



Chapter 16.0 - Planning for Environmental Management

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16.0 Planning for Environmental Management

This EAR has assessed the key environmental elements associated with the proposed KBP in accordance with the ToR. The analysis of each environmental element involved the definition of the environmental concern (usually via the legislative requirements for that element); a description of the existing environment in the KBP corridor and associated study area for that element; an assessment of the possible impacts of the construction of the KBP and strategies to mitigate those impacts.

This assessment identified that the preserved KBP corridor is generally ecologically disturbed. Although potential impacts have been identified associated with the construction of the proposed KBP, all identified impacts are able to be managed through the implementation of the recommended measures outlined in this EAR. The potential impacts identified relate predominately to flora and fauna, visual and community amenity and noise. It is important to note that no impacts have been identified that will obstruct the KBP planning study advancing to subsequent phases.

This chapter is a collation of the impacts and mitigations measures identified in each chapter of the EAR. This chapter is not intended to provide an analysis of the environmental issues presented here, for such detail refer to the relevant chapter in the EAR. This collation of environmental issues is designed to serve as the basis for the development of Environmental Management Plans (EMP) for future stages of the project.

Environmental issues are collated here by their environmental element with reference to the project phase to which they and their mitigation strategies apply. They are also given a reference number to assist with tracking throughout the life of the project as it progresses from this stage.

16.1 Surface Water

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
WQ.01	Design	Change in frequency of hydrologic and water quality disturbance to aquatic ecosystems as a result of increased hardstand area and road-based pollutant loads.	Implement, where practicable, the regional standards imposed by the <i>WSUD Action Plan</i> (part of the <i>South East Queensland Healthy Waterways Strategy 2007-2012</i>). This may include gross pollutant traps, grassed swales and buffer strips, sedimentation basins, bioretention basins and/or constructed wetlands (subject to availability of space within the KBP corridor). Particular areas of focus for WSUD implementation should be those that intercept road runoff water before it enters Cubberla and Moggill Creek tributaries and the Kingfisher Park drainage line. There is high value and good opportunity to implement a succession of WSUD measures along the drainage line in Kingfisher Park given the availability of space, recreational land use and the fact that a large proportion of corridor runoff will drain to this location.
WQ.02		Disturbance to creek bed and banks, particularly at the crossing of the Kingfisher Park drainage line and Moggill Creek.	Avoid the use of in-stream structures where practicable. If these cannot be avoided, utilise structures that minimise afflux and localised scouring, e.g. by positioning pylons away from creek bed and banks.
WQ.03	Construction	Increased turbidity and suspended solid loads in Cubberla and Moggill Creeks and the Brisbane River as a result of earthworks, uncontrolled discharge of wash-down waters and bridge/drainage works.	<p>The following measures are to be included in the EMP (C), as a minimum, to manage on-site EDS control during construction:</p> <ul style="list-style-type: none"> • design of EDS control structures to be consistent with the <i>Soil Erosion and Sediment Guidelines for Queensland Construction Sites</i> (IEAust 1996) and/or <i>Best Practice Erosion and Sediment Control</i> (ICEA Australasia, November 2008); • schedule/stage construction works to minimise the area of exposed soil at any one time and to ensure that vegetation clearing and earthworks are carried out during low rainfall periods; • develop and implement site-specific EDS Control Plans in accordance with relevant standards and guidelines for construction activities that pose unacceptable risk of uncontrolled off-site discharge (e.g. bridge and drainage works); • vehicles and equipment to be washed in designated wash-bay areas that are appropriately contained and the water treated before discharge; • where possible all material stockpiles and storage areas are to be located a minimum distance of 30 metres from waterways and drainage lines; • if a soil stockpile is to be stored for a period greater than two weeks it is to be treated with cover of mulch, hydromulch and/or jutemat; and

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
			<ul style="list-style-type: none"> • revegetation measures or a stabilised surface on exposed areas shall be established as soon as practicable.
WQ.04		Increased hydrocarbon content in Cubberla and Moggill Creeks and the Brisbane River from accidental oil and fuel spillages and/or leakage from machinery and on-site oil and fuel storage areas.	<p>The following measures are to be included in the EMP (C), as a minimum, to manage on-site fuel and oil storage and spill response/prevention during construction:</p> <ul style="list-style-type: none"> • ensure machinery is appropriately maintained; • ensure spill response equipment is readily accessible; • equipment refuelling should be carried out in a bunded area or off-site; and • specify work procedures for on-site spill response, site remediation and equipment refuelling.
WQ.05	Construction	Changes to existing water quality.	<p>It is recommended that water quality monitoring:</p> <ul style="list-style-type: none"> • commence approximately six weeks prior to the commencement of construction; • focus on sites located at accessible locations downstream and upstream of the KBP influence along Cubberla and Moggill Creeks, and downstream of the Kingfisher Park drainage line (upstream monitoring will not be possible due to its location within the alignment); • adopt “no-worsening” water quality performance criteria for upstream verse downstream values as a result of construction activities; • ensures waters requiring discharge from site meet the minimum requirements specified in Table 3.5; and • conduct event-based monitoring when rainfall exceeds 25 mm in a 24 hour period.
WQ.06	Operation	<p>Increase in contaminants including copper, lead, zinc and petroleum derivatives from:</p> <ul style="list-style-type: none"> • vehicle emissions; • vehicular wear; • atmospheric fallout; • pavement degradation; and • road maintenance. 	Effective implementation and maintenance of WSUD measures in accordance with design objectives in the Healthy Waterways’ WSUD Action Plan (see WQ.01).

16.2 Ground Water

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
GW 01	Design	Wells currently drawing on the aquifer or other significant human and environmental receptors impacted by groundwater contamination.	<p>Further assessment could be undertaken to determine existing wells or other significant human and environmental receptors that may be impacted by the construction and operation of the KBP. Assessment may include:</p> <ul style="list-style-type: none"> conducting a census for potential unregistered groundwater wells located within 250m radius of locations where dewatering is to be undertaken; identifying any surface water bodies sensitive to groundwater movement (i.e. dams); and identifying all local users of groundwater resources within a one kilometre radius of the preferred alignment. This would include any potentially significant ecological areas.
GW 02	Design	Impacts to the groundwater flow, quality and quantity.	<ul style="list-style-type: none"> limiting or eliminating the need for dewatering during construction; avoiding contaminated sites or PASS; limiting the depth of excavation in the alluvial areas near the creeks; considering the significance of environmental receptors and groundwater flow impacts in areas proposed of significant compaction, and consider alternatives, such as bridges; and protecting water quality that may infiltrate groundwater via WSUD (detailed in Chapter 3 -Surface Water). <p>Establishing a pre-construction groundwater monitoring program would enable monitoring of the success of these mitigation measures.</p>

