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Your ref: SSI-7319

Mr Daniel Gorgioski

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Dear Mr Gorgioski

M1 Pacific Motorway extension to Raymond Terrace (SSI-7319) – review of EIS

I refer to your e-mail dated 27 July 2021 in which the Planning and Assessment Division (P&A) of the Department of Planning, Industry and Environment (the Department) invited Biodiversity and Conservation Division (BCD) for advice in relation to the Pacific Motorway (M1) extension to Raymond Terrace project (SSI-7319). BCD received copies of field data for the project on 21 July 2021 and GIS shapefiles for it on 9 August 2021.

BCD has reviewed the Environmental Impact Statement, including relevant appendices, in relation to impacts on biodiversity (including matters of national environmental significance [MNES] under the *Environment Protection and Biodiversity Conservation Act 1999*) and flood risk.

BCD's recommendations are provided in **Attachment A** and detailed comments are provided in **Attachment B**. Please note BCD has not reviewed the BioBanking credit calculator files as they were not submitted at the time of this review. As such BCD will either provide an addendum to this letter if the files are submitted soon or consult with the Proponent and their consultant during the Response to Submission phase given the credit calculator will likely need to be rerun, based on advice in this letter, and to ensure we agree with its outcomes.

If you require any further information regarding this matter, please contact Steven Crick, Senior Team Leader Planning, on 02 4927 3248 or via email at huntercentralcoast@environment.nsw.gov.au

Yours sincerely

Joe Thompson
Director Hunter Central Coast Branch
Biodiversity and Conservation Division

Date: 31/08/2021

Enclosure: Attachments A and B

BCD's recommendations

M1 Pacific Motorway extension to Raymond Terrace

Biodiversity

1. Further details are to be provided on the survey effort for *Acacia bynoeana*, *Asperula asthenes*, *Callistemon linearifolius*, *Corybas dowlingii*, *Cryptostylis hunteriana*, *Diuris arenaria*, *Diuris praecox*, *Grevillea parviflora* subsp. *parviflora*, *Maundia triglochinosoides* and *Rutidosia heterogama*.

If targeted survey requirements cannot be met, an expert report should be prepared, or the species should be assumed to be present.

2. Survey effort should be graphically shown separately for each species on maps or figures and indicate the Plant Community Types and habitat surveyed / targeted.
3. Further justification is required as to why the Biodiversity Assessment Report (BAR) only assesses impacts to 161 *Diuris arenaria* plants at Heatherbrae as opposed to the entire 721 plants subject to the project footprint. This justification should include additional information on the approved development application (DA) referred to, such as: - applicant details, DA identification number, approval pathway, consent authority, conditions of consent or approval, and any legal advice on the matter the proponent may have obtained.

If this information cannot be provided, then the BAR should be amended to consider impacts to all 721 plants and the credit calculator re-run to determine the new 'species credit' obligation.

4. The following threatened fauna species require further justification for their exclusion from the list of candidate species, or they need to be assessed in accordance with the BioBanking Assessment Methodology (OEH 2014):
 - barking owl
 - black-tailed godwit
 - eastern grass owl
 - gang-gang cockatoo
 - terek sandpiper
 - turquoise parrot.
5. The accredited assessor should reassess the impacts of the Project on the koala population in the western part of the development footprint (i.e. Black Hill / Beresfield) or provide further justification as to why this area is not considered to be suitable koala habitat.
6. In accordance with the BioBanking Assessment Methodology (OEH 2014) the accredited assessor must provide species polygons for 'species credit' species in the Biodiversity Assessment Report.
7. Further clarification is required: (i) on why the small area (0.6 ha) of BioBanking Agreement No. 173. (Hunter Water Corporation / Hunter Region Botanic Garden) cannot be avoided, and (ii) on how it will be suitably offset in the Biodiversity Strategy.

Flooding and flood risk

8. BCD recommends that the proponent consider the appropriateness of the methodology used to assess climate change flood impacts.

9. BCD recommend that the proponent provide the following information:

- Methodology used to generate local catchment inflows at Purgatory Creek and Viney Creek.
- Independent verification reviews of the flood modelling.
- Description of the changes made to the Williamtown Salt Ash FRMS, BMT, 2017 hydraulic and hydrological models.
- Methodology used to determine tidal influence on flooding within the study area.
- Detailed description of the impacts and how these impacts will be mitigated for the dwellings:

Lot Number	Plan
270	DP605404
100	DP1044020
12	DP740160
1	DP199286

10. BCD recommends that the TULFOW HPC hydraulic model grid mesh is refined around urbanised areas and key hydraulic features using the quadtree mesh.

