
# Review of EIS and supplementary materials on proposed Traveston Crossing Dam, Mary River, SE Qld:

## II: Final report

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# 1 Background

Numerous projects form the South-East Queensland Water Grid, which is being implemented under the SEQ drought emergency strategy. One of these proposes the construction of the **Traveston Crossing Dam** on the Mary River in Queensland.

The proponent of this proposed action has completed a draft EIS and, more recently, a Supplementary Report, on which DEWHA will base their assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EIS and Supplementary Report include, among other things, information relating to nationally threatened and listed migratory species that are protected under the EPBC Act, including:

- Riverine species - the endangered **Mary River cod** (*Maccullochella peelii mariensis*) and **Mary River turtle** (*Elusor macrurus*) and the vulnerable **Australian Lungfish** (*Neoceratodus forsteri*); and
- Species associated with the inter-tidal area and the large seagrass beds within the Great Sandy Strait, downstream of the proposed dam - the listed migratory **dugong** (*Dugong dugon*), **green turtle** (*Chelonia mydas*) and **shorebirds** (specifically Eastern Curlew, Grey-tailed Tattler, Lesser Sand Plover, Terek Sandpiper, Whimbrel, Bar-tailed Godwit, Greenshank and the Grey Plover).

The EIS is intended to provide an assessment of the likely nature and extent of the impacts of the proposed dam on these particular species as well as propose options for mitigating any such impacts if and where they exist. The assessment in the EIS draws on scientific literature on species distribution, abundance and biology (including life-history, reproduction etc.), population surveys and hydrological modelling.

The Department is seeking an independent review of the Traveston Crossing Dam EIS and supplementary materials.

# 2 Objectives and Approach

(i) Evaluate the Draft Traveston Crossing Dam EIS and supporting documentation.

(ii) Consider any other relevant issues raised during the public submission process.

(iii) Consider the response from the proponent to public submissions in the form of the Supplementary Report and review additional technical information provided.

(iv) Present the findings of the review to the Department, both in written report format and as an oral presentation to relevant Departmental staff working on the assessment.

# 3 Scope of this Draft Report

An Initial Review of the Draft Traveston Crossing Dam EIS (SKM, 2007) and supporting materials (including the DEWHA response to the Draft EIS) was submitted to the Department in May 2008. Supplementary documentation also reviewed at that time included: Coxen's Fig-Parrot Recovery Plan 2001-2005 (Coxen's Fig-Parrot Recovery Team, 2001); report on freshwater turtles in the Mary River (Qld EPA, 2007); the Mary River Cod Research and Recovery Plan (Simpson & Jackson, 2005); the lungfish survey of the Brisbane, North Pine and Mary Rivers (Hydrobiologia, 2007) and the recovery plan for stream frogs of south-east Queensland 2001-05 (Hines *et al*., 2002).

The Initial Review identified several generic issues related to the proposed Traveston Crossing Dam including:

- the rationale for construction as presented in the Draft EIS;
- flow regime and environmental flows;
- water quality; aquatic macrophytes; and
- aquatic species of conservation significance.

This Final Report considers: the Supplementary Report to the EIS (SKM, 2008a); the response to correspondence from DEWHA (22 July 2008) requesting clarification and further information on the Supplementary Report (SKM, 2008b); the hydrological modelling review of the Traveston Dam Draft EIS (Bewsher Consulting, 2008) and additional hydrological information (graphs and tables) provided by the proponent; and several publications and reports on species of concern, including the masters thesis on the Mary River turtle (Flakus, 2002); and a recent paper on the status of and threats to the Queensland lungfish (Arthington, 2008).

The Report focuses on each species of concern and considers:

- **Current status of the population** (e.g. distribution, abundance, threats);
- **Impacts of the proposed dam** (following EPBC Significant Impact Guidelines);
- **Mitigation and offset measures proposed** (detailing likely success in mitigating/offsetting the impact/s outlined above);
- **Remaining impacts on the population** (i.e. impact - mitigation/offsets);
- **Summary**

The major focus of this report is on riverine species; especially the endangered Mary River cod and Mary River turtle and the vulnerable Australian Lungfish; largely because these are likely to be most affected by the proposed Dam and altered flow regimes. Two terrestrial/riparian species of concern, the Coxen's fig parrot and the Giant Barred Frog are also considered.