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
GW 03	Construction	Clearing of access roads and the new road itself can alter groundwater recharge, introduce pollutants and increase sediment runoff.	<p>Minimise disturbance and control run off from construction areas.</p> <p>Store all potentially hazardous chemical materials in accordance with AS/NZS 4452:1997 and 1596:2008 and AS 1940-2008.</p> <p>Implement an effective erosion and sediment control plan.</p>
GW 04	Construction	Compaction can result in reduced groundwater recharge and can act as a barrier to shallow groundwater flow in shallow groundwater areas. It can also drive contaminated groundwater out of fill or ASS. Surface compaction is a necessary and common construction activity in the construction of a new section of road. As such, this is expected to occur along the entire alignment.	<p>Identify all contaminated or potentially contaminated sites within the study area, avoiding disturbance of such sites and those identified as having PASS.</p> <p>Consider alternatives to significant compaction, such as bridges.</p> <p>Minimise, where possible, the extent and degree of all compaction activities.</p>
GW 05	Construction	Excavation of road cuttings can alter the groundwater recharge and alter the permeability of the subsurface. It can also decrease the depth that surface contaminants need to traverse to affect groundwater. Fill placement for road construction can reduce recharge and can impact on water quality if the fill is contaminated.	<p>As groundwater levels measured within 500m of the alignment are approximately 10-15m below ground level, significant cuttings would be required before potential consequences to groundwater would be significant. Further investigation of the local hydrogeology would be required to understand and mitigate impacts in this case.</p> <p>Groundwater quality and level monitoring as appropriate to assess the performance of the mitigation measures.</p>

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
GW 06	Construction	<p>Cuttings that intersect groundwater may require dewatering. Groundwater levels in the immediate vicinity of the proposed alignment approximately range from 10-20 mbgl and as such, regular encounters with groundwater are not expected. However, cuttings into natural material are anticipated down to a maximum of 13 mbgl (Chainage 3180) and therefore dewatering may be required in specific locations. Significant dewatering of shallow and/or deep aquifers may cause the following impacts:</p> <ul style="list-style-type: none"> temporary lowering of water levels in the nearby surface water features, including stationary and slow moving bodies of water; and temporary lowering of groundwater levels within any registered or domestic wells. 	<p>Limit or eliminate the need for dewatering during construction through design.</p> <p>Significant dewatering, or as considered necessary, should be conducted under specific management strategies, that could include, but may not be limited to:</p> <ul style="list-style-type: none"> estimate surrounding area impacted by dewatering, dependent on anticipated pumping rates, rate of recharge and dewatering requirements; identify all susceptible receptors to groundwater level changes, including both registered and private monitoring wells; subject as few sites as possible to dewatering, with only the minimum required groundwater extracted during each event; contain poor quality discharge water and treat prior to disposal, subject to water quality guidelines being achieved; gauge daily groundwater levels in nearby privately owned (with permission) and registered bore holes; and should groundwater quality in the immediate vicinity degrade, monitor downstream waterways for impacts. Corrective action may be required and a long term management plan should be implemented until groundwater quality returns to background levels.
GW 07	Construction	<p>The disturbance of contaminated soils in the construction of a road can release contaminants that may mobilise into groundwater. ASS can also become oxidised via construction disturbance, including filling, and can result in the generation of acidic groundwater.</p>	<p>Identify all contaminated or potentially contaminated sites within the study area, avoiding disturbance of such sites and those identified as having ASS potential.</p> <p>Address ASS management, where necessary.</p> <p>Implement appropriate measures if constructing through contaminated sites. Refer to Chapter 8 Topography, Geology and Soils for further details.</p>

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
GW 08	Construction	<p>Fuel, lubricant and other chemical spillages from normal construction activities, chemical storage areas, raw material stockpiles, refuelling areas, and as a result of accidents have the potential to contaminate groundwater.</p> <p>Groundwater impacts from spills are particularly likely in areas where surface soils are porous or where recent soil disturbance has created preferential pathways for the infiltration of contaminants down towards the water table. Consequences to groundwater of spillages will therefore be greater in the unconfined alluvial deposits associated with Cubberla and Moggill Creeks.</p>	<p>Handle and store all potentially hazardous chemical materials in accordance with AS/NZS 4452:1997 and 1596:2008 and AS 1940-2008. Appropriately design storage, stockpiling and refuelling areas, and temporary drainage systems.</p> <p>Emergency response plan to deal with any spillages.</p> <p>Ensure good vehicle and machinery maintenance.</p> <p>Use WSUD to protect quality of water that may infiltrate ground water.</p>
GW 09	Operation	<p>Surface water runoff from roads may include contaminants such as PAH, hydrocarbons (fuel, oils and solvents), nitrogen compounds from exhausts, heavy metals and suspended solids. This runoff would be directed through surface water control measures to achieve water quality objectives, so groundwater impacts of runoff will be controlled primarily through these means. Contaminants in runoff are also likely to be attenuated via infiltration through soil horizons, although this will be lessened in high-permeability areas.</p>	<p>Maintenance of WSUD elements.</p>
GW 10	Operation	<p>Groundwater water quality objectives are likely to be controlled via road drainage design for surface water quality objectives.</p>	<p>Response plans to deal with any spillages.</p>

16.3 Hydrology and Hydraulics

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
HH 01	Design	The Moggill Creek bridge may impact the afflux, floodplain volume and drainage in the surrounding areas.	Further investigation will optimise the Moggill Creek bridge opening of the KBP alignment with respect to afflux and costs.
HH 02			Changes to the alignment of the eastern embankment within the Moggill Creek floodplain and the possibility of balancing culverts
HH 03			Investigation of displaced floodplain volume by the eastern embankment adjacent to Moggill Creek on afflux.
HH 04			Development of an understanding of the existing drainage of the area in the vicinity of the western abutment/embankment, and incorporation of a design to facilitate an effective drainage solution and fauna passage.
HH 05	Design	Afflux and/or increased scour potential along Cubberla Creek.	Further investigation of the impact of the KBP alignment on Cubberla Creek.
HH 06			Simple hydraulic calculations or modelling of the KBP structure at the point of Cubberla Creek crossing.
HH 07	Design	Worsening/interception of existing surface water drainage regime and suitable capacity/standard of new drainage networks.	New drainage works or modifications of existing drainage systems should be done in a manner that does not cause a worsening of the existing drainage regime on downstream owners and property.
HH 08			New outfalls should meet the requirements of QUDM Chapter 3.02 – Lawful points of discharge.
HH 09			Increases or decreases in peak discharges should be evaluated for their potential downstream impacts. The discharge impact assessment should include the change in the physical flow regime, changes to the environment including frequency of flow, pollutant loads, sedimentation, and the legal consequences of the increase in discharge at the inlet and outlet.
HH 10			Surface flows that are concentrated by an open channel or conduit should be controlled prior to discharge on a downstream system or owner. Concentrated flows should be dissipated by the use of detention or energy dissipaters.
HH 11			Outfalls that connect to existing culverts and pipe networks should include an analysis of the capability of the existing system to convey new flows. When required, detention should be provided to minimise the risk of surcharging an existing downstream system.