BCD's detailed comments

M1 Pacific Motorway extension to Raymond Terrace

Biodiversity

Biodiversity Conservation Division (BCD) has reviewed the '*M1 Pacific Motorway extension to Raymond Terrace Biodiversity Assessment Report*' (BAR) dated July 2021 and the Biodiversity Offsets Strategy (BOS) presented as Appendix I of the BAR.

The Proponent must assess biodiversity impacts in accordance with the Framework for Biodiversity Assessment (FBA) and BioBanking Assessment Methodology (BBAM), and be carried out by a person accredited in accordance with section 142B(1)(c) of the *Threatened Species Conservation Act 1995* (the TSC Act). Section 1.5 (Planning and Policy) of the BAR identifies the accredited assessor as Chris Thomson (Jacobs); accreditation number 179.

BCD acknowledges that this biodiversity assessment is facilitated under Clause 28 of the Biodiversity Conservation (Savings and Transitional) Regulation 2016 which permits the proponent to submit the application in accordance with the former planning provisions. This approach was approved by DPIE (formerly Department of Planning and Environment) on 13 November 2017. As such, the former provisions of the TSC Act remain in force for this assessment, rather than the *Biodiversity Conservation Act 2016* (the BC Act).

1. Further details are required of survey effort for ten threatened plants

BCD acknowledges that Section 4.2.1 (Targeted Surveys – Threatened Plants) of the BAR in conjunction with Table 4.5 (Targeted species for non-cryptic threatened plant species) and Table 4.6 (Table 4-6 Summary of targeted surveys for cryptic plant species) provides detailed information regarding surveys undertaken for the assessment. However, BCD is concerned that some of the threatened flora species have not been surveyed at their optimal time in accordance with the DPIE's 'Threatened Species Data Collection (TSDC [formerly the Threatened Species Profile Database])' database. DPIE's threatened flora guidelines DPIE '*NSW Guide to Surveying Threatened Plants*' (February 2016) state that any variation in the survey time from that identified by the TSDC database should be justified and reported in the BAR.

Furthermore, the TSDC database also provides additional survey requirements (under 'General Notes') for many species and where applicable this advice should be used to further refine the targeted surveys. Additional survey requirements can include: - use of reference populations, specified times to which surveying must be undertaken (typically the peak flowering times), multiple survey periods for species that flower over a large time period, and specific use of identification features, such as flowers and fruits (often referencing similar taxa). There appears to be no reference in the BAR (i.e. under survey methodology) to the ancillary survey requirements for many of the species which have the potential to be present on site.

As such further clarification on the targeted survey for the following species will be required :

- *Acacia bynoeana* – were reference populations accessed? These aid positive identification, particularly when plants are in their non-flowering vegetative-state. Further, do the surveys cover all potential habitat on site?

