Appendix G

Risk Assessment

A risk assessment has been undertaken of the potential impacts identified for the Proposed Action construction and operational phases. The risk assessment adopts likelihood and consequence criteria and a risk matrix presented in Table G-1, Table G-2 and Table G-3, consistent with the Action Management Plan Criteria (Attachment C to DAWE request for additional information).

Table G-4 presents the risk assessment results, incorporating a summary of mitigation measures to generate a residual risk outcome for each identified risk. Details of mitigation measures are presented in the Action Management Plan (Appendix H).

Table G-4 includes an assessment whether the nature and scale of impacts is unknown, unpredictable or irreversible, consistent with the DAWE request for additional information.

Table G-1 Likelihood criteria

Likelihood	Criteria
Highly likely	Is expected to occur during the construction/operation period
Likely	Will probably occur during the construction/operation period
Possible	Might occur during the construction/operation period
Unlikely	Could occur during construction/operation but considered unlikely or doubtful
Rare	May occur in exceptional circumstances

Table G-2 Consequence criteria

Consequence	Criteria
Minor	Minor environmental impact that can be reversed
Moderate	Isolated but substantial environmental impact that could be reversed with intensive efforts
High	Substantial environmental impact that could be reversed with intensive efforts
Major	Major loss of environmental value and real danger of continuing
Critical	Severe widespread loss of environmental value and irrecoverable environmental damage

Table G-3 Risk ranking matrix

Likelihood	Consequence				
	Minor	Moderate	High	Major	Critical
Highly likely	Medium	High	High	Severe	Severe
Likely	Low	Medium	High	High	Severe
Possible	Low	Medium	Medium	High	Severe
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	High

Table G-4 Risk assessment of Proposed Action to MNES

Impact	Cause	Is the scale or nature of the impact unknown, unpredictable or irreversible? Confidence in predictions?	Summary[1] of Mitigation	Residual risk		
				Likelihood	Consequence	Risk rating
Direct impact causing loss **of up to**: • 3.99 ha of BWSCP TEC • 141 potential breeding trees for Black Cockatoo species, none of which contain hollows suitable for nesting • 18.7 ha of foraging habitat for Carnaby's Cockatoo • 19.1 ha of foraging habitat for FRTBC and Baudin's Cockatoo • 62 individuals of *C. undulatum* and 7.45 ha suitable habitat • 11 individuals of *A. gracilis* • 3 individuals *of B. mimica*.	**Authorised** clearing of native vegetation within DE	• Scale and nature of the impact is known and predictable based on surveys within the DE, undertaken in accordance with EPA and Commonwealth guidance • Although the DE will be partially revegetated with native vegetation, the direct impact is considered effectively irreversible. Black Cockatoo foraging habitat is expected to establish within revegetation in the mid term (10+ years) and potential breeding trees in the long term (100+ years). It is uncertain whether the BWSCP TEC or threatened flora species will establish within the DE in the long term • High confidence in prediction of direct impacts within DE • Potential to reduce direct impacts during detailed design and construction planning, however this cannot be confirmed at this stage.	• Reduction of direct impacts through planning and design to minimise impacts to MNES within the DE	Likely	High	High (Offset Strategy counter-balances residual risk)
Direct impact causing loss **exceeding**: • 3.99 ha of BWSCP TEC • 141 potential breeding trees for Black Cockatoo species, none of which contain hollows suitable for nesting • 18.7 ha of foraging habitat for Carnaby's Cockatoo • 19.1 ha of foraging habitat for FRTBC and Baudin's Cockatoo • 62 individuals of *C. undulatum* and 7,45 ha suitable habitat • 11 individuals of *A. gracilis* • 3 individuals *of B. mimica*.	**Unauthorised** clearing of native vegetation outside of DE	• The nature of potential impact is known and predictable based on surveys in land adjacent to the DE, undertaken in accordance with EPA and Commonwealth guidance • The scale of potential impacts is unpredictable as it relates to unauthorised clearing, however should it occur it is only likely to be isolated and of a much smaller scale than the authorised clearing • Although rehabilitation will be undertaken in impacted areas, the direct impact of unauthorised clearing may be irreversible. Black Cockatoo foraging habitat is expected to establish within rehabilitated areas in the mid term (10+ years) and breeding trees in the long term (100+ years). It is considered unlikely that the BWSCP TEC and threatened flora species will establish within cleared areas • High confidence in prediction of nature of impacts and moderate confidence in prediction of scale of impacts.	• Identification and demarcation of vegetation to be retained within DE, including MNES where practicable and including Coastal Blackbutt tree (ID 204) • Pre-construction inspection of clearing areas and retention areas to confirm demarcation in place • Induction of construction personnel on the presence and high value of MNES adjacent to the DE, and MNES to be retained within the DE • Daily inspection of clearing areas and retention areas during clearing stage • Temporary construction areas will be located in existing cleared areas, areas to be cleared for permanent works, or in areas devoid of MNES.	Unlikely	Moderate	Low
Indirect impacts to condition of adjacent native vegetation including: • BWSCP TEC • Foraging and potential breeding habitat for Black Cockatoos • Individuals and habitat of *C. undulatum*	Construction plant, equipment and soil movement introducing or spreading weeds and/or dieback to uninfested vegetation	• The nature of potential impact is known and predictable based on identified weed and dieback infested areas and vulnerable vegetation in surveys undertaken in DE and adjacent land • The scale of potential impacts is unpredictable as it relates to weeds and dieback which may progressively spread from the DE boundary into adjacent vegetation, and some vegetation may be resistant to dieback expression as appears to be occurring in some areas in the DE	• Declared Plants within the DE will be treated according to WA Government advice, with the aim of eradication where possible but as a minimum prevent off site movement • WoNS and environmental weeds within the DE will be treated according to Weeds Australia guidance with the aim of controlling off-site movement	Unlikely	High	Medium