I concur with the proponent that species associated with the inter-tidal area and the large seagrass beds within the Great Sandy Strait Ramsar Wetland, downstream of the proposed dam are unlikely to be greatly affected, given the upper catchment location of the proposed dam (~208km AMTD) and relatively minor flow alteration at the mouth of the river (at least as proposed in Stage 1[1]). Similarly, the proposed dam is unlikely to result in the loss, damage or degradation of any of the World Heritage values of either the Great Barrier Reef WHA or Fraser Island WHA.

[1] Noting that this may not be the case for Stage 2

# 4 Species of concern

## *4.1 Mary River Cod*

### 4.1.1 Current status of the population

The Mary River Cod (*Maccullochella peelii mariensis*) is one of Australia's most endangered fish, with natural populations of the species now restricted to suitable areas of habitat in the Mary River system (Simpson & Jackson, 2005). It is estimated that Mary River cod now occur in less than 30% of their former known range in the Mary River system and remnant populations may have become isolated from each other due to habitat fragmentation and the impoundment of streams.

Significant populations of cod are reported to persist upstream (Obi Obi Ck) and downstream (Six Mile Ck) of the proposed Traveston Crossing Dam and it is noted that the project area contains high quality habitat with a "greater extent of good to ideal cod habitat classes than river reaches above the Project area" (SKM, 2007; pp 8-56,59; Fig. 9-5). It is also suggested (SKM, 2008a) that main channel populations of cod may be more substantial than indicated by previous fisheries surveys.

Mary River cod occur in a variety of habitat types within the Mary River system, from high gradient, rocky, upland streams, to large, slow-flowing pools in lowland areas. Ideal cod habitat has been described as comprising deep, shaded, slow flowing pools with plenty of snags and log-piles; similar to that utilised by the closely related Murray cod and trout cod in the Murray River system (Simpson & Jackson, 2005).

Extensive land clearing in many parts of the Mary catchment has exacerbated erosion and subsequent in-filling of river pools. Removal of native riparian vegetation has also led to reduced shading of watercourses, and reduced timber inputs to provide in-stream cover (Simpson & Jackson, 2005). The net effect of these factors has been to reduce and fragment cod habitats. Overfishing and the impoundment and regulation of streams are also considered to have contributed to the decline and limit the natural recovery of cod populations (Simpson & Jackson, 2005).

Mary River cod have been stocked in impoundments in south-east Queensland since 1983, including those within the Mary River system (Simpson & Jackson, 2005). Most stockings outside of the Mary have been into areas that once contained cod (e.g. Brisbane-Stanley and Albert-Logan catchments).

### 4.1.2 Impacts of the proposed dam

The proposed Traveston Crossing Dam will result in the inundation of high quality habitat for cod. This zone is dominated by deeper pools, with a high proportion of large woody debris which is known to be critical cod habitat (SKM, 2007; p5-76) whereas pools upstream tend to be short and shallow (p5-75). It is unlikely that cod will successfully breed and recruit within the impoundment area, given the low or non-existent success in populations of other Australian percichthyid fishes in impoundments (Simpson & Jackson, 2005).

