7.6 Soil, sediments, water and waste

This section assesses soil, sediment, water quality and waste impacts of the project. The assessment is supported by a soil, sediments and water working paper, which is presented in Volume 4 – Working paper 7. The assessment has addressed the Director General's requirements for soil, sediment, water quality and waste (as detailed in **Table 7-48**) as well as the relevant requirements of Schedule 2, Part 3 of the *Environmental Planning and Assessment Regulation 2000*.

The Director General's requirements relating to the hydrological and bed and bank stability impacts of the new bridge are addressed in the Hydrology working paper (Volume 4 – Working paper 8) and **Section 7.7** of the EIS, together with a detailed discussion of potential scour protection measures.

Table 7-48 Director General's requirements for soil, sediments, water and waste

Director General's requirements	Where addressed
Erosion and sediment impacts on the Hawkesbury River during construction/ operation;	Section 7.6.3, Section 7.6.4 and Section 7.6.5
- including an assessment of water quality;	Section 7.6.2
- mitigation measures to prevent water pollution;	Section 7.6.6
- details of the proposed storm water management measures for the containment of pollutants; and	Section 7.6.6
- waste handling.	Section 7.6.6

The assessment has been undertaken on the following aspects of soils, sediments, water and waste:

- Soil and water management.
- Contamination of soils and sediments.
- Hazardous materials.
- Acid sulfate soils.
- Groundwater.
- Waste handling.

7.6.1 Guidelines and methodology

Soil and water

The process of assessing the impact of the project on soil and water impacts and developing mitigation measures has included:

- A review of existing project literature, other studies and water quality data.
- An assessment of the catchments based on the proposed drainage system.
- An assessment of the impact of construction on soils, sediments and water quality.
- A review of water quality treatment measures that could be used to mitigate the impact of construction on water quality, following the principles of *Managing Urban Stormwater - Soils and Construction Volume 1* (Landcom, 2004) and *Volume 2D* (DECC, 2008).
- An assessment of the soil, sediment and water quality impacts of the project during its operation.
- A review of water quality treatment measures that could be used to mitigate the impact of the operation of the project on water quality following the principle of *Procedure for Selecting Treatment Strategies to Control Road Runoff* (RTA, 2003), RMS *Water Policy* (RTA, 1997), and RMS Code of Practice, *Water Management* (RTA, 1999).
- A review of suitable locations and sizes for a sediment basin and a spill containment basin.

Contamination

Site investigations were undertaken generally in accordance with the *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (EPA, 2000). This included:

- A Stage 1 preliminary site investigation which assessed potential contamination issues at the site that may have arisen from past and/or present activities undertaken on and/or adjacent to the site which may represent a risk to human health or the environment.
- A Stage 2 detailed site investigation was also undertaken which involved soil sampling, laboratory testing of soil samples to assess concentrations of key pollutants and comparison of results against appropriate guidelines.

Other studies (such as Birch et al, 1998) on heavy metal contamination of river bed sediments at Windsor were also reviewed and assessed for relevance to the project.

Hazardous materials

A hazardous materials audit was carried out via a visual inspection of the existing bridge structure and bridge supported services and sampling of suspect building materials. The focus of the inspection and sampling was to identify any asbestos, synthetic mineral fibres (SMF), lead based paints, nickel-cadmium batteries or Polychlorinated biphenyls (PCBs).

Acid sulfate soils

Acid sulfate soils (ASS) risk maps from the NSW Natural Resource Atlas database were reviewed to ascertain the presence of ASS within the project area. Sampling and analysis (using Suspension Peroxide Oxidation Combined Acidity and Sulfur analytical method) of river bed sediments was undertaken to determine the presence of acid sulfate soils and any requirements for management based upon the *Acid Sulfate Soils Assessment Guidelines* (ASSMAC, 1998).

Groundwater

Existing groundwater users, groundwater dependent ecosystems and aquifers in the area in and adjacent to the project were identified from groundwater bore databases and relevant reports. The presence of groundwater in the project was assessed during excavations from geotechnical studies undertaken for the project. The construction methodology and design of the project was reviewed to identify potential impacts on groundwater users and aquifers. Groundwater dependent ecosystems are also discussed in **Section 7.9.2**.

Waste management and handling

Where possible, the quantity, type and likely classification of wastes generated from the project were identified from reports on the existing bridge and concept design reports. Resource use for the project was assessed by reviewing existing information including the Concept Design Report (SKM, 2012b) and estimating the resources required for construction and their likely sources.

7.6.2 Existing environment

Soil and water

Water quality

The now defunct Office of the Hawkesbury-Nepean has identified the environmental values that apply to all the waterways within the Hawkesbury-Nepean catchment as:

- Protection of aquatic ecosystems.
- Secondary contact recreation (boating, wading, fishing etc).
- Visual amenity.

Some sections of the river and its tributaries have also been recognised as providing additional environmental values such as:

- Water for irrigation and general use.
- Livestock drinking.
- Human consumption of aquatic foods.
- Raw drinking water.
- Primary contact recreation.

Water quality monitoring at many sites in the Hawkesbury River has been routinely undertaken since the 1980s. Most monitoring has been undertaken by the Sydney Catchment Authority and Sydney Water. In 2009 the then NSW Department of Environment and Climate Change completed a full compilation and assessment of available water quality data (DECC, 2009). The assessment included an analysis of temporal trends in water quality at individual sites along the Hawkesbury River, including at Windsor bridge.