- *Asperula asthenes* – why was the species surveyed outside recommended survey period, which is between October to December? Table 4.5 indicates that surveys were undertaken in December 2014, and April 2014/2016. As such the latter two months are not suitable for this species. This is due to the fact that fruiting material is required to identify the species, as it is easily confused with the *Galium* genera. Further do the surveys cover all potential habitat on site?
- *Callistemon linearifolius* – is not a species that can be readily detected all year round; why was the species surveyed outside recommended survey period, which is between October to January? Table 4.5 indicates that surveys were undertaken in October 2015, and September 2016/2018. As such the latter two months are not suitable for this species. Multiple survey periods (i.e. if not observed in flower, return to site for re-survey later in the survey period) and use of reference populations are recommended (i.e. within 20 kilometres (km) and at similar altitude) are also required; were these adopted? Further, it is not clear if surveys cover all potential habitat on site.
- *Corybas dowlingii* – why was the species surveyed (partly) outside recommended survey periods, which is June to July? Table 4.6 indicates that although surveyed in July (2018), surveys were also undertaken in August 2018 which is outside the recommended timeframe listed in current version of the TSDC database, which now focuses on the peak-flowering time. No justification is provided for this deviation and as such, it is unclear if all the surveys undertaken were during the peak-flowering times, and if so, did they cover all potential habitat on the site?
- *Cryptostylis hunteriana* – why was the species surveyed outside recommended survey period, which is between November to January? Table 4.6 indicates that surveys were undertaken in October 2015, and September 2016/2018. These months are not suitable for this species and no justification is provided for the deviation from the TSDC database. Further, it is not clear if surveys cover all potential habitat on site.
- *Diuris arenaria* – why was the species surveyed (partly) outside recommended survey period, which is September? Table 4.6 indicates that although surveyed in September (2016/2018), surveys were also undertaken in October 2015 which is outside the recommended timeframe listed in current version of the TSDC database, which now focuses on the peak-flowering time. No justification is provided for this deviation and as such, it is unclear if all the surveys undertaken were during the peak-flowering times, and if so, did they cover all potential habitat on the site?
- *Diuris praecox* – why was the species surveyed (partly) outside recommended survey period, which is August? Table 4.6 indicates that although surveyed in August (2018), surveys were also undertaken in July 2018 and September 2014 which are outside the recommended timeframe listed in current version of the TSDC database, which now focuses on the peak-flowering time. No justification is provided for this deviation and as such, it is unclear if all the surveys undertaken were during the peak-flowering times, and if so, did they cover all potential habitat on the site?
- *Grevillea parviflora* subsp. *parviflora* – is not a species that can be readily detected all year round and therefore it is not clear why the species was surveyed outside the recommended survey period, which is between August to November. Table 4.5 indicates that surveys were undertaken between December to April 2016. These months are not suitable for this species as flowers are required to identify it and ensure it is not confused with *G. humilis*. Further, it is not clear if surveys cover all potential habitat on site.
- *Maundia triglochinos* – is not a species that can be readily detected all year round and therefore it is not clear why the species was surveyed outside the recommended survey period, which is between November to March, which is when the plant is flowering and fruiting. Fruits are often required to identify the species, as it is easily confused with *Triglochin* or *Philydrum* genus. Table 4.5 indicates that although surveyed in December (2015), surveys were also undertaken in April 2016/2018 which are outside the recommended timeframe listed in current version of the TSDC database, which now

focuses on the peak-flowering /fruiting times. No justification is provided for this deviation and as such, it is unclear if all the surveys undertaken were during the peak-flowering / fruiting times, and if so, did they cover all potential habitat on the site?

- *Rutidosia heterogama* - were reference populations accessed to help aid identification? Further, it is not clear if surveys cover all potential habitat on site.

Further information on survey effort for the above listed threatened flora is required that describes how BCD's threatened plant survey guidelines have been met, in particular survey timing and additional requirements listed in the TSDC database. If BCD's survey guidelines have not been met, further surveys should be undertaken, or an expert report prepared, or the species may be assumed to be present.

Recommendation 1

Further details are to be provided on the survey effort for *Acacia bynoeana*, *Asperula asthenes*, *Callistemon linearifolius*, *Corybas dowlingii*, *Cryptostylis hunteriana*, *Diuris arenaria*, *Diuris praecox*, *Grevillea parviflora* subsp. *parviflora*, *Maundia triglochoides* and *Rutidosia heterogama*.

If targeted survey requirements cannot be met, an expert report should be prepared, or the species should be assumed to be present.

2. Further clarification is required on the graphical representation of the threatened flora surveys

The presentation of threatened flora survey timing information in the tables of the BAR is confusing when compared to the way it is graphically represented and lends itself to misinterpretation. It also appears that survey effort may not be compliant with the FBA / BBAM. Namely, in Tables 4.5 and 4.6 the survey timing is shown as 'months' whilst on Figure 4-1 (Targeted survey locations for threatened plants [maps 1 to 8]) the same information is recorded as a 'season'. This makes it difficult to determine: (i) whether all potential habitats for threatened flora have been adequately surveyed or (ii) whether the different dated surveys for each date cover the same habitat each year, as you cannot accurately compare survey times from 'Tables' to the 'Figures' given differences in how they are displayed. Furthermore, in accordance with the requirements of the BBAM (OEH 2014), survey effort should be graphically shown separately for each species.

Recommendation 2

Survey effort should be graphically shown separately for each species on maps or figures and indicate the Plant Community Types and habitat surveyed / targeted.

