O.1 Flooding

O.1.1 Background

Hydraulic analysis of the proposed New Chum Creek crossing at Daunia Mine has shown that there is afflux upstream of the crossing and a resulting increase in the flood extents. This is most significant on the western banks of New Chum Creek and extends approximately 280m upstream of the crossing for the 1% AEP event.

The Daunia lease boundary ends approximately 13m upstream of the crossing with the consequence that the majority of the afflux experienced will be on RMI property. With this in mind, further Hydraulic analysis has been carried out in order to estimate the drainage infrastructure required to mitigate this afflux.

O.1.2 Analysis and Results

Two new culvert locations have been added to the design to fit in extra culverts. Several cases have been examined and 2 options selected to report on. The description of each of these options is outlined below in Table O-1.

Table O-1 New Chum Creek Crossing – Flood Mitigation Options

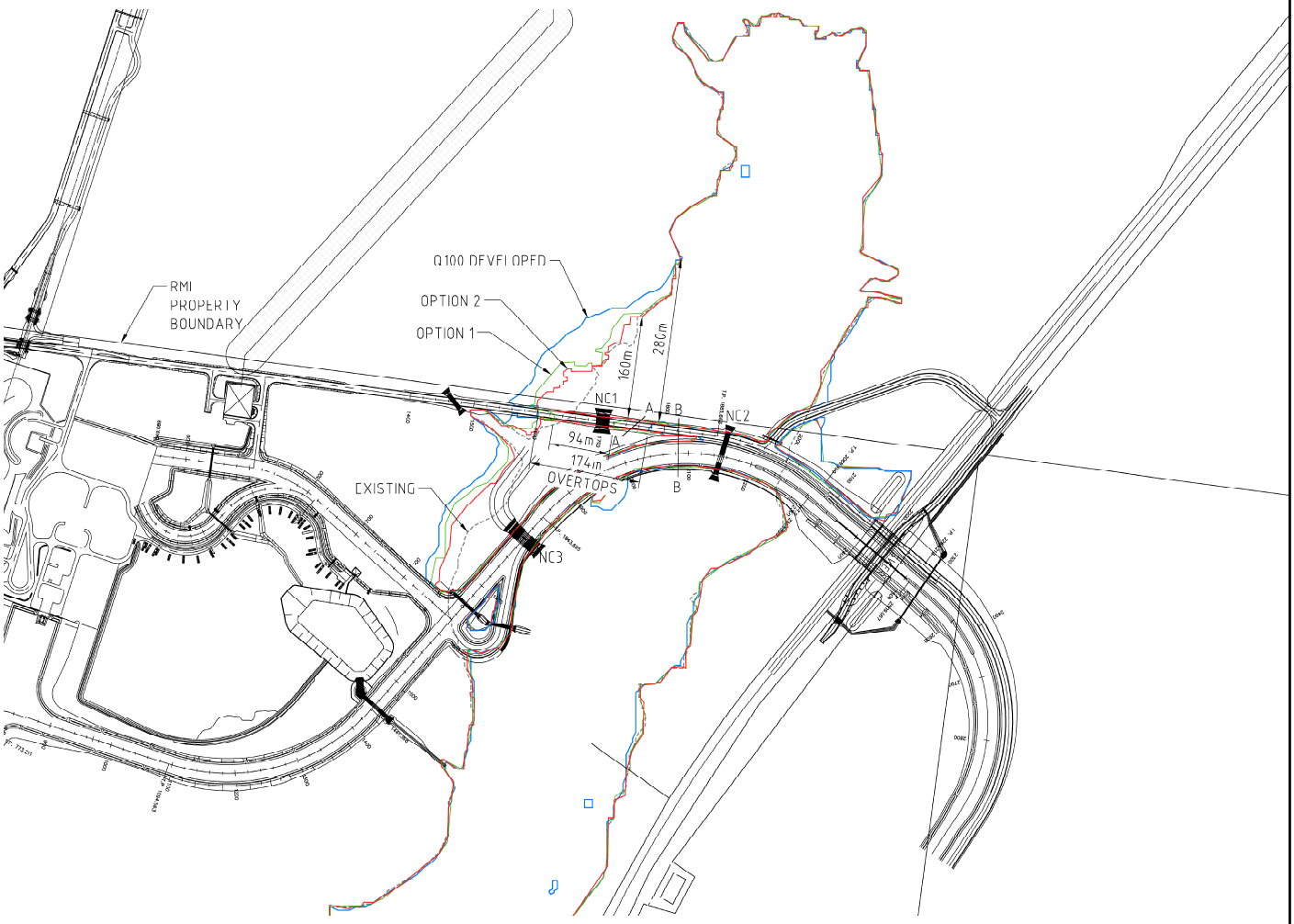
	NC1	NC2	NC3	A (new location for extra culverts)	B (new location for extra culverts)
Design	9/1800 diam RCP	3/2400 diam RCP	9/1800 diam RCP	n/a	n/a
Option 1	9/1800 diam RCP	3/2400 diam RCP	9/1800 diam RCP	9/1800 diam RCP	18/1800 diam RCP
Option 2	9/1800x1800 RCBC	3/2400x2400 RCBC	18/1800x1800 RCBC	9/1800x1800 RCBC	18/2400x1800 RCBC

The flooding extends associated with the Q100 event are presented in **Figure O-1**. Both Option 1 and Option 2 reduce the flood extents but do not completely mitigate the afflux. In both cases the increased flood extent has been reduced to extending 160m upstream of the crossing. In Option 1 the water overtops the floodway along the Light Vehicle Access Road, whereas in Option 2 there is no overtopping. The flood extents for each Option compared with the Existing and the Design flood extents can be viewed in the attached sketch.