In addition to the loss of main channel habitat from inundation, the dam will significantly alter habitat conditions downstream (at least to Fisherman's Pocket, 35km downstream), through modification to flow regimes and associated water quality. It is clear from the EIS that substantive changes will occur to low to medium flows in the river downstream of the proposed dam, which already appear to be significantly

affected by existing entitlements (largely direct abstraction along the river) during the dry season (July-November). Flow duration curves presented in the EIS (SKM, 2007; pp 6-38 to 6-44) clearly illustrate the nature of these changes to the flow regime. Subsequent analyses of the simulated hydrological data downstream of the proposed dam requested by DEWHA (SKM, 2008b) further illustrate the significance of these changes in terms of water depth. The proposed dam will result in significantly longer periods of low flow and shallow water (10-30 cm depth) and significantly shorter periods of medium flows and depths (30cm – 1m) at Dagun Pocket and Fisherman's Pocket, though optimisation may be able to offset this during July-October (see 4.1.3). During the summer/autumn months, with high temperatures, high algal and macrophyte production and high water residence time, water quality in pools is likely to become a significant limiting factor for Mary River Cod. This area downstream of the dam (Gympie zone; SMK, 2007; Section 5.3) is dominated by pool habitats (5-78). The EIS noted evidence of fish kills during their surveys (including cod – Plate 8.2, p58) and that this was attributed to extensive macrophyte growth and low flows (SKM, 2007; p8-41). Given the flow changes and associated water quality conditions in pools downstream, it is likely that the incidence of fish kills will increase as a result of the dam.

*The downstream reduction of pool habitat and associated reduction in water quality for extended periods of time is likely to contribute to the further decline of this species.*

It is suggested that the downstream populations of Mary River Cod cannot be affected by flow regime changes associated with the project because they largely occur in tributaries (SKM, 2007; *Executive summary* p2-17; 9-45). This fails to acknowledge important issues of connectivity and metapopulation dynamics, which will undoubtedly be affected by changing the pattern of flows (timing, frequency and duration of connecting flows). The proposed changes to low- and medium flows downstream of the dam are likely to further reduce connectivity and lead to increased fragmentation of existing remnant populations in tributaries.

The EIS (SKM, 2007) refers to previous studies that suggest that barriers and modified flow and temperature regimes are implicated in the reduction of cod numbers in parts of the Mary. The suggestion is then made that, "… given that cod breed readily in hatchery ponds in the absence of flow and that movement is thought not to be associated with spawning, behavioural changes related to flow *per se* may be disadvantageous to, but not critical to, the long-term survival of this species." This argument is clearly not supported by data presented in the EIS nor supported by previous studies (Simpson & Jackson, 2005).

Previous stocking efforts have demonstrated that Mary River Cod can survive in impoundments (Simpson & Jackson, 2005), but there is considerable doubt as to their ability to breed under such conditions.

Several exotic species of fish are currently present in the Mary River system and two others (carp and *Tilapia*) are also known to occur in the region. In the case of the latter, it is also noted that the risk of it spreading to the Mary River and its tributaries is considered high and it is likely that both species will find their way in this storage as they have in other SEQ impoundments (especially if recreational fishing is promoted[2]). *There is a potential threat that these invasive species will become established in the cod's habitat and predate on eggs and juveniles.*

[2] Note – recreational fishing in the storage, as proposed, also represents a direct threat to this species.

### 4.1.3 Mitigation and offset measures proposed

*Provision of habitat within the impoundment*. It is proposed to protect remnant riparian vegetation and to revegetate fringing margins of the dam to provide logs and standing timber for cod within the impoundment. In addition, snag habitat will be introduced using trees cleared from the impounded area, as well as artificial habitats (e.g. hollow pipes). The suitability of riparian vegetation to provide overhanging habitat will of course depend on the stability of the water level and it is likely to only provide similar conditions to that found along river banks if the storage can be maintained at a high level. Similarly, provision of suitable snag habitat and hollows in shallow water will depend on relatively stable water levels within the impoundment.

*Optimisation of environmental flow releases.* It is claimed (SKM, 2007; Executive summary 2-18) that the downstream flow environment is "likely to suit cod because it will stimulate macrophyte growth and the dam will prevent sediment infilling of pools". The supplementary hydrological analyses suggest that flow optimisation can address impacts to median flows, low flows (10-30 cm depth) and medium flows (30 cm – 1 m) but only for the months July – October. However, it will not address the major changes to low – medium flows during the summer and autumn months. There will still be significantly longer periods of low flow (10 – 30 cm) and shorter periods of medium flows (30 cm – 1 m) downstream of the proposed dam during this period, and the risk of poor water quality and loss of pool habitat remains high.

