Supplementary Study no.11
Assessment of Net Adverse Impacts

Executive summary:
"Our conclusions assume that all our assumptions are met. Implementation of other recommendations of our "Design Review" (Goosem et al. 2004) would further improve the final conclusions with respect to No Net Adverse Impact.
All our assumptions are crucial to our conclusions, however we particularly draw attention to the need to minimise construction impacts outside the road footprint and underneath bridges which have a habitat connectivity role.Our conclusions accept the limitations of the project,
we have not considered off-site conservation offsets,nor have we undertaken temporal analysis of the net adverse impacts at periods during construction."
And in the overall conclusion"On balance, we consider that if our assumptions (for design, construction and remediation) and therecommendations of our design review (see separate report) are implemented, the proposed upgradedKennedy Highway from Smithfield to Kuranda, has the potential to have a net benefit, or in other words will not have an adverse impact on the integrity of World Heritage values. This conclusion is based on our interpretation of the integrity of world heritage values, our and others measurements of numerous mostly quantifiable indices, and the relative emphasis we have placed on various indices."

In Analysis of Temporal Impacts:
he construction phasing has not been finalised, consequently our analysis in this report is based on the existing road and the proposed road once the landscape restoration and revegetation (as set out in our assumptions) has been undertaken. It is expected that this will take in the order of ten years from the completion of each stage. As such our assessment is based on the existing road and ten years after the whole proposed road is constructed.

5 Assumptions

5.1 Design, Construction and Rehabilitation

In order to assess the net adverse impact on the proposed upgraded highway, there must be assumptions as to the rehabilitation of the old road where it does not occur within the footprint of disturbance of the new road.
Essentially for most of the route the new road runs offset yet parallel to the existing road, with bridges over most gullies. A significant aspect for the assessment of the impact and likely habitat connectivity benefit of the upgrade is the level of rehabilitation to be applied to the old road.
Fundamentally we assume that there will be no major environmental accidents or emergencies (i.e. fuel spills, landslide/erosion etc.) during construction. Further, we assume that best practice erosion and sediment control will be implemented.
We assume that many of the recommendations in our accompanying Design Review (Goosem et al., 2004) will be implemented. The assumptions which are critical to the determination of net adverse impact are set bout below. To avoid any doubt, if these assumptions are not met in full, the conclusions of this report may not be able to be met.

5.1.1 Summary of Assumptions, Design Review Findings and Recommendations

The following assumptions have been compiled based on CRC knowledge and assumptions of the proposed design. In particular, the restoration of the old road is vital to the review of the design. There can be no assumption of the reestablishment of connectivity without adequate restoration of the old road.

5.1.2 Minimise Habitat Disturbance

Rainforest habitat will be maintained as close as possible to the road to ensure minimal width of the road clearing and therefore reduce the extent of penetration of edge effects. Removal of roadside trees will be avoided during construction and

maintenance. Revegetation of cut and fill batters will also reduce edge effects by reducing effective clearing width.
Clearing for construction tracks etc, will be avoided by the use of top-down construction of bridges and use of the current road alignment to access the new road areas.
NOTE: We note that some Bridges for which this assumption is critical (those bridges for which we ascribe habitat connectivity value in forest underneath) are not presently planned to be constructed “top down”. We therefore assume that the detailed design phase will result in either all of these “habitat connectivity” bridges being constructed top down with little forest disturbance, or other ways that avoid linear disturbance will be identified (thus avoiding access tracks to bridge footings suitable for rubber tyred vehicles, as currently envisaged in the preliminary design).
To avoid any doubt, this assumption of minimal disturbance during construction of the forest under “habitat connectivity” bridges is crucial to the determination of a benefit for all four connectivity indicators.

Construction camps and material dumps will be only sited in areas of existing disturbance.
All arrestor bed material and fill used for safety ramps will be managed to reduce sedimentation risk.
Adequate water will reach the forest habitat under bridges to sustain natural habitat where necessary for fauna connectivity.
Adequate light reaches the forest habitat under bridges especially on east-west aspects (e.g. Diplazium Gully and top Avondale Creek crossing), particularly in areas where species of high conservation significance are known to occur.

