually diminish after construction as the disturbed areas are stabilised and the vegetation of batters start to establish and hold the soils in place. The key objective is to minimise erosion of disturbed earthworks areas and to contain any sediments on-site before they enter the riparian zone and watercourse / drainage system.

Other potential construction impacts on the geomorphology include: increased impermeable area and / or altered flow paths that may result in increased over bank flows entering the waterway causing erosion; tunnelling activities causing bedrock fracturing and / or subsidence with the watercourse bed.

6.4.1 Wolli Creek

The western surface works have the potential to expose and weaken the terrestrial surface soils. Wind or rainfall may lead to the mobilisation and deposition of these sediments into the channel. Whilst discharges would be into the concrete lined reach of the creek, sediments could be transported to the natural reaches downstream of Bexley Road. With the implementation of best practice sediment and erosion control measures, these impacts can be mitigated.

Kingsgrove surface works would primarily occur within paved areas, with limited disturbance to soils and changes to drainage.

The construction works at the Bexley Road surface works would include clearing of a small portion of grassed / vegetated parkland. Some of this land lies on steep grades and hence have the potential for scour and bank failure in flood events. This is particularly relevant within the Bexley Road South construction compound which is immediately adjacent to Wolli Creek.

Construction and upgrades to the existing drainage and new outlets attributed to the western surface works including a treated groundwater discharge outlet would have the potential to cause localised impacts, such as weaken bed and bank soil structure, localised erosion and mobilisation of sediments.

At western surface works, treated water would be discharged at two locations, each with a discharge rate of up to 2.8 litres per second of treated water. An additional 7.6 litres per second of treated water would be discharged at Bexley Road. The total discharge volume of equating to 13.2 litres per second would enter Wolli Creek during construction.

When compared to the one year ARI flow of 58.9 cubic metres per second at Bexley Road (PB-MWH, 2009), this discharge would contribute an increase of 0.02 per cent. This is a relatively insignificant increase in flow that would likely have minimal impact on stream levels and velocities in the creek hence it is not expected to impact the geomorphology of the creek.

Tunnelling would occur beneath Wolli Creek and its tributaries. The construction methodology would minimise potential impacts to surface geology, such as fracturing and subsidence. As a result no impact on the geomorphology of the watercourses is expected.

6.4.2 Cooks River

A number of construction activities would occur at the Arncliffe surface works, including stockpiling of spoil and construction materials, wastewater treatment and associated discharge infrastructure and outlet at the Cooks River. Construction of the project would result in discharging up to 20 litres per second of treated water into the Cooks River adjacent to Kogarah Golf Course via the existing stormwater system.

When compared to the one year ARI flow of 357.3 cubic metres per second (PB-MWH, 2009), the estimated rate of discharge to Botany Bay from the treatment plant is a very small (less than 0.01 per cent increase). At this location the river is almost fully tidal due to its close proximity to Botany Bay. This small inflow would not impact the geomorphology of the river.

At the outlet location, scour resulting from the discharges related to construction activities has the potential to locally impact the floodplain, bank and bed morphology at the outlet location.

Tunnelling would occur beneath the Cooks River. The construction methodology would minimise potential impacts to surface geology, such as fracturing and subsidence. As a result no impact on the geomorphology of the watercourses is expected.

6.4.3 Alexandra Canal

Bridge construction works would occur at Campbell Road and Gardeners Road, although no piers would be installed within the canal.

Construction and upgrades to the existing drainage and new outlets adjacent to Campbell Road and Gardeners Road bridges have the potential to cause localised impacts, such as weaken bed soil structure, localised erosion and mobilisation of sediments.

Construction of the project would result in up to 7.2 litres per second of treated water discharged at the Ricketty Street Bridge via the existing stormwater system. Contaminated leachate and runoff would be discharged into sewer under a trade waste agreement.

When compared to the one year ARI flow of 83.9 cubic metres per second at its confluence with the Cooks River (PB-MWH, 2009), this discharge would contribute an increase of 0.02 per cent. This is a relatively insignificant increase in flow that would likely have minimal impact on levels and velocities in the canal hence it is not expected to impact the geomorphology of the canal.

6.4.4 Eastern Channel

No discharges would be made to the Eastern Channel during construction of the project. A small extent of land clearing would create the potential for materials to be transported into the existing stormwater detention basin in Camdenville Park though not the channel itself.

6.5 Cumulative impacts

The project area is within a continually altering urban environment. Further developments are likely to occur in or around the project area during and after construction of the project. These include other works on the WestConnex program, as well as mixed used, residential, rail, commercial and precinct developments.

For water quality and geomorphology, the key potential construction related impacts are erosion of exposed soil resulting in sedimentation and water pollution associated with sediment-laden runoff. Although this might be considered a temporary impact, ongoing re-development within the catchment has the potential to persistently expose the receiving environment to these impacts. These cumulative impacts would be managed through proper implementation of the respective Construction Environmental Management Plans (CEMPs).

Significant works are currently underway directly to the west of the project as part of the King Georges Road Interchange Upgrade. The project has produced a Construction Soil and Water Quality Management Plan that has sufficient mitigation measures to significantly minimise the potential for cumulative impacts with the project (Fulton Hogan, 2015).

In regards to flooding, if other construction activities are not in close proximity to the project, cumulative temporary flood impacts are not considered likely. The King Georges Road Interchange Upgrade are not expected to exacerbate flooding in the study area as the only works in the same catchment are upstream of the project (Jacobs, 2014).