The detailed simulation does not include the pre-development scenario – only the 'existing entitlement' scenario – and the effectiveness of the optimisation scenario needs to be considered in this light. The Mary River WRP acknowledges that the latter does not meet environmental flow objectives for most of the JASON month flows. A review of existing entitlements and the degree to which these represent actual use (rather than sleeper/dozer licences) would be recommended to reduce the risk to cod.

*Revegetation of degraded riparian areas below the dam*. Revegetation of riparian areas downstream of the proposed dam is unlikely to have any benefit if flows are modified to the extent proposed.

*Monitoring and operation of the fishway.* There are no data available on the ability of cod to use fish-ways and additional evidence is needed to provide confidence that they can safely move through the proposed fishway. It is not clear how adjustments to operation can be made if monitoring shows the design to be ineffective. If the fishway is found to be ineffective, then catch and carry methods (yet untested) and re-stocking are proposed.

Proposed hatchery breeding for re-stocking has proven to be successful for this species, though requires considerable on-going commitment. Additional support for the hatchery is an important mitigation strategy. However, there is little information on the long-term survivorship of hatchery reared fish or the proportion of hatchery versus wild fish subsequently captured (Simpson & Jackson, 2005).

*Freshwater Species Conservation Centre*. A proposed mitigation strategy is to "implement the findings of the Freshwater Species Conservation Centre". This provides little confidence, given that the findings of subsequent research may conclude that proposed mitigation measures are ineffective.

### 4.1.4 Remaining impacts on the population

Significant changes to low and medium flows during summer and autumn months will occur that cannot be addressed through flow optimisation. These are likely to have major impacts on the presence and quality of aquatic habitat for cod downstream of the proposed dam. Extended periods of low flow are likely during this time and will be accompanied by high temperatures, high aquatic plant production and low water quality events (including DO extremes). These conditions are likely to result in a higher frequency of fish kills than is currently experienced. This will undoubtedly impact on the persistence and quality of available habitat downstream, impeding potential recovery of main channel populations and further reducing connectivity among tributary populations downstream.

Contrary to the summary statement of the EIS Supplementary Report (SKM, 2008a; 20.6.5):

- the proposed storage area will inundate critical habitat for Mary River Cod, especially deep pools with accumulations of large woody debris.
- while cod can be artificially stocked into the impounded area, it is highly unlikely that they will breed in the storage based on data from other related species.
- the downstream (optimised) flow regime cannot address significant water quality problems in pool habitats (particularly during summer/autumn) that will increase the risk of extreme dissolved oxygen depletion and fish kills including cod.
- there is a high risk that the impoundment will create an additional barrier to what are currently highly fragmented subpopulations and there is no evidence that the interaction between upstream and downstream populations was “naturally limited” (p 20-111).
- the need for movement between very small, isolated subpopulations would actually be expected to be high compared with larger subpopulations because the risk of inbreeding and chance local extinction is higher.
- even if cod can continue to be successfully bred in Gerry Cook Fish Hatchery for stocking, availability of critical habitat post-impoundment may be too low to sustain viable populations in the wild.

### 4.1.5 Summary

The Mary River cod is one of Australia’s most endangered fish and they now occur in less than 30% of their former known range in the Mary River system. The proposed impoundment will inundate critical cod habitat within the main channel of the Mary River. The EIS (SKM, 2007) suggests that the downstream populations of Mary River Cod cannot be affected by flow regime changes associated with the project because they largely occur in tributaries. However, significant changes to low and medium flows during summer and autumn months will occur that are likely to further reduce connectivity among these remnant populations. Restoration of riparian and in-stream habitat and a continued commitment to the stocking program are important recovery strategies for this species.