The analysis and comparison of water quality data with the ANZECC/ARMCANZ (2000) water quality guidelines prepared by DECC (2009) is provided in Soils, sediment, water and waste working paper (Volume 4 – Working paper 7). The assessment of water quality at Windsor bridge suggests:

- Conductivity, pH, and turbidity levels were frequently within the ANZECC/ARMCANZ (2000) guideline values over the whole record.
- Dissolved oxygen levels have been steady over time and the majority were within guideline values.
- There has been an improvement in phosphorus (total and filterable phosphorus) levels over time, and the majority of recent monitoring data has met the ANZECC/ARMCANZ (2000) guideline values.
- Nitrogen (total, oxides of nitrogen, and ammonium) levels and chlorophyll-a levels frequently exceed the ANZECC/ARMCANZ (2000) guideline values over the whole record.

Existing water quality treatment

The existing Windsor bridge and approach roads do not have any water quality management devices to treat stormwater runoff or capture spills of hazardous materials. The only water quality management device in close proximity to the project is a Gross Pollutant Trap located near the intersection of Baker Street and The Terrace.

Soil landscapes

The ‘Soil Landscapes of the Penrith 1:100 000 Sheet’ (Bannerman and Hazelton, 1990) classifies the soil landscape at the project site as Freemans Reach (fr). This soil landscape is an alluvium derived from the Narrabeen Group, Hawkesbury Sandstone and Wianamatta Group materials. The soils are typically deep brown sands and loams. It is a dynamic soil landscape where streambank erosion and deposition constantly occur, and the floodplains are subject to scour or sheet and rill erosion during floods. The soils of the Freemans Reach soil landscape are highly erodible. They generally contain a high percentage of fine sand and have low to very low organic matter contents, and are moderately dispersible. The soil’s erosion hazard is very high to extreme for concentrated flows and there is a high streambank erosion hazard.

Contamination

The Stage 1 preliminary site investigations involved an assessment of historical and existing land uses and a review of contaminated sites databases to identify areas that may contain potentially contaminated soils and other materials.

The historical land use information and historical aerial photography review has indicated that the northern bank for the Hawkesbury River at the project location has primarily been used for agriculture since 1793, and the southern bank for residential and urban development since 1810. Several small scale industrial activities have also occurred in this area, however they are no longer active. Use of the river for transportation purposes began in 1795 with the construction of a wharf on the southern bank of the Hawkesbury River, and Windsor bridge, at its present location, was constructed in 1874.

Based upon the outcomes of the Stage 1 preliminary site investigation, sites and potential contaminants of concern were identified (see **Table 7-49**) and the 10 locations for soil sampling for the Stage 2 detailed investigation were determined.

Soil sampling was undertaken at 10 representative locations within the potential sites of concern identified as part of the Stage 1 investigation and samples were analysed for a wide range of contaminants. Contaminant concentrations in all soil samples were below relevant ecological and human health soil contamination guidelines, suggesting that there are no contaminated soils or materials in the project area. The detailed results from the soil sampling and analysis are presented in the Soil, sediment, water and waste working paper (Volume 4 – Working paper 7).

Table 7-49 Potential sites and sources of contamination

Site/ source	Contaminants of concern	Location
Turf farm / agricultural areas	Organochlorine Pesticides (OCP), Organophosphorus Pesticides (OPP), herbicides and heavy metals.	To the north and east of the northern approach of Windsor Bridge. Forms part of the proposed roundabout on the northern bank.
Deterioration of bridge structures underneath Windsor Bridge (i.e. crossbeams, break walls and pylons).	Heavy metals (associated with paints), asbestos, and Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene, Xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAH), Polychlorinated Biphenyls (PCB) (associated with fill material behind the break walls).	Underneath the first span of the bridge on both the northern and southern sides.
Deposition of potentially contaminated sediments from upstream during flooding events.	Heavy metals, OCP, OPP, TPH, BTEX, PAH and PCB	Along river banks and sediments throughout the site.

In 1998 a major study was published on the concentrations of heavy metals in the sediments of the Hawkesbury-Nepean River (Birch et al, 1998) which included the sediments in the river around Windsor. Generally the concentrations of heavy metals in the sediments in the main channel increased marginally with distance upstream, with the sediments at Windsor recording the highest concentrations in the main channel.

Typical average concentrations of key heavy metals in the sediments around Windsor are about 26 micrograms per kilogram of copper, 39 micrograms per kilogram of lead and 110 micrograms per kilogram of zinc. These concentrations are below the low range Interim Sediment Quality Guidelines (ANZECC/ARMCANZ, 2000) and indicate that the sediments in the river around Windsor are not contaminated.

Hazardous materials

Lead based paints (ie. lead at concentrations of greater than one per cent by weight) were detected in paint samples collected from the iron piers and iron cross bracings of the existing bridge. No other potentially hazardous materials were identified.

Acid sulfate soils

Sampling of river bed sediments indicated that there are potentially low strength acid sulfate soils present within sediments near the southern bank. However as noted in the Acid Sulfate Soils Assessment Guidelines (ASSMAC 1998), estuarine sediments may give false positives to the presence of acid sulfate soil especially if there is a high proportion of organic matter in the sediments.

Groundwater

A search of the NSW Natural Resources Atlas database identified no registered groundwater bores within the project area. However one bore (GW106373) is immediately adjacent to the project and is associated with the property Bridgeview, near the corner of Wilberforce and Freemans Reach roads. Seven other bores were registered within a one kilometre radius of the site, however these were of sufficient distance away from the project as to not be impacted. Information on five of the bores was available for review, which is summarised in **Table 7-50**. The location of these bores is shown on **Figure 7-35**. The groundwater bore information suggests:

- That in areas where there are gravels and sands in the top soil profile layers, there is an aquifer of good quality and low salinity water.
- That in areas where there are no gravel and sands in the top soil profile layers, groundwater is only encountered at depths greater than at least 25 metres below ground level and the groundwater is of relatively high salinity.