3. Further detail is required on the *Diuris arenaria* population at Heatherbrae

The endangered orchid, *Diuris arenaria* was recorded in sandy soil dominated dry sclerophyll forest and on cleared land and tracks south-east of the Pacific Highway at Heatherbrae. At the time of the targeted surveys, the majority of plants were identified across areas that had been previously cleared under a separate light industrial precinct Development Application (DA) approval or on existing vehicle access tracks and cleared power easements. The proponent outlines that orchids which occur on the land subject to the DA do not have to be offset or assessed under the BAR, as the orchids have colonised a cleared site which has been given prior development approval. However, the BAR provides no specific details on this DA, such as when was the DA approved, which planning mechanism it was approved under (e.g. Part 4 or Major Project under the *Environmental Planning and Assessment Act 1979*) and who was the consent authority. Nor is a DA identification number provided or any details of whether

or not specific consent conditions may apply to the orchids. This makes it difficult for BCD to understand how the reported DA relates to the project being assessed.

Targeted surveys for this species were conducted over three periods: - two spring periods in different years (2016 and 2018) to capture temporal variation. This resulted in different abundance counts that were thought to be influenced by variation in seasonal climatic conditions prior to each survey. Surveys resulted in 1,447 individuals being recorded in September 2016 compared with 329 individuals in September 2018, which was a drier season. These surveys covered the construction footprint and adjoining areas in order to survey the full extent of the population. Using a precautionary approach, the larger count from 2016 (1,447 plants) was used as population size estimate in the BAR. However, the proponent indicates the majority of the identified population (89.2 per cent) occurs on land previously cleared for the approved DA (off Masonite Road). Therefore, of 721 plants occurring on the current development footprint, 560 plants are located on this parcel of land. As such the BAR outlines the project would only directly impact the remaining 161 plants.

BCD does not necessarily concur with this assumption given that the DA was for a different purpose and no details about it have been provided. Based on the information provided, BCD considers that the project will impact 721 orchids.

Additionally, BCD notes that depending on the age of the DA approval, *Diuris arenaria* may not have been assessed as part of the prior approval, given that the orchid was only discovered at this locality (Heatherbrae) in October 2011 (NSW884989, Royal Botanic Gardens Sydney).

Recommendation 3

Further justification is required as to why the Biodiversity Assessment Report (BAR) only assesses impacts to 161 *Diuris arenaria* plants at Heatherbrae as opposed to the entire 721 plants subject to the project footprint. This justification should include additional information on the approved development application (DA) referred to, such as: - applicant details, DA identification number, approval pathway, consent authority, conditions of consent or approval, and any legal advice on the matter the proponent may have obtained.

If this information cannot be provided, then the BAR should be amended to consider impacts to all 721 plants and the credit calculator re-run to determine the new 'species credit' obligation.

4. Further justification is needed as to why certain threatened fauna were not assessed

BCD notes that a number of potential threatened fauna 'candidate species' listed in Table 4-1 (Ecosystem credit species based on Interim Biogeographic Regionalisation for Australia (IBRA) subregion, Plant Community Type (PCT), patch size and condition) and Table 4-3 (List of candidate species credit species and second filtering step) have been discounted from further assessment and surveying on the basis that there are no known records of them within the locality or there is no suitable habitat. Under the BBAM (OEH 2014) a species must still be included for assessment if:

- the geographic distribution of the species is known or predicted to include the IBRA subregion in which the development site is located, and
- the development site contains habitat features or components associated with the species, as identified in the TSDC database

As such BCD considers that the following threatened fauna species should still be considered potential 'candidate species' and require further assessment. These species are either

recorded in the locality or the Hunter IBRA sub region or have suitable habitat in the study area (as per BioNet records, accessed August 2021):