## *4.2 Mary River Turtle*

### 4.2.1 Current status of the population

The Mary River Turtle (*Elusor macrurus*) is endemic to the Mary River in SEQ and is listed as endangered under the Queensland Nature Conservation Act (1992) and the EPBC Act. It is regarded as the most threatened species of freshwater turtle in Queensland and one of the most threatened in Australia (Qld EPA, 2007). It was known only to the pet trade for over 30 years and not formally discovered and described until the mid 1990s (Flakus, 2002). Prior to this, it had been heavily exploited for the pet trade with estimates of up to 12,000 eggs harvested annually over a 12 year period (Flakus, 2002). Not surprisingly, the population is thought to have declined dramatically since 1974. Individuals do not reach maturity until they are 25-30 years of age and there is evidence of a long period without successful recruitment. As noted in the EIS (SKM, 2007), one of the most pervasive current threats to this species is the loss of eggs on nesting banks – either through human removal, cattle trampling or predation.

The Mary River Turtle is a cloacal breathing species and requires access to well-oxygenated water, in either flowing streams or large water bodies (Qld EPA, 2007). There is evidence that the species can survive and breed in small impoundments such as weir pools where there are stable water levels and base flows. Small juveniles are thought to be at greatest risk if water quality declines and there is reduced oxygen availability.

Most of the turtles (both the endangered Mary River turtle and the white-throated snapping turtle) recorded in EIS were in the inundation area or downstream, predominantly in deep pools >3m deep where there was cover available such as logs and snags or dense macrophyte beds (SKM, 2007; 8-92). Sections of the Mary River within the proposed inundation area and immediately downstream of the dam were therefore considered to be critically significant. However, the Qld EPA (2007) report suggests that the species also occurs in deeper holes of Mary River further downstream.

### 4.2.2 Impacts of the proposed dam

Recent detailed mapping of potential nest sites for the Mary River Turtle in the project area implies that most will not be directly inundated by the proposed Traveston Crossing Dam (SKM, 2008a; p20-68). However, of the 66 potential sites identified, 32 of these will be inundated (48%) and an additional 3 will be directly downstream of the dam in the zone most affected by flow alteration (pp20-56 - 58). Although downstream reaches of the river near Tiaro have historically been considered to be critical habitat, nesting sites within the project area are likely to be important for local recruitment.

There is little doubt that adults, and especially juvenile turtles, will be threatened by the direct loss of riverine pool habitat. The inundation zone is dominated by deeper pools, with a high proportion of large woody debris which is known to be important turtle habitat (SKM, 2007; p5-76) whereas pools upstream tend to be short and shallow (p5-75). The inundation area was suggested to be critical habitat for turtles with a high proportion of juveniles (SKM, 2007).

The Supplementary Report (SKM, 2008a) suggests that the most significant turtle habitat is not the inundation area but in fact the 5km reach downstream from the dam site. Substantive changes will occur to low to medium flows in the river downstream of the proposed dam, which already appear to be significantly affected by existing

entitlements during the dry season. The proposed dam will result in significantly longer periods of low flow and shallow water and significantly shorter periods of medium flows and depths at Dagun Pocket and Fisherman's Pocket, though optimisation may be able to offset this during July-October (see 4.2.3). During the summer months in particular, with high temperatures, high algal and macrophyte production and high water residence time, water quality in pools is likely to become a significant limiting factor for this species. This area downstream of the dam (Gympie zone; SMK, 2007; Section 5.3) is dominated by pool habitats (5-78). Juvenile turtles are considered to be at greatest risk if water quality declines and there is reduced oxygen availability (Qld EPA, 2007).

*Inundation of important habitat areas by the dam and the downstream reduction of pool habitat and associated reduction in habitat (water) quality for extended periods of time is highly likely to contribute to the further decline of this species.*

Studies cited in the Qld EPA (2007) report suggest that impoundment structures are a barrier to the movement of turtles and that no existing fish-way design has been proven suitable for enabling them to pass safely back and forth. It is likely that the proposed Traveston Crossing Dam will fragment the remnant populations of turtle.