Groundwater level measurements were undertaken at all geotechnical investigation locations (see **Figure 7-35**) where free groundwater or seepage was observed in boreholes. Groundwater was only encountered on the northern bank of the Hawkesbury River. A summary of the groundwater level observations recorded during the site investigations are presented in **Table 7-51**. These levels were close to the level of the river during normal flow periods (-0.5 to 0.7 m AHD). Groundwater flow would be expected to be towards the river as generally this would the lowest point in the aquifer.

Table 7-50 Registered Natural Resources Atlas database boreholes

Borehole ID	Easting	Northing	Depth (metres)	Water bearing zones (metres below surface)	Salinity (Total Dissolved Solids mg/L)	Bore Usage
GW101009	297703	6280636	107	27-30m 42-45m	6000	Domestic Stock
GW106373	297878	6279899	15	10-15m	467	Domestic
GW109520	297309	6278401	6	Not applicable	No data	Monitoring Bore
GW109521	297371	6278340	6	Not applicable	No data	Monitoring Bore
GW103069	206676	6279119	84	75-76m	2200	Domestic Stock

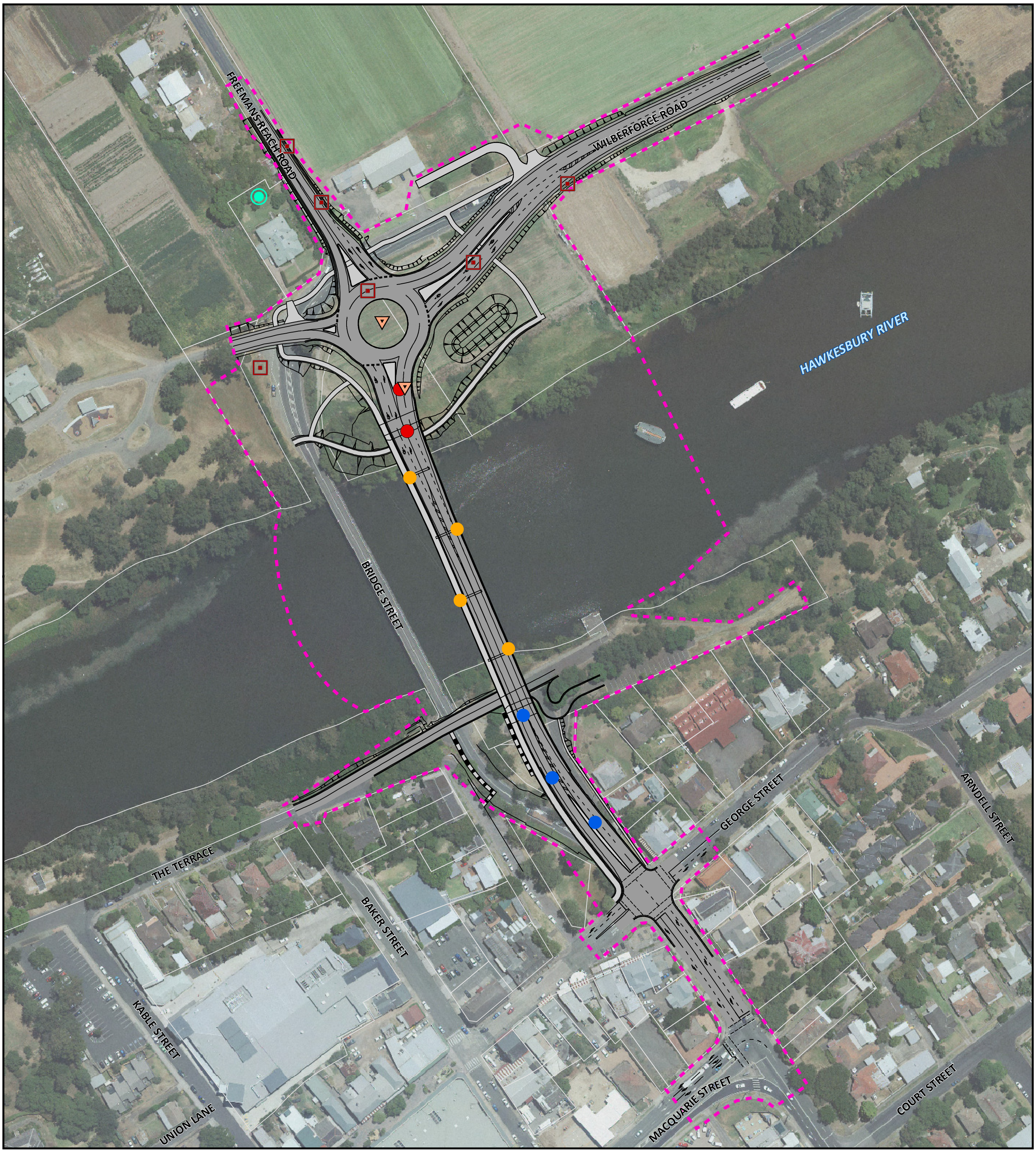
Table 7-51 Groundwater observation levels during investigations

Location ID	Surface RL (metres AHD)	Water Level (m bgl)	Water Level (m AHD)
NA-BH02	7.80	6.90	0.90
NA-CPT01	9.20	8.05	1.15
NA-CPT02	10.00	8.90	1.10

Note 1. m AHD = Metres Australian Height Datum. Note 2. m bgl = Metres Below Ground Level. Note 3. RL = Relative level.