- Barking owl – numerous records for the Lower Hunter and Hunter Sub IBRA, though BCD acknowledges these are not near the development footprint (old record from Beresfield – 1998). Suitable habitat is present in the development footprint: - this species inhabits woodland and open forest, including fragmented remnants and partly cleared farmland; it is flexible in its' habitat use, and its' hunting range can extend into closed forest and more open areas, which would match numerous PCTs (particularly in the southern footprint of the project).
- Black-tailed godwit – known from the Hunter Estuary and surrounds with various records in the Hunter Sub IBRA, within 5km at Hexham Swamp (recorded in 2002 and 2012); and suitable habitat present on the development footprint: - open saline mudflats and semi-tidal saline muds (Plant Community Type [PCT] 1746 – *Saltmarsh Estuarine complex*: 1.26 hectares (ha)) and tidal muds (PCT 1747 – *Grey Mangrove low closed forest*: 2.27 ha).
- Eastern grass owl – known from the Lower Hunter and Hunter Estuary, with nearby records from Hexham /Hexham Swamp (recorded in 2007 and 2008) and Tomago area (2010 and 2013); and suitable foraging habitat present on the development footprint: - in swampy areas and grassy plains, which could include PCT 1736 (*Water Couch – Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter*: 59.04 ha) and PCT 1742 *Jointed Twig-rush sedgeland*: 1.45 ha).
- Gang-gang cockatoo – known from the Lower Hunter and Hunter Sub IBRA (numerous records predominantly south of the project), nearest records at Beresfield (recorded in 2004); and suitable habitat present on the development footprint: - during autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas, which would match numerous PCTs.
- Terek sandpiper - known from the Hunter Estuary and surrounds with various records in the Hunter Sub IBRA, at Hexham Swamp (recorded in 2006); and suitable habitat present on the development footprint: - intertidal mudflats (Plant Community Type [PCT] 1746 – *Saltmarsh Estuarine complex*: 1.26 ha) and mangroves (PCT 1747 – *Grey Mangrove low closed forest*: 2.27 ha).
- Turquoise parrot – known from the Lower Hunter and Hunter Sub IBRA, nearest records at Beresfield (recorded in 2004) and Lenaghan (recorded in 2002); and suitable habitat present on the development footprint: - lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland, which would match numerous PCTs.

If the assessor proposes to remove a species from the list of candidate species (including species from the threatened species database search) then appropriate justification must be provided in the BAR, such as specific details of the lack of suitable habitat or evidence it does not occur with the IBRA subregion. In instances where appropriate justification is not provided then appropriate further assessment is requirement in accordance with the BBAM (OEH 2014).

Recommendation 4

The following threatened fauna species require further justification for their exclusion from the list of candidate species, or they need to be assessed in accordance with the BioBanking Assessment Methodology (OEH 2014):

- barking owl
- black-tailed godwit
- eastern grass owl
- gang-gang cockatoo

- terek sandpiper
- turquoise parrot.

5. Assessment of koalas in the Black Hill / Beresfield area

BCD considers that further assessment of koalas in the western part of the development (i.e. Black Hill / Beresfield) is required.

The BAR states that '*While koala feed tree species also occur at the south western end of the project around Black Hill (i.e. the primary feed tree Eucalyptus tereticornis and secondary feed trees E. agglomerata and E. eugenioides) there are no historic sightings at Black Hill and the scat surveys suggest no evidence of koala presence in this portion of the construction footprint*'. As such the BAR concludes that any loss of habitat at Black Hill is not expected to impact on the koala and no further assessment is undertaken or any 'species credits' generated for the loss of habitat. Furthermore, Table 4-10 (Threatened species survey results) states that there are no recent of koalas in the Black Hill area. As such it appears that only koala habitat in the northern footprint of the Project was assessed.

BCD disagrees that there are no recent records of koalas in the Black Hill / Beresfield section of the Project. Interrogation of the BioNet database (August 2021) reveals a number of recent records from the Black Hill area and surrounds (including records within 5 km radius): - 2015 (from Black Hill), 2010 (from 'F3 1 kilometre south of John Renshaw Drive, Black Hill'), and 2006 (from Hexham Swamp area). These records are recorded from vegetation which is generally contiguous with the project footprint at Black Hill.

The accredited assessor should reassess the impacts to koalas in this part of the project. As per the case with the assessment of koalas in the Tomago / Heatherbrae area (51.12 ha; which also recorded no records of koala despite extensive surveying), this reassessment should adopt the precautionary approach with suitable habitat determined on the basis of PCTs containing primary feed trees, and recent koala records from BioNet. As such suitable areas (approximately 40 ha) of PCT 1590 (Spotted Gum – Broad-leaved Mahogany – Red Ironbark shrubby open forest) and PCT 1588 (Grey Ironbark – Broad-leaved Mahogany – Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast) in Black Hill / Beresfield area that represent suitable koala habitat should be assessed and a species polygon produced to determine the 'species credit' obligation, or further justification should be provided as to why this area is not suitable koala habitat.

Recommendation 5

The accredited assessor should reassess the impacts of the Project on the koala population in the western part of the development footprint (i.e. Black Hill / Beresfield) or provide further justification as to why this area is not considered to be suitable koala habitat.