[1] Details provided in Action Management Plan

Impact	Cause	Is the scale or nature of the impact unknown, unpredictable or irreversible? Confidence in predictions?	Summary[1] of Mitigation	Residual risk		
				Likelihood	Consequence	Risk rating
• Individuals and habitat of *A. gracilis* • Individuals and habitat of *B. mimica*	Unauthorised site access introducing or spreading weeds and/or dieback to uninfested vegetation	• The impact from weeds is potentially reversible with intensive efforts using established methods (e.g. mechanical removal, targeted herbicide, replanting native species) • The impact from dieback is considered effectively irreversible. Phosphite treatment is effective at controlling the spread and impact of dieback in infested areas for periods of up to five years • High confidence in prediction of nature of impacts and moderate confidence in prediction of scale of impacts.	• Topsoil containing Declared Pests or WoNS will not be reused in landscaping or revegetation • All heavy plant and machinery will be inspected prior to entry at the work site and confirmed to be clean and free of vegetation and soil material • Dieback protectable areas will be identified and established within the DE and adjacent land to guide dieback hygiene practices including restrictions on equipment and vehicle movement, soil movement, and Clean on Entry and/or Exit (CoE).			
	Construction dewatering causing groundwater drawdown affecting groundwater dependent vegetation	• The nature of the impact is known as Conservation Advice (TSSC 2016) states that the dominant Banksia species of the BWSCP TEC are vulnerable to impact from groundwater lowering. Other MNES present within the DE are not known to be vulnerable to groundwater drawdown, including the threatened flora, Jarrah and Marri • Subject to final design, the scale of the groundwater drawdown is expected to be localised to the vicinity of t the Hale Road and Welshpool Road intersections for proposed foundation construction works (< 2 m depth approximately), and temporary for the period of dewatering required (2 months approximately) • Due to clayey soil characteristics in the area, the extent of drawdown (cone of depression) is expected to be limited. Dewatering at Hale Road and Welshpool Road will be far enough apart to avoid intersecting cones of depression; therefore, drawdown in the aquifer is minimised. • The impact is expected to be reversible as groundwater levels will recover once dewatering ceases. Groundwater dependent vegetation is expected to recover with groundwater availability as long as dieback has not occurred • Moderate confidence in prediction of nature and scale of impacts.	• Identification and demarcation of potential groundwater dependent vegetation that may be affected by dewatering • Groundwater level monitoring and vegetation condition monitoring undertaken at all identified areas of potentially affected groundwater dependent vegetation, to identify any early impacts of dewatering • If groundwater dependent vegetation are exhibiting signs of impact from dewatering, remedial measures (e.g. infiltration trenches, diaphragm walls) will be implemented to restore groundwater levels to pre-construction levels.	Unlikely	Moderate	Low
	Surface water runoff and spills from temporary construction areas causing erosion, sedimentation or contamination	• The nature of the impact is known as construction will involve ground disturbance, generation of wastes and use of hazardous materials (e.g. diesel fuel), and will occur adjacent to BWSCP TEC, Black Cockatoo habitat and habitat for threatened flora species. • The scale of the impact is unpredictable as it relates to major storm or spill events, however it is expected to be localised to land in the vicinity of the DE.	• Temporary erosion and sediment controls will be maintained within the DE during construction to prevent stormwater runoff from construction areas from eroding or causing sediment deposition in adjacent native vegetation. • Waste and hazardous materials management measures will be implemented in construction to prevent contaminant discharges to adjacent native vegetation.	Unlikely	Moderate	Low