Groundwater dependent ecosystems are “any ecosystem that uses groundwater at any time or for any duration in order to maintain its composition and condition” (Serov et al, 2012). Such ecosystems can range from highly dependent to opportunistic users of groundwater. Groundwater dependent ecosystems in the vicinity of the project were identified from recent mapping undertaken for the NSW Office of Water and National Water Commission (SKM, 2012c). The only groundwater dependent ecosystem within two kilometres of the project is a small area of Cumberland River Flat Forest in the western section of Macquarie Park, immediately adjacent to the river (see **Section 7.9.2** for additional information).

Figure 7-35 | Location of groundwater bores and geotechnical investigation sites



Indicative only – subject to detailed design

- Concept design
- Construction work zone
- Cadastral boundary
- Groundwater borehole

Stage 1: Northern Approach
- Borehole
- Cone penetrometer test
- Test pit/sub grade testing

Stage 2: Southern Approach
- Borehole

Stage 3: Overwater/barge Works
- Borehole

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Sydney Spatial Team - Prepared by : DD
Checked by : JC

7.6.3 Construction impacts

Soil and water

The construction phase of the project would involve both land-based and water-based construction activities. These would present a risk to soil, sediment and water quality if management measures are not implemented, monitored, maintained and adjusted throughout the construction process. Soil, sediment, water and waste, demolition impacts are discussed separately in **Section 7.6.4**.

Land-based construction

The risks from land-based construction would largely be during rainfall and wind events, when sediments or pollutants resulting from construction can flow or be blown to sensitive receiving environments. The highest risk to soil, sediment and water quality would occur during construction activities such as:

- Earthworks, including stripping of vegetation and topsoil, excavation or filling.
- Stockpiling of topsoil, vegetation and other construction materials.
- Transportation of cut or fill materials.
- Movement of heavy vehicles across exposed earth.
- Removal of riparian vegetation.
- Construction in any areas of highly erodible soils.
- Construction in any contaminated land.
- Construction in any acid sulfate soils.

These activities expose soils and, without proper management, may result in sediments and associated pollutants being washed during rainfall events or blown into downstream watercourses, with consequent potential degradation of water quality. The impact of unmitigated construction activities on receiving surface waters could include:

- Increased sedimentation smothering aquatic life and affecting the ecosystems of the river.
- Increased levels of nutrients, metals and other pollutants, transported via sediment to the river.
- Fuel, chemicals, oils, grease and petroleum hydrocarbon spills from construction machinery directly polluting the river and soils.
- Spills of concrete during concrete pours directly polluting the river and soils.
- Contamination from site compounds, chemical storage areas and washdown locations.
- Increased levels of litter from construction activities polluting the river.
- Contamination of the river as a result of disturbance of contaminated land.
- Acidification of the river as a result of disturbance of acid sulfate soils during construction.
- Tannin leachate from clearing and mulching of vegetation. This impact would be unlikely as vegetation clearance would be minimal and any cleared vegetation would be removed from site shortly after clearing.

Water-based construction

Water-based construction activities would be conducted from barges and/or jetties and would include construction of the bridge piers and installation of scour protection. Construction of the bridge piers would involve the installation of piles to the required depth at each pier location, and installing pile caps and the pier columns. Rock scour protection would be installed along the northern bank and at the piers. Removal of bed and bank material is needed to allow for the required volume of rock scour protection. On the southern bank a piled retaining wall would be installed for scour protection.

The water-based construction activities would cause disturbance of river bed sediments. If unmitigated or inadequately managed, this would cause a decline in water quality and visual amenity around the construction activities, particularly due to increased turbidity levels. The water-based construction activities may result in the direct pollution of the receiving environment from fuel, oil and chemical spills or from machinery hydraulic hose failure.

Environmental management measures would be put in place to avoid or minimise these impacts (see **Section 7.6.6**).

Contamination

The risk of encountering contaminated soils during construction of the project would be low as all soil samples collected returned analytical results below the site assessment criteria. These risks would be further reduced as earthworks for the project would be relatively minor (ie. the majority of works involve placing fill on the existing land surface). However despite the low risk, contaminated soils and materials may still be encountered especially on the southern bank as this area has a long history of urban use and not all areas could be sampled at the time of the assessment. Soil at the turf farm presents a lower risk with respect to unknown contamination as it is relatively homogenous and has generally been used for agriculture.

Based upon studies of the river sediments in the Hawkesbury River (Birch et al, 1998), the river sediments at Windsor are not identified as contaminated with heavy metals and therefore the risk of impacts due to mobilising contaminated sediment during construction would be negligible.

Construction activities could result in the contamination of soils due to the spillage or leakage of fuels and/or chemicals from plant and equipment and from storage areas. However provided standard environmental management measures as detailed in **Section 7.6.6** are implemented, the risk of significant impacts would be negligible.

Acid sulfate soils

The analytical results have identified potential acid sulfate soil in the river sediments. There would be a risk of potential acid sulfate soil disturbance and exposure during piling and dredging works for the installation of scour protection (SKM, 2012b). The risk from the potential acid sulfate soil would occur once the sediment is brought to surface and is exposed to air. This would start the process of oxidation of the potential acid sulfate soil in the sediment, which would result in the production of acid. If water from rainfall or other sources comes into contact with oxidised potential acid sulfate soil, acid runoff would be produced which could lower the pH of any receiving waterways and soils - adversely impacting on aquatic and terrestrial environments. It should be noted that the oxidation of the potential acid sulfate soil would not be instantaneous and would occur over a period of weeks or months.

Environmental management measures would be put in place to avoid or minimise these impacts (see **Section 7.6.6**).

Groundwater

The main potential impacts on groundwater would be:

- Interference with the aquifer – resulting in a decrease or change in groundwater levels. impacting upon groundwater users and groundwater dependent ecosystems.
- Pollution of the groundwater resources.