6. Species polygons need to be provided for 'species credit' species based on area

Under Section 6 (Assessing threatened species and populations) of the BBAM (OEH 2014) an accredited assessor must prepare species polygon for all 'species credit' species, particularly for those which are based on an area rather than a count. The species polygon must:

- be mapped using a satellite (ADS-40) or the best available ortho-rectified aerial image of the development site
- use the unit of measurement identified for that species in the TSDC database
- include the locations of the species or areas occupied by the species

- contain the specific habitat feature or habitat component associated with that species on the development site
- utilise GPS to confirm the location of the species polygon on the best available ortho-rectified aerial image of the development site or biobank site.

Furthermore, a description of the species and the habitat feature or habitat component associated with the species on the site and its abundance must be included in the BAR.

BCD notes that no species polygons have been produced in the BAR for 'species credit' species, including those that are based on area rather than count. Table 4-10 (Threatened species survey results) implies how the overall area for a 'species credit' was determined but this does not link to any section of the BAR that has produced species polygons. BCD also notes the term 'habitat polygons' is used but these are not graphically reproduced. As such it is extremely difficult to understand which PCTs or percentages (part of) of PCTs make up the assessed species habitat for most species. For example, Table (4-10) may provide a list of the PCTs with feed trees; it does not however (nor does the associated text), explain how the accredited assessor came up with the figure of 51.12 ha of impacted habitat.

Recommendation 6

In accordance with the BioBanking Assessment Methodology (OEH 2014) the accredited assessor must provide species polygons for 'species credit' species in the Biodiversity Assessment Report.

7. Clarification on why BioBanking Agreement No. 173: Hunter Water Corporation (Hunter Botanic Gardens) cannot be avoided

Section 2.2.6 (Existing BioBanking sites) of the BAR indicates that the construction footprint of the proposed M1 realignment overlaps with a small portion of an existing BioBanking Agreement Site on land owned by Hunter Water Corporation (Lot 1 / DP 748716) and administered by the Hunter Region Botanic Garden, at Heatherbrae (refer to Figure 2-1 in the BAR). The construction footprint impacts on around 0.6 ha of the western edge of this BioBanking site, next to the existing Pacific Highway. This would result in impacts to 0.5 per cent of the 106ha BioBanking Site and include minor impacts to native vegetation (PCT 1598, PCT 1071 and PCT 1717). The vegetation impacts within the BioBanking site are included in the total native vegetation impact calculations, as listed in Table 8-1, and are not additional. The proponent intends to acquire this impacted land and offset the impacts to the existing BioBanking site.

BCD note that neither the BAR or EIS provide any details on why the Biobanking Site cannot be avoided. Specifically, no mention of this impact is mentioned under Section 7 (Avoiding and minimising impacts). As such BCD is unclear why impacts to this small section of BioBanking Agreement No. 173 could not be avoided.

Furthermore, even though the proponent has agreed to offsetting the impacts to the existing Biobanking Site, the BOS fails to provide any specific details on how this will be achieved. Given that the PCTs being impacted upon all are considered endangered ecological communities, then in this instance BCD believes the offsets should be 'like for like' for ecosystem credits, namely they should be matched to: PCT 1598 (*Forest Red Gum grassy open forest on floodplains of the Lower Hunter*), PCT 1071 (*Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion*) and PCT 1717 (*Broad-leaved Paperbark – Swamp Mahogany – Swamp Oak – Saw Sedge swamp forest of the Central Coast and Lower North Coast*). It is unknown whether the credits generated from this BioBanking Site have been retired and if so, this would make a stronger case for a like for like match. Similarly, any 'species credits' sourced for this impact, such as koala, should also be 'like for like'.

Recommendation 7

Further clarification is required: (i) on why the small area (0.6 ha) of BioBanking Agreement No. 173. (Hunter Water Corporation / Hunter Region Botanic Garden) cannot be avoided, and (ii) on how it will be suitably offset in the Biodiversity Offset Strategy.

Flooding and flood risk

8. Estimates of Climate change impacts may be overly conservative

The estimated climate change flood impacts due to increased frequency and intensity of severe rainfall events, may be overly conservative due to:

- Lower runoff from rainfall resulting from dryer catchment conditions.
- Increased rainfall intensities are unlikely to extend across the entirety of the Hunter River catchment.

Daily evaporation rates for eastern NSW are projected to increase by up to 40% by 2070. This will result in reduced rainfall runoff due to higher rainfall losses.