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
HH 12			Drainage systems should be designed following the standards outlined in the <i>Road Drainage and Design Manual</i> and QUDM.
HH 13			Maintain separation between off-site surface water run-off and roadway drainage to minimise the size and volume of detention and treatment.
HH 14			Convey existing flows, trapped against the KBP, by an open channel to a culvert under the KBP to discharge into a nearby creek.
HH 15			First flush run off provided for in pavement surface drainage networks.
HH 16	Design	Release of gross pollutants in surface water flows discharging directly into nearby creeks.	Provision of hydrodynamic oil/grit separators or Gross Pollutant Traps (GPT) at surface water outfalls prior to discharge into creeks.
HH 17	Design	Release of hydrocarbon contaminants into nearby waterways.	Provision of oil spillage containment for 40,000 litres in detention or sedimentation ponds. Space is available to the south of the KBP at the base of the batter slopes by the Gem Road – Moggill Creek crossing.
HH 18	Design	High velocity run-off in open channels from the Moggill Road intersection.	Minimise slopes and provide adequate vegetation in the channels. If necessary, small check dams may be provided to flatten grades and minimise velocities.
HH 19	Design	Climate Change	Design of structure over Moggill Creek to consider climate change effects.
HH 20	Construction	Impingement on the Moggill Creek channel and adjacent floodplain.	Avoid, where possible, constructing new features (i.e. piers) in the main channel of Moggill Creek.

16.4 Fauna

Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
FA 01	Construction	Habitat loss	Drainage and fill of wetland in Section E	Employ species specific mitigation measures discussed in Section 6.4.1 for <i>Ardea alba</i> , <i>Ardea ibis</i> and <i>Rallus pectoralis</i> .
FA 02	Construction		Disturbance to the drainage lines in Section A and B	Employ species specific mitigation measures discussed in Section 6.4.1 for <i>Adelotus brevis</i> to the extent practical given the constraints of the narrow corridor.
FA 03	Construction		Removal of <ul style="list-style-type: none"> • 2.5ha at Section A; • 3.1ha at Section C; and • 0.5ha at Section E 	Minimise vegetation clearance and revegetate progressively with local provenance using a mosaic rehabilitation scheme (i.e. mixed vegetation community, age and structure).
FA 04	Construction			In accordance with MRS11.51 Clause 10.9.1, make use of already cleared areas i.e. the pony club and park area (Section D and B), for construction equipment and office sites.
FA 05	Construction			Minimise disturbance and clearing along Moggill Creek.
FA 06	Construction			In accordance with MRS11.51 Clause 10.9.1, logs, hollow logs, boulders, small trees and shrubs to be retained under bridges where possible, to provide protection for fauna movement along Moggill Creek or in hold points to create shelter habitat for terrestrial fauna.
FA 07	Construction			Construct the KBP in planned stages/phases (stage clearing works): <ul style="list-style-type: none"> • do not remove all vegetation within the area at the same time; and • allow remaining habitat at Section C (see Figure 6.2) to provide continuous connectivity to Rafting Ground Reserve. Revegetate as necessary.

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
FA 08	Construction			<p>Develop a <i>Compensatory Habitat Program</i>:</p> <ul style="list-style-type: none"> • undertake a field visit to identify suitable existing areas for rehabilitation; • Rafting Ground Reserve (BBC owned) is an ideal location; • vegetate disturbed areas with local provenance, including species with a high food resource value (nectar and fruit); • where feasible, juvenile woody plants should be transplanted to the site; • mount artificial hollows (three for every one removed - standard best practice) to mature native trees to compensate for any hollows lost during clearing activities; • develop and undertake a weed and pest species management program to remove noxious weeds from area; • coordinate with the local catchment management group to undertake vegetation protection of the area; • initiate a monitoring program on a yearly basis to assess the habitat values; and • prepare a report on the findings of the program.
FA 09	Construction	Removal and depletion of food resources	Removal of trees providing nectar and fruit	In accordance with MRS11.51 Clause 10.9.1, minimise vegetation clearance.
FA 10	Construction		Depletion of food resources available in the area	Co-ordinate <i>Compensatory Habitat Program</i> to include flora species with a high food resource value (nectar and fruit provision).

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
FA 11	Construction			Revegetate areas disturbed by construction activities with flora species that provide a high food resources value. Ensure the placement of these species does not increase the chance of injury to fauna, eg do not plant food trees directly adjacent to the KBP.
FA 12	Construction	Removal of nesting and breeding sites	Removal of mature trees	Minimise the removal of mature native trees where possible, especially those trees greater than 20 metres in height and 0.5 metres in diameter. Notable species are identified in Figure 6.4.
FA 13	Construction			Minimise vegetation clearance and revegetate post construction with local provenance.
FA 14	Construction		Removal of hollow bearing trees	Provide artificial hollows in nearby habitat areas (Rafting Ground Reserve) and/or in conjunction with the <i>Compensatory Habitat Program</i> .
FA 15	Construction			In accordance with MRS11.51 Clause 10.9.2, appoint a registered spotter-catcher to locate nests and tree hollows.
FA 16	Construction			Relocation of nests and hollows found in the KBP corridor to similar vegetation nearby (Rafting Ground Reserve and in conjunction with the <i>Compensatory Habitat Program</i>).
FA 17	Construction			Disturbance and/or removal of nesting trees during the breeding season
FA 18	Construction	Decreased numbers and diversity of aquatic fauna.	Increased bank and bed scour due to the placement of in-stream structures, i.e. bridge pylons and drainage structures	Careful selection of drainage structures to minimise creek bank and bed disturbance (Management Strategy WQ.02, refer to Chapter 5, Hydrology and Hydraulics (FA.01).
FA 19	Construction		Shading causing by the placement of permanent overhead structures, i.e. bridge deck and pylons.	Design bridge deck with minimal width required in order to minimise aquatic shading affects, FA.01 and design a split bridge structure such that the two (2) bridges far enough apart to maximise light penetration.

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
FA 20	Construction	Reduction of the photosynthetic potential for aquatic flora and consequent reduction of habitat and dissolved oxygen levels for in-stream fauna	Increased sedimentation in Moggill Creek due to vegetation clearing and general earthworks	Refer to Chapter 3 Surface Water Quality, WQ.03, incorporating the standard erosion, drainage and sediment control measures specified under WQ.03. Sedimentation effects can also be minimised by flagging-off a 'No-Go' Zones along the riparian area of Moggill Creek within the construction site.
FA 21	Construction	Inhibition of fauna movement/ disruption to wildlife corridors	Construction of road, fragmenting Sections B and D	In accordance with MRS11.51 Clause 10.9.1, minimise vegetation clearance and progressively revegetate disturbed areas.
FA 22	Construction		Construction of bridge across Moggill Creek; disrupting movement of fauna along riparian strip	Retain /improve the fauna corridor along Moggill Creek.
FA 23	Construction			Incorporate fauna-friendly bridge design: <ul style="list-style-type: none"> • design to consider two bridge structures spaced appropriately apart with bridge clearance heights to allow for fauna-friendly passage; • bridge to allow for a dry passage route to allow access to traversing terrestrial fauna; and • revegetate under bridges with understory brackish-tolerant flora species.
FA 24	Construction	Injury to fauna	Direct loss or injury during intensive construction activities	Implement fauna exclusion devices to discourage species from entering the construction site.
FA 25	Construction			In accordance with MRS11.51 Clause 10.9.3, monthly reporting of any fauna injuries or deaths as a result of construction activities and initiate additional mitigation measures if required.
FA 26	Construction			Indirect loss or injury through use of materials/ equipment potentially hazardous to fauna