5.1.3 Rehabilitation

A detailed rehabilitation plan will be prepared which sets out the phased rehabilitation of the old road, new cut and fill batters and other construction disturbance as construction progresses.
For permanent streams culverts, pipes and abutments of the old road will be removed to recreate the original streambed. Banks will be stabilised and the grade of the stream re-established as far as possible (leaving riffle's/pools intact).
However, in all cases the environmental cost/benefit of the above will be carefully evaluated, particularly the ongoing drainage required for the old road, access for maintenance of any drainage structures, and (if culverts are removed as above) how stormwater from the road bench surface to the natural watercourse without causing greater disturbance and new erosion points etc.
For the larger ephemeral streams and smaller gullies where the new road alignment provides bridging over the gully upstream and further downstream habitat connectivity will also be maintained using the above treatment.
On the old road, stream banks will have gabion structures or other stabilisation at the interface between the rehabilitated streambed and the remaining road formation methods to ensure long-term stability.
The old road surface will be ripped, asphalt/bitumen removed (taken outside WHA), and topsoil re-established and stabilised then planted. Table drains will be left on the road formation together with suitable drainage that includes erosion protection and energy dissipation from them to the streambed.
Canopy connectivity will be retained under bridges, particularly in riparian corridors and where the micro-topography allows opportunity for faunal

movements.
Habitat recreation will be achieved through the use of logs, rocks etc. on the old road formation particularly where the road cross-section allows for fauna movement (i.e. where there are no vertical barriers).
Existing weeds will be removed, particularly in areas where there is a possibility of establishing canopy connectivity.
Rehabilitation should aim to re-establish a forest, which is essentially similar in terms of structure and floristics, to the adjoining forest and/or what occurred in the immediate vicinity prior to the original road disturbance.

Soil disturbance will be kept to the minimum, as any disturbance tends to encourage weeds over other species.
The initial treatment of the newly exposed margin will be carefully managed to reduce the weed edge effect as quickly as possible.
Revegetation will consider using recommended species (see Table 1, Goosem et al., 2004).

5.1.4 Likely Impacts on Barrier Effects and Highway Mortality

A ‘fence and funnel’ strategy is adopted for the majority of the road. In particular, any parts of the road that have New Jersey barriers in the centre that divide the uphill and downhill streams of traffic, will be fenced to prevent entrapment of animals on the lanes and subsequent wildlife-vehicle collisions. Ramps or one-way gates will be provided where fauna may stray onto the roadway to prevent trapping individuals.
A fine mesh or solid screen will be included at the base to exclude amphibians and smaller reptiles and mammals from the road surface. Such a fence needs to be buried for several centimetres to prevent animals digging underneath. Where cassowaries are expected, wire mesh fences will not be used. (These are not appropriate as they may damage themselves on the mesh whilst attempting to get through).
Regular maintenance of fences will be undertaken.
Provision of some cover for escape of animals adjacent to the road will be included where cuttings occur (e.g. in the area of the quartzite outcrop), however upgraded fencing will be included when traffic increases to a point where the mortality outweighs the connectivity benefit.
Under low bridges, rocks and logs will be placed to form refuges for moving animals and vegetation will be maintained as close to the bridge as possible as refuge against predators.

5.1.5 Importance of Connectivity

Construction phases will be planned to avoid increasing the barrier effect during the long period of construction to ensure that not all key connectivity corridors are affected concurrently.
Once construction is concluded, Bridge 24 will be established as a wildlife underpass.
The north/south ridge has been assumed to become a restored wildlife corridor by ensuring that the preferences of cassowaries to move through and under bridges is considered. These birds dislike steep slopes, so we assume reasonable access will be provided near the east abutment of the top bridge.
Fish will be provided with adequate connectivity by improvement of water depth and speed of flow at the existing Streets Creek culvert, especially during times of normal flows.

5.1.6 Bridge Construction

Every effort will be made to minimise disturbance underneath bridges as they are constructed.

Adequate water will reach the canopy and soil in a natural rainfall pattern (under each bridge where habitat connectivity is expected).

Bridges 5, 6, 7, 8, 9, 10, 11a, 13La, 14b, 17, 19, 20Lc, 22, 23, 25, 26 and 28 will be constructed to ensure canopy connectivity is maintained underneath. Bridges 4,12,14a and 27 will be constructed using techniques to minimise surface and vegetation disturbance.

NOTE: We note that some Bridges for which this is assumption is critical (those for which we ascribe habitat connectivity value in forest underneath) are not presently planned to be constructed “top down”, we therefore assume that the detailed design phase will result in either all of these “habitat connectivity” bridges being constructed top down with little forest disturbance, or other ways that avoid linear disturbance (including access tracks to bridge footings suitable for rubber tyred vehicles, as currently envisaged) will be developed.

To avoid any doubt, this assumption of minimal disturbance during construction of the forest under “habitat connectivity” bridges is crucial to the determination of a benefit for all four connectivity indicators.

5.1.7 Construction Environmental Management

Best practice environmental management will be implemented during construction. With a third party audited, construction environmental management plan being implemented assumed.