Increased rainfall intensity due to climate change is unlikely to have a significant impact on flooding in large catchments. Climate change is expected to produce more frequent, higher intensity storms. To assess flooding impacts the 0.5% Annual Exceedance Probability (AEP) and 0.2% AEP flood events were used. These events represent a 17% and 45% increase in the Hunter River peak flows for the current day 1% AEP flood event. This methodology assumes that the increased rainfall intensity will occur over the entire catchment and will be maintained over the catchment's critical duration. This assumption may not be valid for extremely large catchments, such as the lower reaches of the Hunter (22,000 km²), where there is significant upstream storage and long critical durations (>72 hours).

BCD considers that it is unrealistic to assume that future higher rainfall intensities will occur over the entire area the Hunter River catchment and adopting a reduced rainfall intensity may be more appropriate. However, BCD acknowledges that it is difficult to predict with confidence the likely changes to peak flows for large Hunter River flood events under warmer climate scenarios. BCD further acknowledges the lack of Australian published guidance for climate change flooding impacts on large catchments.

Recommendation 8

BCD recommends that the proponent consider the appropriateness of the methodology used to assess climate change flood impacts.

9. Insufficient information has been provided to assess the flood impact methodology

Insufficient information has been provided to assess the flood impact methodology. Key information on the flood modelling is missing.

The Hydrology and Flooding Working Paper has not provided details on how local catchment inflows were generated for Purgatory Creek and Viney Creek. The Working Paper states that the flood assessment used the Williamstown Salt Ash FRMS, BMT, 2017 hydrological models to generate runoff hydrographs. The 2017 study used flood frequency analysis to estimate flows for the Hunter and Williams Rivers and XP Rafts rainfall runoff routing for local catchment flows. Local catchment flows were not generated for major tributaries below Windeyer's Creek.

The Hydrology and Flooding Working Paper predicted that a number of residential dwellings will be affected by afflux exceeding the adopted criteria in both the construction and operation phases. BCD requires a detailed description of the impacts and how these impacts will be mitigated for the dwellings:

Lot Number	Plan	Zoning	Address	Phase criteria exceeded
270	DP605404	E2	30 Woodlands Close, Hexham	Construction
100	DP1044020	E2	1 Woodlands Cl, Tarro	Construction / Operation
12	DP740160	R1	81 Redbill Dr, Woodberry	Construction
1	DP199286	E3	14 Woodberry Rd, Tarro	Construction

S3.3.3 of the Hydrology and Flooding Working Paper states that independent verification reviews of the flood modelling were carried out by third parties external to the project design and environmental assessment. However, the independent reviews have not been provided.

S3.3.3 of the Hydrology and Flooding Working Paper states that the XP-RAFTS hydrology and TUFLOW hydraulic models from the Williamstown Salt Ash FRMS, BMT, 2017 have been reviewed and updated. However, the refinements made have not been described.

The Hydrology and Flooding Working Paper has not provided the methodology used to determine how ocean tides affect flood levels within the study area. The Working Paper states that the flood assessment tide levels were used to define flood behaviour for each design event. However, no details have been provided. Change in the sea level will have a more immediate impact on Hunter River flood levels closer to Newcastle Harbour.

Recommendation 9

BCD recommend that the proponent provide the following information:

- Methodology used to generate local catchment inflows at Purgatory Creek and Viney Creek.
- Independent verification reviews of the flood modelling.
- Description of the changes made to the Williamstown Salt Ash FRMS, BMT, 2017 hydraulic and hydrological models.
- Methodology used to determine tidal influence on flooding within the study area.
- Detailed description of the impacts and how these impacts will be mitigated for the dwellings:

Lot Number	Plan
270	DP605404
100	DP1044020
12	DP740160
1	DP199286

10. Hydraulic model grid is too coarse to assess flood impacts in urbanised areas

The Hydrology and Flooding Working Paper states that the TUFLOW HPC model adopted a 20-metre grid. BCD considers that this will provide an appropriate level of resolution and detail across rural areas of the catchment, while keeping model runtimes reasonable. However, BCD considers that a 20m grid resolution is too coarse for urbanised areas. Urban area flooding

requires a finer grid resolution, in the order of 2m, in order to account for smaller scale flow patterns, due to stormwater drainage and flow obstructions due to buildings.

A better representation of urbanised flooding can be achieved using the TUFLOW HPC quadtree mesh which allows for localised refinement for the grid mesh.

Recommendation 10

BCD recommends that the TULFOW HPC hydraulic model grid mesh is refined around urbanised areas and key hydraulic features using the quadtree mesh.