Furthermore, turtles can be injured by sudden flow releases downstream from dams when they congregate close the outlet under low flow conditions. They can also be trapped and die on filter systems on water release intakes within the impoundment.

Issues of physical connectivity of key habitats (barrier effects of the dam plus altered downstream flows) and the consequences for population viability are not well considered in the EIS and it is even suggested that "the need of the species for significant movement is likely to be low"; though no evidence is provided to support this notion. In the absence of high levels of connectivity and dispersal, the risks of local extinction (e.g. from poor water quality events) are likely to be high.

A large proportion of the project area is suggested to remain as suitable nesting habitat when the dam is in place (SKM, 2007) and potentially reduce the degree of impact. However, one of the proposed mitigation strategies to control invasive weeds (e.g. para grass) along the littoral margins of the impoundment is to permit cattle access. This will undoubtedly pose a significant risk of trampling of potential nest sites.

### 4.2.3 Mitigation and offset measures proposed

*Habitat suitability of the proposed impoundment.* Observations that Mary River Turtles appear to survive quite well in shallow, slowly flowing habitats (Qld EPA, 2007) have been taken to assume that the Traveston Crossing impoundment will create suitable habitat for feeding and nesting. However, all of the cited examples of use of impoundments are from small, shallow weir pools and barrages with relatively stable flows and water levels. It is unlikely that the Traveston Dam can be operated under similar stable habitat conditions to these small weirs and barrages.

The assumed establishment of extensive macrophyte beds has also been suggested to provide additional benefits for turtles as an important food source. It is assumed that conditions in the proposed dam will favour macrophyte growth. However, this is rarely observed in other water storages that are used for water supply where water levels fluctuate beyond the tolerance range of submerged macrophytes or where phytoplankton blooms effectively out-compete submerged macrophytes for light and nutrients.

It is proposed to protect remnant riparian vegetation and to revegetate fringing margins of the dam to provide logs and standing timber for turtles within the impoundment. In addition, snag habitat will be introduced using trees cleared from the impounded area. The suitability of this habitat will of course depend on relatively stable water levels within the impoundment.

*Relocation and protection of nest sites.* Relocation of egg clutches from nesting sites that will be in deep water to suitable sites above FSL is proposed. No evidence is provided to indicate the likely success of relocation of eggs and this appears to be a high risk strategy. Protection of nest sites from predation and stock trampling is clearly an important mitigation strategy though how it will be achieved is unclear.

*Optimisation of downstream flows.* The EIA Supplementary Report (SKM, 2008a) suggests that turtles in the area downstream of the dam will actually benefit from flow regime changes and that this will be a focus area for habitat improvement. As indicated in 4.1.3, the supplementary hydrological analyses suggest that flow optimisation can address impacts to median flows, low and medium flows but only for the months July – October. However, it will not address the major changes to low – medium flows during the summer and autumn months. There will still be significantly longer periods of low flow and shorter periods of medium flows downstream of the dam during this period, and the risk of poor water quality and loss of habitat for turtles in pools remains high.

The detailed hydrological simulation (SKM, 2008b, 5.1 & 5.2) also suggests that the proposed optimisation cannot offset impacts to low flows and medium flows in all years. There apparently will be significant periods of extended low-flow below the dam (on occasion for up to 3 years) under the proposed optimisation scenario. This will undoubtedly have major consequences for all aquatic species in the main channel of the river. As noted in 4.1.3, this detailed simulation does not include the pre-development scenario – only the 'existing entitlement' scenario – and the effectiveness of the optimisation scenario needs to be considered in this light. The Mary River WRP acknowledges that the latter does not meet environmental flow objectives for most of the JASON month flows. A review of existing entitlements and the degree to which these represent actual use (rather than sleeper/dozer licences) would be recommended to reduce the risk to turtles.

*Rehabilitation of riparian and in-stream habitats below the dam*. Rehabilitation of degraded riparian and in-stream habitats downstream of the proposed dam is unlikely to have any benefit if flows are modified to the extent proposed.