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
FA 27	Construction	Spread of introduced pest species	Drainage of wetland and potential spread of <i>Gambusia</i> spp.	When the wetland is drained ensure all <i>Gambusia</i> spp. are euthanized (heavy fines apply if kept or moved).
FA 28	Construction		Potential spread of fire ants	<p>Ensure an Approved Risk Management Program be prepared by the contractor and submitted to DPIF for approval prior to construction activities commencing and ensure it is strictly enforced:</p> <ul style="list-style-type: none"> • a site inspection must be conducted by a DPIF Inspector or Approved Person prior to moving or disturbing any soil; • businesses must not move <i>S. invicta</i> infested material outside the restricted area without the approval of a DPIF Inspector and only to approved disposal sites within a restricted area. Infested soil may only be moved to a DPIF Approved Disposal Site; • all high risk materials must be treated before being moved out of the restricted area; • materials not infested with <i>S. invicta</i> may be disposed within the restricted area using approved disposal sites only; • a business must have an ARMP or use a Fire Ant Declaration (FAD) form to move high risk materials (unless otherwise exempted or directed); and • all materials moved from within the restricted area must be accompanied by a Movement Certificate or FAD Form.
FA 29	Construction	Waterway habitat degradation	Erosion and runoff along banks of Moggill Creek due to removal of vegetation and potential for exposed soil surfaces	Hydromulching or matting earthwork areas.
FA 30	Construction			Do not remove vegetation along creek (preferably within 10m) and minimise vegetation clearing within close proximity to Moggill Creek.

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
FA 31	Construction	Disturbance to fauna	Construction activity within the corridor	Ensure storage of equipment and machinery is located on already disturbed areas. Where practicable areas outside the footprint should not be disturbed for these purposes.
FA 32	Construction			Ensure any waste material is disposed of properly.
FA 34	Operation	Injury to fauna	Road strikes	Install fauna exclusion fencing where appropriate.
FA 35	Operation			Don't plant habitat trees adjacent to the KBP.
FA 36	Operation			Install signage warning users of the potential for fauna crossing.
FA 37	Operation	Waterway habitat degradation	Runoff from roads and banks created by the raised road sections	Incorporate a filtration system into the drainage design in order to minimise pollutants entering Moggill Creek.
FA 38	Operation			Revegetate banks of raised road.
FA 39	Operation			Revegetate creek banks with local provenance.
FA 40	Operation	Reduced aquatic habitat quality	Increased concentrations of motor vehicle pollutants in Moggill Creek due to motor vehicle use on the newly constructed road	Refer to Chapter 3, Surface Water Quality, WQ.04, for maintenance of water sensitive urban design (WSUD) measures in accordance with design objectives in the Healthy Waterways' WSUD Action Plan.
FA 41	Operation	Spread of introduced pest species	Spread of weed species along transport corridor by passing vehicles	Monitoring and management of weed species to be implemented.
FA 42	Operation	Failure of mitigation measures	Lack of ongoing maintenance for mitigation measures	Monitoring regime as prescribed for <i>Compensatory Habitat Program</i> and the artificial wetland.
FA 43	Operation			Continued collaboration with local catchment groups.
FA 44	Operation			Maintain revegetated areas.
FA 45	Operation			Maintain wildlife proof fencing.
FA 46	Operation			Ongoing monitoring of local fauna and mitigation success.

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16.5 Flora

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
FL 01	Design	Loss of threatened flora species	The alignment, where possible, to avoid directly impacting the identified populations of <i>L. brisbanica</i> on the banks of a small tidal tributary of Moggill Creek.
FL 02			Positive identification to species level of the <i>Macadamia</i> species located in Section A and confirmation of a cultivated or naturally occurring specimen.
FL 03			Minimise the construction footprint by using a bridging structure rather than fill to cross the Moggill Creek flood plane, thereby avoiding excessive shading.
			Transplanting trials, to determine rates of successful cultivation, should be conducted prior to construction where populations of <i>L. brisbanica</i> cannot be retained in their current locations. A suitable, tidal site for transplanting will also need to be found in consultation with the DPIF as the lead state government agency responsible for the management and protection of all marine plants and the EPA, as the administering authority for the NCA.
FL 04	Design	Clearing of marine plants.	All marine plants are protected through the provisions of the <i>Fisheries Act 1994</i> . Clearing of marine plants, including plants in tidal areas, requires a Fisheries Development Approval from DPIF. It will be necessary to negotiate with DPIF to determine a suitable location and area for any compensatory works.
FL 05	Construction	Loss of threatened flora species (<i>L. brisbanica</i>).	Implement appropriate erosion and sediment control measures to ensure the area of habitat for <i>L. brisbanica</i> is not adversely impacted by erosive runoff and/or pollutants.
FL 06	Construction	Loss of forest vegetation.	Rehabilitation of wooded areas with native species that are compatible with road operation to replace weed species.
FL 07			Revegetation – significant areas devoid of forest vegetation occur adjacent to the alignment in Section E and Section C. These areas may offer the opportunity for revegetation with locally occurring native species.
FL 08			Cooperation with local conservation initiatives should be considered by way of compensation.
FL 09			Where feasible, seed of native species should be collected locally for use in both revegetation and rehabilitation.

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
FL 10			Collecting and propagating the seed of <i>A. precatorius</i> for use in rehabilitation and revegetation.
FL 11	Operation	Loss of threatened flora species (<i>L. brisbanica</i>).	Implement appropriate pollution control measures to ensure the area of habitat for <i>L. brisbanica</i> is not adversely impacted by erosive runoff and/or pollutants.

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16.6 Topography, Geology and Soils

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
TGS 01	Construction	If ASS or PASS are disturbed by excavation during works, then acid and metal-rich runoff can be generated from stockpiles or from in situ disturbed ASS.	Undertake a geotechnical investigation of the alignment prior to design (including ASS assessment).
TGS 02			Avoiding disturbance of ASS.
TGS 03			Where disturbance of ASS cannot be avoided, develop an ASS management plan as per the <i>Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines v 3.8</i> and the SPP 2.02.
TGS 04			Address ASS management and verification of any ASS management (e.g.: liming on treatment pads).
TGS 05		Suspected or known contaminated land is discovered during any phase of the project.	Further assessment by personnel qualified in contaminated land management will be required.
TGS 06			Fill Material - All fill material imported from offsite is to be procured from a licensed quarrying facility and accompanied by relevant documentation to verify it is contaminant and ASS free.
			All onsite fill material is to be cleared for contamination prior to disturbance and stockpiled in separate, bunded and lined treatment areas where it is to be analysed for contaminants and ASS prior to being reused onsite. All documentation related to fill shall be retained on file by the Construction Contractor.
TGS 07		Construction works causing land contamination.	Ensure good vehicle maintenance.
TGS 08			Appropriate design of storage, stockpiling and refuelling areas and temporary drainage systems. Guidelines on the storage requirements and the adequacy of bunding around stores are provided in Australian Standards AS1940: <i>Storage and Handling of Flammable and Combustible Liquids</i> , and AS3780: <i>The Storage and Handling of Corrosive Substances</i> .
TGS 09	The EMP (C) must acknowledge all identified sensitive receptors within the construction corridor and include a suitable Emergency Spill Containment Plan.		