Impacts of temporary environmental protection measures are assessed and minimised or mitigated (eg large sedimentation basins constructed outside the disturbance footprint are avoided in favour of other physical means of capturing sediment.

5.1.8 Design of Cuts and Fills

Rock-filled gabions and “Green Terramesh” (Macaferri, 2004) or other mechanisms will be used to minimise the areas of disturbance of cut and fill batters.

5.1.9 Catchment Integrity

The drainage design addresses catchment integrity to the extent that runoff from bridges and the road surface matches the capacity of the receiving catchment.

5.1.10 Noise

Quiet pavement material will be used in areas such as Streets Creek where noise impacts on fauna are a concern.

5.1.11 Light

No general roadway lighting will be introduced to sections of road other than the intersections.

5.2 Integrity of current habitat

We make the fundamental assumption that the habitat on either side of the Kennedy Highway currently have a level of habitat integrity sufficient to maintain the populations of all species presently occurring within it. That is not say that there hasn’t been past disturbance (there definitively has been), but that ecological

processes are still functioning. An increase in connectivity will reduce the current fragmentation between the two areas of forest. These two relatively large continuous areas of largely natural forest with canopy cover are currently fragmented by the presence of the highway. Such fragmentation means that the road forms a barrier to many species . This fragmentation caused by the current road can only be exacerbated with increasing traffic levels and probable progressive widening and removal of canopy connections to accommodate the passing lanes demanded by greater traffic levels.

6 Ecological Processes Indicators

6.1 Canopy Connectivity

Key assumptions relevant to this indicator are:
• maintenance or growth of tree canopy under bridges,- see notes below
• rehabilitation of old road will re-establish canopy connectivity – see notes below
• arboreal mammals will use existing canopy connectivity under bridges after 1 year has lapsed since disturbance.
The indicator has been stratified by:
• areas of importance for plants and animals as shown in Figures 1 and 2; and
• whole road vs. Wet Tropics WHA.

Subsequent to the completion of this assessment additional work has been completed by the Rainforest CRC (Turton & Pohlman 2004) into the fate of the canopy under major bridges (BD05 (Avondale Creek lower), BD14 (Avondale Creek upper), BD22/23 (north / south ridge / Diplazium Gully) and BD25 (Streets Creek)). This research investigated in detail the effects of mechanical canopy removal required to construct the bridges due to geometric conflict, as well as the effect of shading and moisture depletion. While this work revealed that the '10 m clearance' rule assumed in this assessment tended to overstate the survival of canopy under bridges, it is likely that, given attention to maintaining light and moisture levels in key locations (or by the addition of ‘furniture’ to facilitate movement by canopy dwellers), sufficient canopy or canopy function will remain to provide the assumed connectivity. Our conclusions of a net benefit with respect to this indicator are still valid.

They also make multiple assumptions (IAS Addendum SS Net Adverse Impact 5.1.2.ff) that include:

1. **That there will be no major environmental accidents or emergencies (i.e. fuel spills, landslide/erosion etc.) during construction**.
2. **That best practice erosion and sediment control will be implemented**.
3. ***that the restoration of the old road occurs. This is vital to the review of the design. There can be no assumption of the reestablishment of connectivity without adequate restoration of the old road. (note: restoration of the road along all its length is by no means definite. It is possible part of it will be used as a walking/cycle track)***
4. Rainforest habitat will be maintained as close as possible to the road to

ensure minimal width of the road clearing and therefore reduce the extent of penetration of edge effects. Removal of roadside trees will be avoided during construction and maintenance.

5 **Revegetation of cut and fill batters will also reduce edge effects by reducing effective clearing width. (*100% revegetation of batters is highly unlikely as noted elsewhere)***

6 **Clearing for construction tracks etc, will be avoided by the use of top-down construction of bridges and use of the current road alignment to access the new road areas.(*NOTE: some Bridges for which this assumption is critical (those bridges for which habitat connectivity value in forest underneath is ascribed) are not presently planned to be constructed "top down".).***

It is noted:

"To avoid any doubt, this assumption of minimal disturbance during construction of the forest under "habitat connectivity" bridges is crucial to the determination of a benefit for all four connectivity indicators." (IAS Addendum SS Not Net Adverse Impact)

Other assumptions made in IAS Addendum SS Net Adverse Impacts

1 Construction camps and material dumps will be only sited in areas of existing disturbance.

2 All arrestor bed material and fill used for safety ramps will be managed to reduce sedimentation risk.

3 Adequate water will reach the forest habitat under bridges to sustain natural habitat where necessary for fauna connectivity.

4 **Adequate light reaches the forest habitat under bridges especially on east-west aspects (e.g. Diplazium Gully and top Avondale Creek crossing), particularly in areas where species of high conservation significance are known to occur**.