*Potential barrier effects.* Problems of death and injury of turtles have been recorded with some fishway devices and other dam infrastructure; however, QWI engineers believe that these can be designed to exclude turtles from areas of potential harm. A passive transfer by-pass channel is now proposed to enable turtles (and other biota) to move up- and downstream of the dam wall. It is noted, however, that this technology is untried and would be a research project of the Freshwater Species Conservation Centre. This poses a significant risk if subsequent research proves that such mitigation is unsuccessful.

Catch and carry of juveniles, adult males or eggs is proposed as a practical and feasible solution to overcome problems of fragmentation of turtle populations. Captive breeding and translocation is unlikely to be a successful mitigation strategy, however, if

suitable adult and juvenile habitat is substantially reduced both downstream and within the impounded area.

### 4.2.4 Remaining impacts on the population

The proposed inundation zone is dominated by deeper pool habitats with a high proportion of large woody debris, and large numbers of adult and juvenile turtles were recorded in the EIS. This critical habitat will be eliminated by the impoundment. The proponent believes that turtles will make significant use of the storage area – including potential use for breeding and feeding. There is little direct evidence to support this conclusion, which is based on observations from shallow, stable-flowing weir pools and barrages. It also assumes the establishment and persistence of suitable macrophyte beds which cannot be guaranteed.

The area 5km downstream of the proposed dam is also considered by the proponent to be an important habitat for turtles (SKM, 2008a; 20-61). Significant changes to low and medium flows during summer and autumn months will occur that cannot be addressed through flow optimisation. This is likely to have major impacts on the presence and quality of aquatic habitat for turtles downstream of the proposed dam. Extended periods of low flow are likely during this time and will be accompanied by high temperatures, high aquatic plant production and low water quality events (including DO extremes). In light of these impacts, it is extremely unlikely that turtles will benefit from the flow regime changes as claimed.

As noted in the EIS, one of the most pervasive threats to this species will continue to be the loss of eggs on nesting banks – either through human removal, cattle trampling or predation. Protection of nesting banks must be seen as a priority action for the recovery of this species, irrespective of the outcome of the Traveston Dam proposal.

Contrary to the summary statement of the EIS Supplementary Report (SKM, 2008a; 20.6.5):

- the proposed storage area will inundate critical habitat for Mary River Turtles, especially deep pools with accumulations of large woody debris.
- It is unclear as to whether turtles will use the larger impounded area, as other records of ‘impoundment’ use are from small weir pools and barrages.
- the downstream (optimised) flow regime cannot address significant water quality problems in pool habitats (particularly during summer/autumn) that will increase the incidence of extreme dissolved oxygen depletion and risk to turtles (especially juveniles).
- there is a high risk that the impoundment will create an additional barrier to what are currently highly fragmented subpopulations and there is no evidence that the interaction between upstream and downstream populations was “naturally limited” (p 20-111).
- the need for movement between very small, isolated subpopulations would actually be expected to be high compared with larger subpopulations because the risk of inbreeding and chance local extinction is higher.
- even if turtles can be successfully bred in the proposed Freshwater Species Conservation Centre, availability of critical habitat post-impoundment may be too low to sustain viable populations in the wild.

### 4.2.5 Summary

The Mary River Turtle is regarded as the most threatened species of freshwater turtle in Queensland and one of the most threatened in Australia. Loss of eggs from nesting banks continues to be a major threat to this species and protection of nesting sites and captive breeding are important mitigation strategies. However, half of the potential nesting sites within the project area will be inundated by the proposed dam. The proposed storage area will also inundate critical habitat for turtles, especially deep pools with accumulations of large woody debris.

The area 5km below the proposed Traveston Crossing Dam site is also considered in the EIS (SKM, 2008a) to be very important habitat for turtles. Significant alteration of low- and medium flows will result in a reduction in the availability and quality of shallow, flowing pool habitat for extended periods of time. This is highly likely to lead to a continued decline in population size of the Mary River turtle. Proposed flow optimisation strategies, are unlikely to address this issue.