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
TGS 10	Construction	Site disturbances during construction have a high risk of causing erosion.	Hazardous Materials - The nature, quantity and location of all hazardous material on site should be recorded in a manifest, which is to be maintained on site and updated regularly. Such materials should be stored in clearly designated areas as far as practicable from residences and water courses. Storage areas will consist of a compacted base and bunding to contain spillages and roofing to prevent contamination and infiltration of stormwater.
TGS 11			The Construction Contractor shall nominate a Site Safety Officer and provide an Emergency Response Plan, along with prescribed placarding, hazchem cards and fire extinguishers. Where onsite storage exceeds minor storage limits a permit shall be obtained from the appropriate authority for bulk storage of chemicals, oils and/or petroleum products.
TGS 12			Residual stocks of hazardous materials will be removed from the construction site and returned to an appropriate storage area or disposed of at an appropriate waste facility at the end of construction.
TGS 13			Develop and implement an ESCP for any surface works, embankments and excavation work, water crossings and stormwater pathways.
TGS 14			Allow for regular review and updating of the ESCP on a temporal basis and in reflection of stages of progress during construction.
TGS 15			Minimise disturbance and controlling run-off from construction areas.
TGS 16			Revegetate and mulch progressively as each section of works is completed. The interval between clearing and revegetation should be kept to an absolute minimum.
TGS 17			Coordinate work schedules, if more than one contractor is working on a site, so that there are no delays in construction activities resulting in disturbed land remaining destabilised.
TGS 18			Program construction activities so that the area of exposed soil is minimised during times of the year when the potential for erosion is high, for example during summer when intense rainstorms are common.
TGS 19			Stabilise the site and install and maintain erosion controls so that they remain effective during any pause in construction. This is particularly important if a project stops during the wetter months.
TGS 20	Construction		Keep vehicles to well-defined haul roads, and keep haul roads off sloping terrain wherever practical.

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
TGS 21		Issues that may influence the construction of the project include the competency of founding and sub-grade soils, shrink/swell clays, ease of excavation and soil aggressivity.	Installation of shake down grids at each site entry/exit point.
TGS 22			Cultivate the cut surface to increase infiltration of rainfall and decrease the velocity of water across the slope during rain and therefore reduce erosion.
TGS 23			A geotechnical investigation is required to investigate the soils along alignment and confirm the actual ground conditions.
TGS 24	Operation	Poorly designed or maintained erosion and water quality structures can contribute to erosion.	Maintenance of WSUD/anti-erosion infrastructure.
TGS 25		As per Section 8.2.1, slope instability can also pose a risk to the operation of a road.	Slope stability can be mitigated through design.
TGS 26		Major spillages of fuel or chemicals caused by accidents can contaminate land adjacent to the road.	Response plans to deal with any spillages.

16.7 Noise

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
N 01	Design	Noise impacts from the KBP exceeding the criteria as set per the DMR COP (2008)	Ensuring that the proposed mitigation measures are consistent with the current design.
N 02	Construction		<p>Implementation of noise mitigation measures as per detailed design which may include:</p> <ul style="list-style-type: none"> • Choice of road pavement surface type; • noise barriers; and • individual in-house treatments to dwellings under exceptional circumstances, subject to negotiations with property owners.

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16.8 Air Quality

Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
AQ 01	Design	Changes to modelled levels of pollutants at sensitive receptors due to alterations in gradient or the addition of intersections or interchanges.	Design changes from those proposed.	Re-model the emissions and dispersion characteristics to re-assess impacts on sensitive receptors.
AQ 02				Design to avoid steep gradients and acceleration/deceleration.
AQ 03	Construction	Dust from earthmoving and construction activities carrying to sensitive receptors.	Construction activities.	An adequate dust suppression program needs to be maintained.
AQ 04				Careful scheduling of activities to be planned around known prevailing wind conditions.
AQ 05				Establishing speed limits and regulations for vehicle movement around the site.
AQ 06				Suitable stabilisation of spoil heaps.
AQ 07				Covering haul vehicles bringing fill on or off site.
AQ 08				Maintaining a dust monitoring program and suspending activities pending procedure review if dust levels exceed DMR Guidelines.
AQ 09				Construction
AQ 10	Ensure motorised equipment is operated in optimum regimes for the tasks they are undertaking (i.e. idle cycles etc.).			
AQ 11	Construction	Fumes from refuelling activities.	Construction activities.	Designate refuelling areas.
AQ 12				Define refuelling procedures.
AQ 13				Define and promulgate spill response procedures.
AQ 14	Operation	Air pollution at nearby residences.	Vehicles using the KBP.	Although all air pollutants are expected to be within acceptable limits noise barriers will further minimise the impact on residents of air pollution from the roadway.

16.9 Land Use and Planning

Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
LU 01	Design	Residential Displacement/ Fragmentation: there is a potential for residential communities to be fragmented or displaced as a result of the KBP.	Communities physically fragmented and isolated as a result of the roadway cutting access to parts of the existing community.	Alternative access in design for existing residential areas so that the residents may still access their community.
LU 02			Communities left with a loss of access to transport networks, including public transport, suburban collector roads and local roads.	Alternative access and pedestrian over/under passes in design in existing residential areas so that the residents may still access their community.
LU 03		Interrupted Local Access: local access in the area of the alignment may be interrupted as a result of the operation of the KBP.	Community isolation and disruption through the loss of local access.	Allow for both pedestrian and vehicle under/over passes in the design in existing residential areas so that the residents may still access their entire community.
LU 04			Pedestrian and cycle access interruption due to closure of public access ways.	Provision of appropriate alternative public access ways.
LU 05	Construction	Reduced Residential Amenity: there may be a reduction in the residential amenity as a result of the construction of the KBP.	Increase in ambient noise and vibration and incidental and repetitive noises as a result of the construction of the KBP.	Timely provision of noise attenuation measures for sensitive receivers as defined by the DMR <i>Road Traffic Noise Management -COP</i> (2008). Refer to Chapter 9 (Noise).
LU 06				Implementation of a construction management plan to document and report complaints regarding noise. Refer to Chapter 9 (Noise).
LU 07			Increase in the occurrence of noise and vibrations from heavy construction equipment and construction activities.	Timely provision of noise attenuation measures for sensitive residential receivers as defined by DMR COP (2008). Refer to Chapter 9 (Noise).