The risk of these impacts from construction activities would be very low as:

- There are either no permanent aquifers (southern bank) or groundwater levels are very close to the river level (northern bank) and are not close to the ground surface.
- Apart from piling, no construction activities would potentially interfere with any permanent aquifer. No dewatering would be required for piling activities.
- Predominately the flow of groundwater would be towards the river and therefore the project would be unlikely to decrease groundwater levels at nearby groundwater bores which are further away from the river.
- The footprint of the project would be relatively small and therefore its potential impact on groundwater would also be small.
- The risk of pollution of groundwater would be minimised through the implementation of appropriate management measures detailed in **Section 7.6.6**.
- The groundwater dependent ecosystem in Macquarie Park (Cumberland River Flat Forest) is 700 metres away from the project and immediately adjacent to the river. It would not be impacted by the construction of the project because of it's distance from the project and proximity to the river.

Waste management and handling

As the project only consists of the bridge, short sections of approach roads and other relatively minor works, the construction of the project would not generate significant quantities of waste. Demolition of the existing bridge which would generate substantial quantities of waste is discussed below. The type of wastes that would be generated during construction and their management is presented in **Table 7-52**.

Although the project would require the importation of about 10,800 cubic metres of fill material, some excess spoil would be generated including:

- Soils – This includes topsoil and natural B horizon soils (ie. soils between the topsoil and underlying bedrock).
- Fill material – This includes imported soils and other material that has been used for infilling (eg. old concrete, wood).
- Natural rock – This material would be generated from bored piling activities and where excavation of bed rock is required (eg. for service relocations).
- Road construction material – This would include material generated from the demolition of the existing roads such as asphalt, geotechnically stabilised road sub-base and base material.
- River bed sediments – This material would originate from dredging for the installation of scour protection.

The natural rock and the road construction material would be geotechnically suitable for reuse for road construction. However they may not be able to be reused on the project as the northern river bank is flooded in a 1 in 3 year flood event and longer term stockpiling of excess material in this location would not be prudent due to potential water quality impacts if flooding occurred. Also there would be limited space on the southern bank, so stockpiling on this side of the river for later reuse may not be possible. If this material is unable to be reused on site alternative off-site reuse opportunities would be investigated.

Although the soils from the northern river bank would be suitable for landscaping, because of the restrictions in on-site stockpiling, the reuse of these soils for the project may not be possible. These soils would either be stockpiled off-site for later use on the project or sent to recycling facilities.

All other excess spoil materials would be likely to be geotechnically unsuitable for road construction or unsuitable for landscaping. On the southern bank, small quantities (less than 500 cubic metres) of geotechnically unsuitable fill and soil material would be generated. Based on initial contamination testing this would likely be classified as General Solid Waste (non-putrescible) and would be disposed off an appropriately licensed landfill.

Initial sampling of the river bed sediments indicates that low strength acid sulphate soils may be present near the southern bank. Further sampling would be required as part of the detailed design to confirm the presence of acid sulphate soils. The river bed sediments would not be suitable for reuse and would require disposal at an appropriately licensed landfill.

The construction of the project would require raw and processed materials such as concrete, steel, imported fill and fuel to power construction equipment. As the project is relatively small in size, the quantities of different materials required for construction would not be significant and would be able to be sourced within the region. Apart from flyash in concrete, the opportunity to use recycled material in construction would be limited as the replacement bridge and approach roads would have higher quality specifications that typically required as they would have to withstand regular immersion by flood waters. The use of recycled material in the replacement bridge may increase its chance of failure or deterioration due to risks of inconsistencies in the quality of recycled materials.

The only recycled material that would be used during construction would be the imported fill (about 10,800 cubic metres). Where possible, suitable fill material may be sourced from another construction project which has excess spoil.

Table 7-52 Type and management of waste materials generated during construction

Material	Management
General office waste – These would include paper, food packaging, food scraps and other general waste.	Where possible, recyclable material would be separated and sent to recycling facilities. Non-recyclable waste would be classified and disposed of at an appropriately licensed facility.
Vegetation – Removal of small areas of existing vegetation would be required.	All woody vegetation such as trees would be mulched and reused either on site for landscaping or sent to recycling facilities. Weeds would be bagged and sent to landfill.
Concrete – Small volumes of excess concrete would be generated from the construction of the replacement bridge and structures. Also the demolition of existing kerbs and other concrete structures may generate small volumes of concrete	Any excess concrete would send off-site to a licensed concrete recycling facility.
Steel - Small amounts of excess steel reinforcement would be generated from the construction of bridge and structures	All excess steel would be sent off-site to a licensed steel recycled facility.
General construction waste – This would consist of bags, packaging, off-cuts and other general waste generated by construction activities	Where possible, recyclable material would be separated and sent off-site to licensed recycling facilities. Non-recyclable waste would be classified as General Solid waste and disposed of at an appropriately licensed facility.
Special construction waste – This would include batteries, waste oil and containers and other potentially hazardous materials	Where possible, recyclable material would be separated and sent to recycling facilities. Non-recyclable waste would be classified as per the Waste Classification guidelines and disposed of at an appropriately licensed facility.

7.6.4 Demolition impacts

Soil and water

Demolition and removal of the existing bridge would also present a potential risk to the water quality of the river. The demolition of the existing bridge would take place after the opening of the replacement bridge.

Removal of the bridge deck and piers would involve cutting these bridge elements into discrete sections, lifting the sections out by crane and placing them on trucks for transportation to a disposal facility. The demolition activities could potentially result in rubble and debris entering the river and disturbance of the river bed material. Appropriate management measures would be in place to avoid adverse impacts on the river's water quality such as increased turbidity.