5 A detailed rehabilitation plan will be prepared which sets out the phased rehabilitation of the old road, new cut and fill batters and other construction disturbance as construction progresses.

6 permanent streams culverts, pipes and abutments of the old road will be removed to recreate the original streambed.

7 Banks will be stabilised and the grade of the stream re-established as far as possible (leaving riffle's/pools intact).

8 On the old road, stream banks will have gabion structures or other stabilisation at the interface between the rehabilitated streambed and the remaining road formation methods to ensure long-term stability.

9 The old road surface will be ripped, asphalt/bitumen removed (taken outside WHA), and topsoil re-established and stabilised then planted.

10 Table drains will be left on the road formation together with suitable drainage that includes erosion protection and energy dissipation from them to the streambed.

11 **Canopy connectivity will be retained under bridges, particularly in riparian corridors and where the micro-topography allows opportunity for faunal movements.**
12 Habitat recreation will be achieved through the use of logs, rocks etc. on the old road formation particularly where the road cross-section allows for fauna movement (i.e. where there are no vertical barriers).
13 **Existing weeds will be removed, particularly in areas where there is a possibility of establishing canopy connectivity**.
14 **Rehabilitation should aim to re-establish a forest, which is essentially similar in terms of structure and floristics, to the adjoining forest and/or what occurred in the immediate vicinity prior to the original road disturbance** (the difficult of this is not elsewhere under habitat loss)
15 **Soil disturbance will be kept to the minimum, as any disturbance tends to encourage weeds over other species.**
16 **The initial treatment of the newly exposed margin will be carefully managed to reduce the weed edge effect as quickly as possible.**
17 Revegetation will consider using recommended species
18 **A 'fence and funnel' strategy is adopted for the majority of the road.**
19 any parts of the road that have New Jersey barriers in the centre that divide the uphill and downhill streams of traffic, will be fenced to prevent entrapment of animals on the lanes and subsequent wildlife-vehicle collisions.
20 Ramps or one-way gates will be provided where fauna may stray onto the roadway to prevent trapping individuals.
21 A fine mesh or solid screen will be included at the base to exclude amphibians and smaller reptiles and mammals from the road surface. Such a fence needs to be buried for several centimetres to prevent animals digging underneath.
22 **Where cassowaries are expected, wire mesh fences will not be used. (These are not appropriate as they may damage themselves on the mesh whilst attempting to get through*).-note-cassowaries are seen throughout the highway area***
23 Regular maintenance of fences will be undertaken.
24 Provision of some cover for escape of animals adjacent to the road will be included where cuttings occur (e.g. in the area of the quartzite outcrop), however upgraded fencing will be included when traffic increases to a point where the mortality outweighs the connectivity benefit.
25 Construction phases will be planned to avoid increasing the barrier effect during the long period of construction to ensure that not all key connectivity corridors are affected concurrently.
26 Once construction is concluded, Bridge 24 will be established as a wildlife underpass.
27 The north/south ridge has been assumed to become a restored wildlife

corridor by ensuring that the preferences of cassowaries to move through and under bridges is considered. These birds dislike steep slopes, so we assume reasonable access will be provided near the east abutment of the top bridge.

28 **Fish will be provided with adequate connectivity by improvement of water depth and speed of flow at the existing Streets Creek culvert, especially during times of normal flows.**

29 **Every effort will be made to minimise disturbance underneath bridges as they are constructed.**

30 **Adequate water will reach the canopy and soil in a natural rainfall pattern (under each bridge where habitat connectivity is expected).**

31 Bridges 5, 6, 7, 8, 9, 10, 11a, 13La, 14b, 17, 19, 20Lc, 22, 23, 25, 26 and 28 will be constructed to ensure canopy connectivity is maintained underneath. Bridges 4,12,14a and 27 will be constructed using techniques to minimise surface and vegetation disturbance.

32 **Best practice environmental management will be implemented during construction**.

33 a third party audited, construction environmental management plan being implemented

34 Impacts of temporary environmental protection measures are assessed and minimised or mitigated (e.g. large sedimentation basins constructed outside the disturbance footprint are avoided in favour of other physical means of capturing sediment.

The conclusion is **"if these assumptions are not met in full, the conclusions of this report may not be able to be met**.", i.e. there may be net adverse impact. The least likely assumptions have been highlighted.

Before environmental approvals are assessed, it is vital that **an independent assessment of the Rainforest CRC's research, the IAS and IAS Addendum is done using wider terms of reference including the environmental impact on the integrity of WH values of the urbanisation and industrialisation that the highway facilitates.**