After the significant increase in the drainage infrastructure was analysed in Option 2 and did not yet completely mitigate the afflux, no further increase in the structure sizes was investigated. This was because the number and sizes of the culverts was reaching a point where more detailed design would be required to check that there is sufficient room to fit the required structures.

O.1.3 Comments and Recommendations

It should be noted that this analysis was based on estimated culvert locations and levels. Detailed analysis would have to check that the appropriate design cover is achieved above the selected boxes/pipes. The new culverts A and B could have their invert levels reduced providing the appropriate earthworks and drains are possible. This would increase their capacities.



LEGEND

- Option 1
- Option 2
- Q100 Developed

FIGURE 0-1

DAUNIA COAL MINE

Q100 Flooding Extent

BMA

BHP Billiton Mitsubishi Alliance

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O.2 Velocities through Culverts

O.2.1 Background

Concerns have been raised regarding culvert velocities and the requirements of the Department of Fisheries for fish passage through creek crossings. The “Fisheries Guidelines for Design of Stream Crossings” recommend that velocities through the culverts are maintained below 1 m/s. The culvert velocities found in the hydraulic modelling of the proposed design have been extracted for review.

O.2.2 Considerations

Design Guidelines

The “Fisheries Guidelines for Design of Stream Crossings” recommend design velocities through creek crossings be less than 1m/s. These guidelines show a preference towards the use of box culverts, but do not exclude the use of pipes. It is further recommended that multiple culverts be employed and built to match the stream width, a design consideration consistent with the proposed Daunia creek crossing design.

Natural Velocities

Analysis of the existing creek pre-development has shown that the natural velocities range from 1.0m/s to 1.5m/s along the creek length 500m upstream of the crossing to 200m downstream of the crossing. Thus to achieve velocities less than 1.0m/s would be against the natural existing conditions and any type of cross drainage structure would result in afflux upstream of the crossing.

Upstream Creek Crossing

There is an existing creek crossing located approximately 650m upstream of the proposed Daunia creek crossing. The drainage infrastructure at this location consists of 2/ HA 76 CM Arches. Using the hydrological model setup for the Daunia Project, the peak 1% AEP flow at this crossing was estimated to be 155m^3/s. The hydraulics of this structure was then analysed based on the levels from the DEM available for the Daunia Project. From this assessment, the outlet velocity of the flow through the arches was found to be 4.5m/s. This is well above the flow velocities found at the proposed Daunia crossing of New Chum Creek.

It is also important to note that there are no existing waterholes that may be isolated between the existing upstream crossing and the proposed Daunia crossing. These in-stream freshwater pools would have provided important habitat for native fish of the area in an otherwise ephemeral creek.

O.2.3 Design Culvert Velocities

The design culvert velocities through the culverts along the main channel of the creek (NC2) are outlined in the Table O-2.

Table O-2 Current design predicted culvert velocities through NC2

AEP (%)	Culvert Velocity (m/s)
0.02	2.0
0.1	3.2
0.5	3.2
1	3.3

An investigation into the resulting velocities if box culverts were to be used has been carried out. The 3/2400 diam RCP culverts at NC2 have been replaced by 3/2400x2400 RCBC culverts and analysed for the 1% AEP storm event. The resulting velocities are outlined in Table O-3.

Table O-3 Predicted culvert velocities through NC2 using box culverts

AEP (%)	Culvert Velocity (m/s)
0.02	2.0
0.1	3.8
0.5	4.2
1	4.3

The increased capacity at NC2 increases the flow through these culverts and ultimately results in the increased velocity through them.

From this we can conclude that it is not possible to add culverts in at NC2 to achieve velocities that will meet the less than 1m/s criteria as advised in the “Fisheries Guidelines for Design of Stream Crossings”.

The Fisheries Guidelines also recommends a maximum culvert length of 6 metres which we are unable to conform with as the crossing on New Chum creek is provided to cater for a light vehicles and heavy vehicles ie. to suit Cat 793B coal haulers. The width of either of these roads exceeds the fisheries requirements as the road widths are designed to meet specific requirements of the Queensland Coal Mining Act. Specifically the heavy vehicle road must be 3.5 times the width of the vehicle to meet safety requirements and light vehicle and heavy vehicle must travel on separate roads given the disparity in size of both vehicles and the potential for loss of life in an accident.

Additional culverts would be limited by the natural width of the main channel of New Chum Creek and would necessitate channel widening and modification to place the extra culverts. This would in turn increase the impact area on the riverine habitat with the larger footprint for entry and exit structures and culverts. It is also impractical to consider putting baffles into the culverts to slow velocities as the culvert pipes are generally fully submerged in most rain events and any restrictions would dictate the provision of additional culvert which is not practical for the reasons outlined above and there would also be an increase in flood levels upstream of the culverts.

The drainage infrastructure change from pipe culverts to box culverts represents an approximate increase in infrastructure cost of $1M. This is a significant increase of around 3 times the cost of the proposed design using pipes and provides no mitigation affect to the maximum velocities through the culverts.

Providing additional pipe culverts at locations A and B, also adds significant infrastructure cost to the project, approximately $7M. BMA believe that this significant additional cost outweighs the benefits of an 80 m reduction in the distance upstream that is affected by afflux. Accordingly BMA has commenced discussions with the upstream landholder, and agreements will be sought prior to construction. Taking the above findings into consideration, it has been decided to progress with the proposed design in the Project EIS.