Acid sulphate soils

Acid sulfate soils may be present in the river sediments adjacent to the existing bridge. If they are present there they may also be in the hollow piers of the existing bridge and may be brought to the surface during the demolition of the existing bridge. The volume of acid sulfate soils in the piers would be very low. Sampling for acid sulfate soils in the river sediments near the existing bridge has not been undertaken, however would be undertaken before construction commences.

Hazardous materials

The hazardous material audit found that paint samples from the iron piers and iron cross bracings of the existing bridge contained high levels of lead. If during demolition of the existing bridge, this paint was to find its way into the river it could cause aquatic ecosystem, sediment quality and water quality impacts. Environmental management measures would be put in place to avoid or minimise this impact (see **Section 7.6.6**).

Waste management and handling

The existing bridge superstructure and substructure would be removed in sections, with temporary bracing installed, as required, to maintain the stability of remaining sections during the demolition process. Where possible the process of demolition would involve cutting the superstructure and substructure into sections, with each section transported off-site for further processing at a licensed facility. This approach would minimise environmental impacts, such as noise, dust, disturbance of roads and contamination of the river.

Bridge materials resulting from the demolition would be recycled where possible. Metals that have the potential to be reused include the iron piers, railings and the service conduits. Lead-based paint has been identified on some metal elements of the existing bridge and would need to be removed before recycling or reuse of materials. Any lead based paint removed from the metal elements of the existing bridge would be likely to be classified as hazardous waste under the Waste Classification Guidelines and would require disposal at an appropriately licensed facility. The concrete sections of the existing bridge would be sent to a concrete recycling facility – where it would be crushed and sold as temporary road base or for other uses. Up to 2000 tonnes of concrete would be generated from the demolition of the bridge.

Some material from the bridge demolition may not be able to be recycled and would require classification and disposal at an appropriately licensed landfill.

Other aspects

The demolition of the existing bridge would not result in any significant impacts or risks to groundwater and contamination.

7.6.5 Operational impacts

Soil and water

During the operational phase of the project, the approach roads and bridge would be sealed, cleared areas landscaped and scour protection installed. There would be no exposed topsoil and therefore little or no risk of soil erosion and transport of eroded sediments to the river. Water quality risks during operation would instead be associated with the runoff of pollutants from the new road surface, with pollutant sources including atmospheric deposition, vehicles and litter from motorists. Pollutants deposited onto road surfaces by vehicles typically include:

- Hydrocarbons and combustion derivatives.
- Lubricating oil.
- Rubber.
- Heavy metals such as lead, zinc, copper, cadmium, chromium, and nickel.
- Brake pad dust and potentially asbestos from older brake pads.

These deposits build up on road surfaces and pavement areas during dry weather and would be washed off and transported to waterways during rainfall periods. Other pollutants in the atmosphere, such as nitrogen, that are derived from local and regional sources would also be deposited and build up on the road pavement and contribute to operational impacts on water quality.

Pollutants deposited by motorists, such as non-biodegradable garbage and food wastes, could also impact water quality, amenity and aquatic conditions during operation of the project by washing into downstream watercourses.

During the operation there would also be a risk of accidental spillage of petroleum, chemicals or other hazardous liquids as a result of vehicle leakage or road accidents on the new bridge or approach roads. Although the likelihood of a potential spill would be low, the consequence to the environment could be considerable as spills of this nature would pollute the river if unmitigated.

The design of the project has considered these potential impacts and water quality control measures have been included for both the southern and northern drainage systems. These are described in greater detail in **Section 7.6.7**. As the existing bridge and approach roads do not have any water quality control measures, the provision of water quality control measures for the project would result in an improvement in stormwater quality discharged from the project and a reduction in the likelihood that spills or leaks of fuels from road accidents would find their way into the river.

Waste management and handling

During operation of the project, small quantities of waste would be generated and would potentially include spills and leakages from vehicles, litter generated by road users and sediment from the water quality control basin. In addition, small quantities of waste would be generated from road maintenance and repair activities. The volume of operational waste would be minor and would be classified and disposed of at an appropriately licensed landfill.

Other aspects

The operation of the project would not result in any significant impacts or risks to groundwater, contamination, hazardous materials and/or acid sulfate soils.

7.6.6 Environmental management measures

Construction

Soil and water

Potential impacts to soil, sediment and water from the project's land-based construction activities will be mitigated and managed by implementing local erosion and sediment controls. An erosion and sediment control plan will be developed during detailed design in accordance with Managing Urban Stormwater – Soils and Construction - Volume 1 (Landcom, 2004) and Volume 2D (DECC, 2008). The detailed erosion and sediment control plan will incorporate erosion control measures to limit the movement of soil from disturbed areas, and sediment control measures to remove any sediment from runoff prior to discharge into the river.

Appropriate measures will be implemented to contain any turbid water by applying best management practices such as silt curtains or similar. The Soil and Water Management Plan which will include the erosion and sediment control plan for land-based construction works, will also include environmental management measures to minimise the impacts of water based construction activities.

Development and implementation of a water quality monitoring program will also assist in identifying water quality issues during construction and assessing the effectiveness of mitigation measures. The water quality monitoring program will be developed during detailed design, covering pre-construction, construction and post-construction phases, and in accordance with the RMS Guideline for Construction Water Quality Monitoring (RTA, no date).

Contamination

While no contaminated soils or materials were found in the project area from the Phase 2 investigations, unknown contaminated soils and material may be encountered during construction. The following environmental management measures will be implemented to address this risk:

- During excavations, soil and fill material will be visually monitored to identify potential contaminated material or soils.
- If potentially contaminated material or soils is suspected additional investigations and monitoring will be undertaken.
- If it is confirmed that contaminated material or soils are present on site immediate measures will be put in place to ensure worker safety and protection of the environment. An appropriate investigation and remediation plan will be developed and implemented.
- All fuels and chemicals will be stored and used in compliance with appropriate guidelines and standards. A spill management procedure will be developed and implemented, if required.