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures	
LU 08	Construction			Implementation of a complaints register as part of Construction Management Plan that sets out recording person responsible and action.	
LU 09				Increase in dust pollutants from heavy construction vehicles and construction work	Refer to Chapter 10 (Air Quality).
LU 10					Dust suppression undertaken during dust generating activities.
LU 11					Implementation of a complaints register as part of Construction Management Plan that sets out recording person responsible and action.
LU 12				Loss of visual amenity from the nature of the construction phase.	Keep construction timeframes as short as possible and maintain a tidy worksite with appropriate fencing.
LU 13		Interrupted Local Access: local access in the area of the alignment may be interrupted during the construction of the KBP.	Temporary (and changeable) road disruptions, such as traffic diversions and delays, throughout the entire alignment during the construction phase.	Implementation of a Traffic Management Plan to minimise disturbances through monitoring and management of construction activities.	
LU 14				Keep the local and wider community informed of changes through ongoing community engagement and appropriate notice.	
LU 15				Traffic diversion and delays during construction likely to increase traffic on local roads.	Minimise disturbances through monitoring and management of construction activities.
LU 16				Pedestrian and cycle access interruption during construction due to closure of public access ways.	Provision of appropriate alternative public access ways during construction.
LU 17					Keep the local and wider community informed of changes through ongoing community engagement and appropriate notice.
LU 18	Undertake regular community engagement so as to inform the community of how they will be affected and protected.				

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures		
LU 19	Construction	Reduced Functionality: there is the potential for a negative impact on the functionality of some sites and uses during the construction of the KBP.	Partial and whole property resumptions may cause a loss in the functionality of certain land uses.	Ensure appropriate engagement with affected property owners to minimise the impact on site functionality.		
LU 20			Functional open space currently providing linkages and access ways may be severed during construction	Provision of appropriate alternative public access ways during construction.		
LU 21				Keep the local and wider community informed of changes through ongoing community engagement and appropriate notice.		
LU 22			Changes to Existing Land Uses: the KBP may change several of the existing uses within and adjacent to the corridor.	Changes to the access arrangement for the Kenmore Churches Soccer Club may affect its ability to function as a local, district and city wide formal sport and recreation facility.	Appropriate and well-signed pedestrian and vehicular detours provided during construction phase.	
LU 23					Keep the local and wider community informed of changes through ongoing community engagement and appropriate notice.	
LU 24					Road reserve currently utilised by local community as open space and pedestrian access will be closed to the public removing this informal use.	Undertake regular community engagement so as to inform the community of how they will be affected and protected.
LU 25						Keep the local and wider community informed of changes through ongoing community engagement and appropriate notice.
LU 26			Ensure public safety through restricted access to worksites.			
LU 27		Yarawa Pony Club operating on DMR land is likely be displaced as the operating space will be significantly reduced by the construction of the KBP.	Notification with appropriate lead time of the KBP works to allow the club to re-site its activities.			
LU 28	Operation	Reduced Residential Amenity: there may be a reduction in the residential amenity as a result of operation of the KBP.	Increase in noise levels above DMR's Code of Practice Noise Criteria as a result of the operation of the KBP.	Timely provision of noise attenuation measures for sensitive residential receivers as defined by the DMR COP (2008). Refer to Chapter 9 (Noise).		

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
LU 29	Operation		Increase in the occurrence of vibrations from large volumes of vehicles.	Timely provision of noise attenuation measures for sensitive residential receivers as defined by the DMR COP (2008). Refer to Chapter 9 (Noise and Vibration).
LU 30			Increase in air borne pollutants from vehicles.	Refer to Chapter 10 (Air Quality).
LU 31			Shadowing may occur for residences that are close to large structures.	Refer to Chapter 13 (Landscape and Visual Amenity).
LU 32			Loss of visual amenity for residences from large structures and also from vehicles using the KBP.	Where practicable, utilise strategies to mitigate the visual impact of the road on sensitive receptors.
LU 33		Residential Displacement/ Fragmentation: there is a potential for residential communities to be fragmented or displaced as a result of the KBP.	Communities left with a loss of access to transport networks, including public transport, suburban collector roads and local roads.	Ensure access points are well signed and are easily accessible.
LU 34		Reduced Functionality: there is the potential for a negative impact on the functionality of some sites during the operation of the KBP.	Functional open space currently providing linkages and access ways may be severed	Provision of appropriate alternative public access ways.
LU 35				Keep the local and wider community informed of changes through ongoing community engagement and appropriate notice.
LU 36			Changes to access to the Kenmore Churches Soccer Club may affect its sporting activities.	Appropriate and well-signed pedestrian and vehicular alternative routes provided.
LU 37	Keep the local and wider community informed of changes through ongoing community engagement and appropriate notice.			

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
LU 38	Operation		Loss of land value due to the loss in amenity and potential part land resumptions.	Current Queensland Government policy allows for compensation for directly affected landowners (i.e.: land required for the road corridor) through either hardship or acquisition processes. Notably there is no provision for the payment of monetary compensation to indirectly affected landowners who benefit or are detrimentally affected by Government projects.
LU 39		Changes to Existing Land Uses: the KBP may significantly change several of the existing uses within and adjacent to the corridor.	Loss of the informal use of the road reserve for open space and pedestrian access.	Undertake community engagement prior to construction so as to inform the community of how they will be affected and how they will be protected.
LU 40				Keep the local and wider community informed of changes through ongoing community engagement and appropriate notice.
LU 41			Yarawa Pony Club operating on DMR land will be displaced.	Engagement with appropriate lead time about the KBP to allow the club to re-site its activities.
LU 42		Existing Development Approvals Disrupted: there may be a negative impact on proposed developments within or adjacent to the alignment during the operation of the KBP.	Access to sites with Development Approval may be changed.	Well signed and highly visible alternative access routes to prevent delays to construction on sites.
LU 43		Business Impacts	Potential positive impacts on local business as a result of changed traffic flow.	Minimal impacts are expected from the KBP.

16.10 Socioeconomic

Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
SE 01	Construction	Loss of privacy, visual amenity and loss of security and safety for residential properties adjoining the road construction site.	Construction of road at rear of properties in an area that is currently green space.	Installation of security and screen fencing at the rear of properties adjoining the road construction site.
SE 02		Loss amenity created by uncontrolled parking and construction traffic and storage into a previously quiet residential area.	Uncontrolled parking and construction traffic and storage in the area.	Adequate provision being made for worker parking and construction traffic and storage in areas separate from residential areas where possible. Consultation with the community as to the location of these areas prior to their installation.
SE 03		Resident distress created by impacts of construction activities.	Construction activity impacts such as noise, dust, lighting, hours of operation.	Provision of a hotline/website and communication officer to hear and address community concerns.
SE 04		Major disruption to residents created by the cumulative impacts of multiple road projects and their timing.	Lack of consideration of timing of the KBP project construction with respect to other planned road projects both State and local.	Planning of the commencement of the project take into account the timing and project needs of other road projects in the western Brisbane area.
SE 05		Resumptions adversely affecting the use of residential properties.	Resumptions which cut through existing residential lots.	Design of the road so that areas required for resumption are located on the boundary of affected residential properties rather than through residential lots.
SE 06		Severance of active transport options through bridging of Fig Tree Pocket Road and Kenmore Road.	Bridging design focus upon vehicular traffic and inadequate design focus on active transport options.	Design to provide for safe active transport options as well as vehicular traffic for bridging of Kenmore Road and Fig Tree pocket Road.
SE 07		Splitting of the community into two because of severance of Gem Road.	Due to engineering constraints, Gem Road is severed.	Provision to be made for adequate and safe active transport connections to connect the two areas.