Impact	Cause	Is the scale or nature of the impact unknown, unpredictable or irreversible? Confidence in predictions?	Summary[1] of Mitigation	Residual risk		
				Likelihood	Consequence	Risk rating
		• The impact is expected to be reversible as erosion, sediment deposition and contamination can be remediated with established technologies. • Moderate confidence in prediction of nature and scale of impacts.	• No storage of waste or hazardous materials within 50 m of BWSCP TEC, Black Cockatoo habitat or habitat for threatened flora.			
	Surface water runoff from road surface causing erosion, sedimentation or contamination	• The nature of the impact is known as the DE will comprise upgraded carriageways and intersections that will generate stormwater runoff, and lie adjacent to BWSCP TEC, Black Cockatoo habitat and habitat for threatened flora species. • The scale of the impact is unpredictable as it relates to major storm or spill events, however it is expected to be localised to land in the vicinity of the DE. • The impact is expected to be reversible as erosion, sediment deposition and contamination can be remediated with established technologies. • Moderate confidence in prediction of nature and scale of impacts.	• Surface runoff within the DE will drain into infiltration basins and/or swales constructed within the DE. The infiltration basins/swales will be designed to capture and infiltrate runoff from a 1 in 100 year Average Recurrence Interval (ARI) rainfall event, to prevent stormwater runoff into adjacent areas of native vegetation. The infiltration basins/swales will be planted with native vegetation to assist with nutrient stripping of stormwater during infiltration.	Rare	Moderate	Low
	Damage to vegetation from accidental fires caused by construction activities Damage to vegetation from fires caused by weed growth or fuel build up in road verge	• The nature of the impact is known, as the BWSCP TEC and *B. mimica* are known to be vulnerable to more frequent fire regimes. Other MNES are expected to be resilient to fire in the urban environment • The scale of the impact is expected to be within the area of native vegetation that lies between the DE and un-vegetated areas (e.g. roads, cleared land) that will form firebreaks and fire suppression lines in the urban environment • The impact from fires is expected to be reversible through recovery of most vegetation that is adapted to fires • Moderate confidence in prediction of nature and scale of impacts.	• All hot work will be undertaken in accordance hot work procedures • All vehicles, plant and equipment to be fitted with fire extinguishers and restricted to designated cleared areas unless involved in clearing operations • Fire danger ratings and Local Government vehicle movement bans to be observed and the requirements of these implemented • Regular maintenance of road verge during operations to treat weeds and reduce fuel build up consistent with current maintenance programs.	Rare	Moderate	Low
Injury or mortality to Black Cockatoo individuals	Vehicle collision with birds during construction	• The nature of the impact is known, as the DE contains and lies adjacent to Black Cockatoo habitat, and Black Cockatoos have been known to be killed through vehicle strike • The scale of the impact is unpredictable as it relates to unplanned events and bird/flock behaviour. Collisions are expected to impact individuals or small numbers of birds, however the number of collisions is unpredictable • The loss of a limited number of birds to mortality/injury over a temporary period is considered reversible, as the population is expected to recover over time once construction is completed • Moderate confidence in prediction of nature and scale of impacts.	• Speed limits between 40-60km/hr will be applied throughout the construction site for safety purposes which will consequently reduce the risk of fauna strikes during construction • A list of local wildlife rescue organisations and carers will be maintained on site to contact in the event of fauna injury • Induction of construction personnel on reducing the risk of fauna injury and the procedure in the event of fauna injury or death.	Unlikely	Moderate	Low

Impact	Cause	Is the scale or nature of the impact unknown, unpredictable or irreversible? Confidence in predictions?	Summary[1] of Mitigation	Residual risk		
				Likelihood	Consequence	Risk rating
	Clearing of active breeding trees	• The nature of the impact is known, as the DE contains and lies adjacent to two trees with hollows suitable for Black Cockatoo nesting that could potentially be used during construction, however neither tree have breeding records and they are not expected to be utilised for breeding during construction • The scale of the impact is unpredictable as it is uncertain whether breeding will be occurring during construction, however it is considered unlikely given the lack of breeding records in the vicinity • The loss of small numbers of birds to mortality/injury over a temporary period is considered reversible, as the population is expected to recover over time once construction is completed • Moderate confidence in prediction of nature and scale of impacts.	• Within 7 days prior to clearing, trees with hollows used by or suitable for use by Carnaby's Cockatoo will be inspected by a suitably qualified person to confirm that there are no hollows being used by Carnaby's Cockatoo within the area to be cleared.	Rare	Moderate	Low
	Vehicle collision with birds during operations (additional impact above and beyond existing road)	• The nature of the impact is known, as the DE lies adjacent to Black Cockatoo habitat and Black Cockatoos have been known to be killed through vehicle strike • The scale of the impact is unpredictable as it relates to unplanned events and bird/flock behaviour. Collisions are expected to impact individuals or small numbers of birds, however the frequency of collisions is unpredictable • The ongoing loss of birds to mortality/injury is considered to be effectively irreversible, as the population will be continually affected by vehicle movements over the long term. However, the additional impact above the existing road will be marginal • Moderate confidence in prediction of nature and scale of impacts.	• Where trees that are known to be Black Cockatoo habitat are retained within the DE but are located within 10 m of the edge of the road seal the risk of fauna strike will be assessed to determine if wildlife hazard signage is required • Revegetation within the DE that is within 10 m of the road seal will not be planted with Black Cockatoo foraging species.	Unlikely	Moderate	Low