Waste management and handling

The following environmental management measures will be implemented to minimise the impact of waste generation:

- Detailed waste management measures and procedures would be included in the CEMP for the project.
- Waste management measures would be based upon the philosophy of reduce, reuse, recycle and appropriate disposal.
- The project induction would cover waste management measures in the CEMP.
- All waste material requiring off-site disposal would be classified using the Waste Classification Guidelines and disposed of at an appropriately licensed facility.
- Procurement and waste management strategies would be based upon the philosophy of reduce, reuse, recycle and appropriate disposal.
- Where applicable, waste that will be re-used will comply with the conditions attached to EPA resource recovery exemptions for specific materials (e.g recovered aggregates, excavated public materials, excavated natural material exemptions).

Acid sulfate soils

The following environmental management measures will be implemented during construction to minimise the impact of acid sulfate soils.

- Further acid sulfate soils investigations would be undertaken during detailed design of the project.
- If the presence of ASS is confirmed in the river sediment, an ASS management plan would be developed and implemented. The plan will detail the management, handling, treatment and disposal of ASS and will be prepared in compliance with the Acid Sulfate Soils Assessment Guidelines (ASSMAC, 1998) and the Guidelines for Managing Acid Sulfate Soils (RTA, 2005).

Groundwater

Monitoring of groundwater at piezometers installed for project and the adjacent groundwater bore will be undertaken to identify any impacts during construction. If any impacts on groundwater levels or quality are detected, the potential cause and environmental management measures will be identified and developed.

Other aspects

The construction of the project does not require environmental management measures for hazardous materials.

Demolition

Soil and water

Environmental management measures that will be implemented during demolition of the existing bridge will include:

- Cutting and removing the existing bridge in large sections and transporting them from the site for demolition and recycling or disposal in a licensed facility. By cutting the bridge into large sections the amount and risk of debris falling into the river is reduced.
- Preventing falling debris and rubble entering the river.
- Containing any disturbance or turbidity by installing self-containment equipment such as silt curtains.
- Monitoring water quality in the river in accordance with the RMS Guideline for Construction Water Quality Monitoring (RTA, no date) to assess the effectiveness of water quality mitigation measures.
- Scheduling demolition activities to avoid or minimise works taking place during times of higher rainfall and river flows.

Acid sulfate soils

The following environmental management measures will be implemented during construction to minimise the impact of acid sulfate soils.

- Acid sulfate soils investigations will be undertaken before construction in the area around the existing bridge.
- If the presence of ASS is confirmed in the river sediment near the existing bridge, an ASS management plan will be developed and implemented. The plan will detail the management, handling, treatment and disposal of ASS and will be prepared in compliance with the Acid Sulfate Soils Assessment Guidelines (ASSMAC, 1998) and the Guidelines for Managing Acid Sulfate Soils (RTA, 2005).

Hazardous materials

Any demolition of bridge structures containing lead based paints will be undertaken in accordance with the following:

- Australian Standard AS 4361.1 – 1995, Guide to lead paint management, Part 1: Industrial applications
- Australian Standard AS 4361.2 – 1998, Guide to lead paint management, Part 2: Residential and commercial buildings
- Australian Standard AS 2601 – 2001, The demolition of structures.

The options for the management of lead based paints during the demolition of the existing bridge structure (based on the respective Australian standards) are as follows:

- Containment – this option will involve the implementation of a high level of containment to prevent dust and debris spreading beyond the immediate works site during demolition.
- Paint stabilisation – paint stabilisation will require the existing surfaces to be stabilised with another non-hazardous covering. During both stabilisation and structure removal, a moderate level of containment will be required.
- Paint removal – paint removal will require the existing painted surfaces to be removed prior to demolition. During paint removal, a high level of containment will be required. Little to no containment will be required to manage the demolition of the structure following removal of the lead based paints.

The preferred option for management of lead based paints and the associated mitigation measures will be identified during the construction and demolition planning process. The demolition plan for the existing Windsor bridge would include the details on the reuse, recycling and/or disposal of the demolished components.

Waste management and handling

The following environmental management measures will be implemented to minimise the impact of waste generation:

- Detailed waste management measures and procedures will be included in the CEMP for the project.
- Waste management measures will be based upon the philosophy of reduce, reuse, recycle and appropriate disposal.
- The project induction will cover waste management measures in the CEMP.
- All waste material requiring off-site disposal will be classified using the Waste Classification Guidelines and disposed of at an appropriately licensed facility.

Other aspects

The demolition of the existing bridge does not require environmental management measures for risks to groundwater and contamination.

Operation

Soil and water

Operational impacts to water quality would be managed by the use of water quality control devices incorporated into the project's drainage design. These are described below. The water quality controls will remove pollutants from stormwater runoff generated by the new bridge and approach roads, and will provide a mechanism for capturing any accidental spills of hazardous liquids that may occur.

Southern outlet

The southern stormwater outlet will be located about 25 metres east of the southern abutment of the replacement bridge. The catchment area for the southern stormwater system will include the southern road approach between George Street and the southern bridge abutment as well as reconstructed areas of The Terrace. There is very little available space to provide a conventional water quality treatment device, such as an in-line gross pollutant trap due to existing development and the proximity of The Terrace to the river's southern bank. Also as The Terrace may contain undiscovered archaeological sites, minimising excavation in this area would avoid potential impacts.

Instead an end of pipe net type gross pollutant trap connected to the stormwater outlet will be provided. A photograph of an example in operation is provided in Soil, sediments, water and waste working paper (Volume 4 – Working paper 7). The net will collect gross pollutants (litter) contained in stormwater runoff, preventing them from entering the river and causing a decline in the river's visual amenity and water quality. The net will be emptied on a regular basis by RMS or Hawkesbury City Council to ensure it continues functioning as intended.