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
SE 08	Construction	Inadequate provision is made for the safe and convenient access safety for residents and visitors to the Brisbane Independent School.	KBP design does not accommodate the access requirements of properties in the vicinity of its connection to Moggill Road.	Adequate provision is made in the KBP design for safe and convenient access for residents and visitors to the Brisbane Independent School.
SE 09	Operation	Road carrying traffic through the middle of a quiet residential area which currently experiences principally local traffic.	Planned road corridor to accommodate additional western suburbs traffic preserved whilst the surrounding area and environs develops with residential development and creating further traffic demand.	Road design to be sensitive to its location in a residential area, so as to reduce adverse impacts (noise, dust, lighting spill, loss of privacy, security and safety, loss of visual amenity, reduced access) as far as practicable through design solutions.
SE 10		Loss of green space.	Clearing of vegetation in the road corridor to allow the road to be constructed.	Landscape along the road corridor where possible and practicable.
SE 11		Lack of clarity about alternate access routes should Gem Road be severed.	Due to engineering constraints, Gem Road is severed and alternate access routes via Marland Street and Gem Road/Annabel Street.	Provision to be made for signage and other street improvements to clarify what the access routes are in the area.
SE 12		Inadequate provision for protecting the safety and amenity of visitors to Rafting Ground Reserve.	Recreation and amenity values and visitor needs to Rafting Ground Reserve are not adequately considered in the KBP design.	Safe access to and from Rafting Ground Reserve is protected for vehicular and active transport to the Reserve. Landscaping and buffering of the KBP is provided to minimise any adverse visual impacts that the KBP may have upon enjoyment of the recreation values of the reserve.
SE 13		Changes to existing 431 and 433 bus routes and potential new bus routes.	Separation of Gem Road.	Altered bus routes must continue to service catchment of existing route.
SE 14		Access issues with Gem Road separation.	Separation of Gem Road.	Ensure the Sunset Road access complies with design standards.

16.11 Landscape and Visual Amenity

Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
LVA 01	Construction	A reduction in landscape and visual amenity during the construction period.	Introduction of contrasting features and elements into a suburban area i.e. construction traffic, temporary works compounds, stockpiles and weed colonisation	Aim to limit works compound areas. Where practical, locate in areas furthest from residential properties and where views from residential areas are harder to achieve. E.g. at Centenary Motorway and Moggill Road, thus avoiding unnecessary visual impact.
LVA 02				Control invasive species, for example, through preparation of a weed management plan.
LVA 03				Limit disturbance of existing topsoil where possible. Where unavoidable, stockpile soil which is free from invasive species for use within the project.
LVA 04				Limit construction works to daylight hours only if possible.
LVA 05				Avoid disturbance in the residential areas to the greatest extent possible e.g. limit construction access to Centenary Motorway and Moggill Road.
LVA 06	Construction	View of construction activities by residents and visitors.	Clearance of vegetation within the proposed KBP corridor	Undertake a detailed survey of the existing vegetation and, where opportunities arise, seek to retain good quality/screening vegetation. Demark trees in the planting plans and on site, worthy of retention at detailed design stage, prior to construction.
LVA 07				Protect existing vegetation adjacent to the corridor works falling outside of the clearing boundary in order to prevent inadvertent damage or unnecessary removal during the construction process. Particular attention should be made to those private property boundaries along Marland and Twilight Streets.
LVA 08				Keep construction works site and corridor to a minimum to minimise clearance of vegetation as far as possible.
LVA 09				Undertake progressive landscape works to the KBP during the construction process to encourage rapid screening of views, in order to minimise visual disturbance.
LVA 10				Investigate opportunities for advance planting that would not be impacted by KBP (for example off site planting program in private properties).

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
LVA 11	Construction	Loss of characteristic landscape elements, such as existing tree cover.	Clearance of characteristic vegetation along the route (for example, tree cover on Gem Road Spur and at Moggill Creek bridge crossing).	Seek appropriate areas for offset replacement tree planting, and in those areas not impacted by the KBP seek opportunities for advance planting.
LVA 12	Operation	Loss of green space through land-take of perceived and actual public open space.	Introduction of uncharacteristic transport infrastructure (i.e. road, noise walls) into an open space corridor, sections of which are perceived to be actual open space.	The aim should be to provide a visual barrier between the residents and KBP such as landscaping. This is a particular consideration for residents along Marland and Twilight Streets.
LVA 13				Avoid unnecessary land take for KBP infrastructure. For example the pedestrian bridge option C in Marland and Twilight Street Parks.
LVA 14	Operation	Reduction and loss of visual amenity with the introduction of a bypass into a Brisbane suburb.	Introduction of uncharacteristic transport infrastructure that will be viewed by a large number of viewers in the surrounding area both during the day and night.	Encourage development of detailed Landscape, Revegetation and Urban Design Guidelines at the detailed design stage.
LVA 15				Where retaining structures or steep embankments or cuttings are required, opportunities for benching for planting should be investigated to reinstate green outlook.
LVA 16				Design cuttings and embankments so they can be vegetated, where practicable. Ensure embankments are sufficiently shallow (i.e. 1: 2.5 or preferably shallower) for vegetation treatments such as planting and grass cover to establish and be maintained.
LVA 17				Seek to use other materials in preference to shotcrete. Where necessary ensure shotcrete is as visually integrated into the landscape as possible (refer to the <i>NSW Road Traffic Authority Shotcrete Design Guidelines</i>).
LVA 18				Avoid reflective materials on all external surfaces (such as noise barriers) that are to be viewed by private residents.
LVA 19				Use recessive colours (for example, muted, light greys) where appropriate to assist integrating structures into the landscape (with the exception of the pedestrian footbridge).

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Reference Code	Project Phase	Potential Impact	Trigger	Potential Mitigation Measures
LVA 20	Operation	Reduction and loss of visual amenity with the introduction of a bypass into a Brisbane suburb.	Introduction of uncharacteristic transport infrastructure that will be viewed by a large number of viewers in the surrounding area both during the day and night.	Where significant structures such as noise walls and bridges are required, seek to create a consistent urban design language to unify the structures. The language or theming should reflect aspects of the local character to engender a sense of place and community pride. For example patterning on concrete noise walls and retaining structure.
LVA 21				Avoid over lighting the KBP. Develop a lighting strategy that minimises the impact of lighting on residential properties, for example edge lighting that is directed onto the road. Investigate passive means of lighting e.g. installation of reflectorised roadway markers, lines, warnings or informational signs.
LVA 22	Operation	Potential for adverse change in landscape character and decline in existing suburban quality.	Deliberate introduction or invasion of non-indigenous plant species and weeds (particularly grasses) due to need for embankment stabilisation and landscaping, or insufficient vegetation re-establishment at completion of construction on disturbed ground. Inappropriate buffer planting that does not respect established vegetation patterns.	Encourage development of detailed Landscape, Revegetation and Urban Design Guidelines at the detailed design stage.
LVA 23				Control invasive species, for example, through preparation of a weed management plan.
LVA 24				Ensure that sufficient funds are set aside for planting and landscape management.
LVA 25				Seek to include a minimum 12 month establishment period for vegetation.
LVA 26	Operation	Visual perception of community severance.	Introduction of a new bypass transport corridor into an existing suburb.	Ensure the proposed pedestrian over-bridge is an attractive, positive feature and safe to use to minimise the sense of separation between communities north and south of the KBP.