To mitigate against potential spills of hazardous liquids, a lockable shut-off valve will be provided at a stormwater pit immediately upstream of the outlet. In the event of an accidental spill, the shut-off valve will be closed manually by RMS or the NSW Fire Brigade Emergency Response Team. Any accidental spill will then be contained within the stormwater system and prevented from entering the river. The spill will then be removed from the stormwater system and appropriately disposed of before reopening the shut-off valve.

Northern outlet

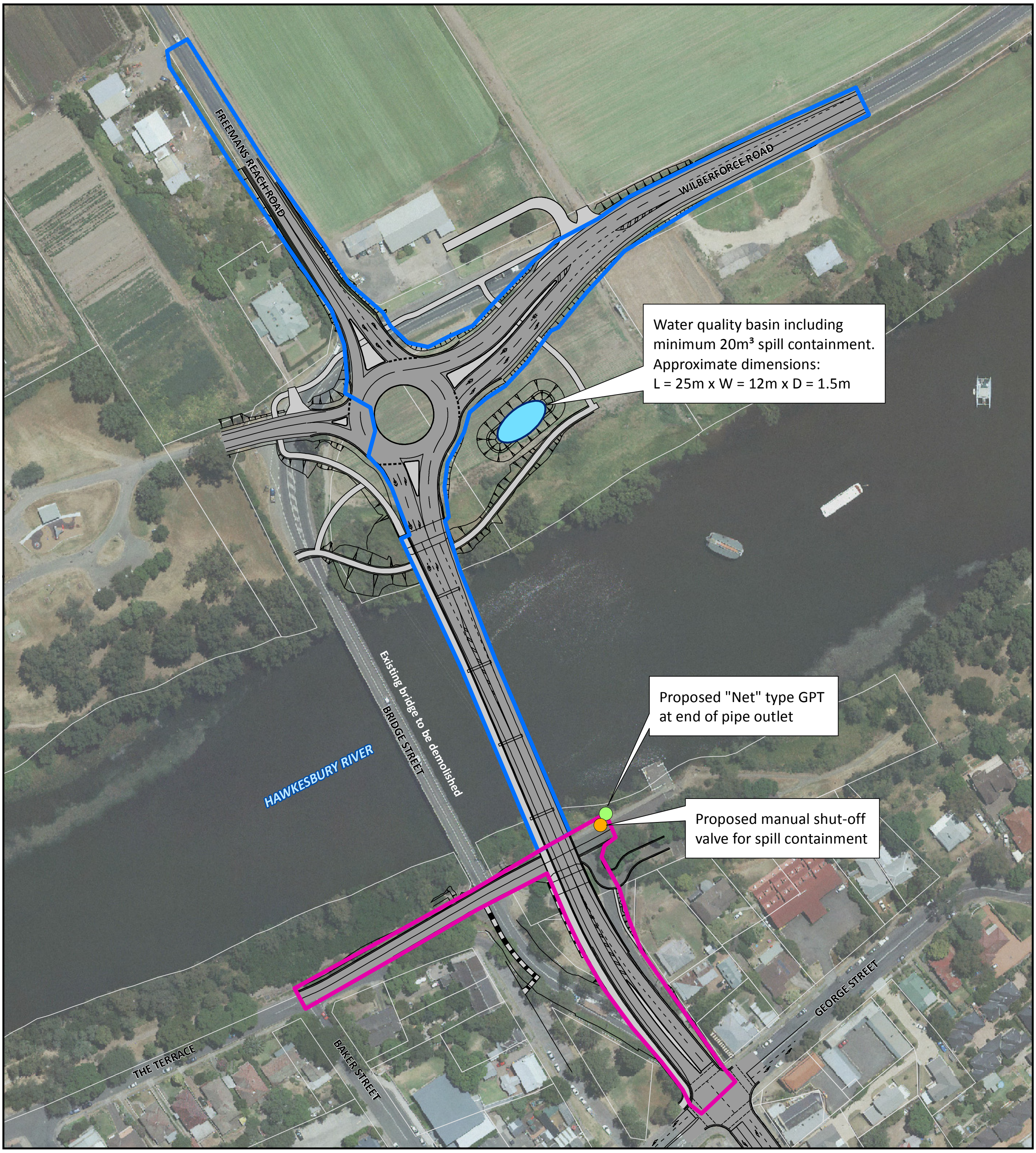
The northern stormwater system will discharge into a permanent water quality basin near the south eastern corner of the new roundabout on the northern bank. The basin will remove suspended solids and gross pollutants from stormwater runoff before discharging to the river. The basin's dimensions will be about 25 metres long, 12 metres wide, and 1.5 metres in water depth. The size of the basin will be refined during detailed design. Regular maintenance by RMS or Hawkesbury City Council will be undertaken to remove sediment and other captured pollutants from the basin.

The basin will be fitted with an underflow baffle arrangement to provide accidental spill capture and containment for a minimum volume of 20 cubic metres. The baffle will prevent hazardous liquid spills from entering the river during dry weather and smaller more frequent rainfall events. Any captured spills will be removed from the basin and disposed of appropriately.

Other aspects

The operation of the project does not require environmental management measures for risks to groundwater, hazardous materials, contamination and acid sulfate soils.

Figure 7-36 | Proposed operational phase water quality controls



Indicative only – subject to detailed design

LEGEND

Concept design

Cadastral boundary

Effective catchment areas

Northern catchment

Southern catchment

Site

WQ basin

Proposed GPT

Proposed shut-off valve

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Metres

AUSIMAGE SKM