16.12 Aboriginal and Historical Cultural Heritage

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
CH01	All phases		The Turrbal People recommend that DMR open discussions and negotiations with the Turrbal representatives regarding native title matters (particularly in relation to that portion of the Yarawa Pony Club which is subject to the Turrbal Native Title claim) and cultural heritage during the life of this project.
CH02	Construction	Loss of Aboriginal cultural heritage.	The UQASU recommend that representatives of the Aboriginal Party collect the two stone artefacts from Kenmore Road prior to commencement of earthmoving activities associated with the KBP
CH03	Construction	Loss of as yet unknown Aboriginal or historic cultural heritage.	<ul style="list-style-type: none"> The UQASU recommend that representatives of the Aboriginal Party monitor the initial earthmoving activities associated with the KBP and collect any stone artefacts exposed by the earthmoving; The Turrbal People recommend that all ground-breaking activities undertaken by DMR which may impact on the Turrbal cultural heritage values be monitored by Turrbal personnel. DMR recommends that as part of the environmental site inductions, all site personnel should be made aware of the potential for as yet unknown items of historical heritage remaining with the project area, for example, around the Yarawa Pony Club and the former Chinese market garden near Cubberla Creek. <p>Additionally, all site personnel should be made aware of their obligation under the <i>Queensland Heritage Act 1992</i> to report the discovery of an archaeological artefact to the Chief Executive of the Environmental Protection Agency, stating where it was discovered and including a description and photograph (s.89).</p>
CH04	Construction	Removal or destruction of flora and fauna.	<p>The Turrbal People recommend that:</p> <ul style="list-style-type: none"> The removal of mangroves and/or vegetation (especially around Moggill Creek) which may be associated with the project be monitored by Turrbal personnel; and All activities in the precinct of Moggill Creek and the Brisbane River that may impact on marine life be monitored by Turrbal personnel.

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16.13 Climate Change Impact

16.13.1 Greenhouse Gases

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
CC01	Design	Increased GHG emissions	Develop a detailed carbon management plan detailing goals and targets. Reduce fuel and electricity use.
CC 02	Construction	Exhaust emissions from construction vehicles and machinery.	Consider replacing conventional fuel types (petrol and diesel) with bio-fuels.
CC 03	Construction		Use high-efficiency motors in equipment that is continuously operated.
CC 04	Construction		Ensure that vehicles and equipment are mechanically sound, regularly serviced and fitted with appropriate emission control equipment.
CC 05	Construction		Implement work scheduling and methods that: <ul style="list-style-type: none"> • Minimise equipment idle time and double handling of material; • Optimise machinery use to avoid unnecessary fuel usage.
CC 06	Construction		Minimise haul distances.
CC 07	Design		GHG emissions from electricity used for lighting and cooling of the site.
CC 08	Construction	Purchase accredited GreenPower for site offices.	
CC 09	Construction	Procure and install energy efficient fixtures and fittings (e.g. energy efficient lights in the site office(s)).	
CC 10	Construction	Construct during the day to reduce the need for floodlighting during night works.	
CC 11	Design	Production processes (embodied energy of construction materials) resulting in GHG emissions.	Identify local sources of recycled materials.
CC 12	Construction		Use recycled materials where possible (e.g. recycle wastes from demolition of existing structures where possible).
CC 13	Construction		Use locally produced materials.
CC 14	Construction		Give preference to products with low embodied energy.
CC 15	Design		Consider adopting a design that requires fewer materials.
CC 16	Design	Loss of carbon sequestration potential.	Implement government policies with respect to “net loss” of vegetation
CC 17	Design		Develop a re-planting strategy.
CC 18	Construction		Plant/re-establish vegetation with high carbon sequestration potential (carbon sink)

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
CC 19	Construction		Plant vegetation that occurs naturally in the location
CC 20	Construction	Cumulative GHG emissions from the construction process.	Purchase accredited carbon offsets
CC 21	Construction		Work with third parties (suppliers, distributors and contractors) to reduce emissions (e.g. through recycling materials)
CC 22	Design	Exhaust emissions from vehicles travelling on the KBP.	Optimise the road design to promote steady and constant traffic movement (reduce stop/start).
CC 23			Minimise gradient changes along the alignment.
CC 24	Operation		Regularly monitor and maintain the infrastructure.
CC 25			Ensure signals are adequately timed to reduce delays.
CC 26	Design	GHG emissions from electricity used for lighting (streetlights).	Investigate energy efficient street lighting options
CC 27	Operation		Install the most energy efficient lighting technology suitable for the road requirements.

16.13.2 Climate Change

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
CC28	Design	Underestimation of the likelihood and consequences of identified impacts.	<ul style="list-style-type: none"> Proactively consider climate change implications; Undertake a more detailed climate change risk assessment to develop a better understanding of the likelihood and consequences of the identified impacts; and Undertake a more detailed assessment of the design options available to address the identified climate change impacts.
CC 29	Design	Power failures occurring during times of extreme heat and extreme weather (storms).	Ensure there is adequate back-up power supply at the construction site. Develop contingency plans to be implemented in the event of a power failure.
CC 30	Design	Conditions being more suitable for fires.	Ensure access to construction sites and the KBP for emergency vehicles.
CC 31	Design	Flooding of the surrounding area and/or the KBP.	Ensure all planning and design work is based on a rainfall scenario that includes consideration of climate change.

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Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
CC 32			Consider the consequences and responses needed to cope with an event that goes beyond the planned scenario.
CC 33			Ensure access to and from the KBP can be maintained in extreme rainfall events.
CC 34			Develop emergency response plans to effectively evacuate the KBP during extreme weather/flooding.
CC 35	Construction	Damage to the construction site, injuries or fatalities and/or disruptions to the construction schedule.	<p>Ensure the construction site can cope with more extreme weather events, heat and rainfall:</p> <ul style="list-style-type: none"> • Ensure sediment and waste are securely stored in case of extreme weather events; • Develop an extreme heat policy and actions to reduce the impacts of severe temperatures on construction workers; and • Develop contingency plans to allow work to continue safely during extreme weather events such as torrential rain.
CC 36	Construction	Construction workers exposed to extreme heat.	Ensure work practices protect health and safety of workers in times of extreme heat (e.g. appropriate PPE, stop-work guidelines).
CC 37		(This is likely to be beyond the scope of influence at the project design stage.)	Ensure temperature-critical construction practices (e.g. laying of concrete) occur when conditions are suitable.
CC 38	Operation	Impacts on the durability and suitability of materials.	<p>Consider the long-term durability of the KBP over its design life (100 years). Consider the long-term durability of materials. Give preference to durable materials that perform well under increased stress (e.g. in hot conditions).</p>
CC 39	Operation	Loss of plants in landscaped areas.	<p>Use drought resistant plants in landscaping</p> <p>Maximise water harvesting opportunities to enable stormwater to be re-used to irrigate plants.</p>
CC 40	Operation	Changes to the watertable/ groundwater levels.	Ensure construction materials can cope with wetting/drying cycle.