Catch and carry of juveniles, adult males or eggs offers a feasible solution to overcome problems of fragmentation of turtle populations above and below the dam, though would require ongoing commitment and intervention. However, availability of critical habitat post-impoundment may be too low to sustain viable populations in the wild.

## *4.3 Giant (Southern) Barred Frog*

### 4.3.1 Current status of the population

This endangered species occurs in moist riparian forests from Maryborough to central coastal NSW in association with slow moving streams. Numerous records have been made for the Mary River catchment and the species was noted in the EIS to be prevalent from several lowland tributary systems that will be affected by the dam inundation (Belli, Happy Jack and Skyring Creeks). This species has suffered declines in the southern part of its range and at elevated habitat areas in the Conondale Range, apparently due to Chytrid fungus. In addition to the fungus, current pressures include riparian clearing, stock access to riparian zones, changes in flow regimes and degradation of water quality (Hynes, 2002).

### 4.3.2 Impacts of the proposed dam

As noted in the EIS Supplementary Report (SKM, 2008a; 20-35), there is a possibility of a long-term decrease in the population size of this species given the anticipated loss of ~215 ha of habitat (and loss of individuals in known populations) along tributary streams due to inundation.

The population genetic structure of this species is unknown but it is worth noting that current populations along tributaries appear to be fragmented by lack of suitable habitat along the main channel of the Mary River. Inundation may further fragment existing populations.

Given the observed declines in upland areas in SEQ and throughout its southern range there is increased significance of these lowland populations. It is possible that the loss of potential habitat along tributary streams due to inundation from the proposed dam will adversely affect habitat critical to the survival of this species. Without quantitative assessment of the relative significance of these habitat areas and the population

genetic structure throughout the species range, it is difficult to assess the implications of this decline on the survival of the species.

Proposed mitigation measures in the Recovery Plan include protection and rehabilitation of riparian areas and control of stock access on private land. Accordingly, loss of riparian areas due to inundation may interfere with current recovery efforts.

### 4.3.3 Mitigation and offset measures proposed

Rehabilitation of riparian habitat along tributaries upstream of the FSL is proposed. However, it is unlikely that this will be successful in the short- to medium-term until new riparian habitat is established.

Research on captive husbandry is proposed with the aim of reintroduction of individuals to maintain genetic diversity in isolated populations. It is suggested that this "will ensure the long-term viability of these populations" (p20-36) though there is no evidence to suggest that this will be the case. In fact, there can be significant risks to population viability from translocation of individuals between isolated populations (see Hughes *et al*., 2003).

Control of invasive weeds and feral animals (e.g. pigs) in the QWI land purchase area is proposed and is likely to be important. However, it is unclear from the EIS as to what methods will be used and what the likely ongoing investment will be. Some proposed control measures for invasive weeds (including cattle grazing) may impact on frog populations.

### 4.3.4 Remaining impacts on the population

This species is likely decline in population due to loss of critical habitat, especially in the short to medium term while rehabilitated riparian areas upstream of the inundation area become established.

Impacts of additional fragmentation of habitat on isolated populations are difficult to assess without further knowledge of population genetic structure. The proposed captive breeding is untried and translocation of individuals poses an unknown risk.

### 4.3.5 Summary

Observed declines of this species in upland areas in SEQ and throughout its southern range place increased significance on lowland populations in the project area. The proposed inundation of these critical lowland habitats is likely to have a significant impact on the population of this endangered species

## *4.4 Coxen's Fig Parrot*

### 4.4.1 Current status of the population

Coxen's fig-parrot is one of Australia's rarest and least known birds and is listed as endangered on Schedule 2 of the Queensland *Nature Conservation (Wildlife) Regulation 1994*, on Schedule 1 of the New South Wales *Threatened Species Conservation Act 1995*; and under the Commonwealth *EPBC Act 1999.* It also meets the criteria for critically endangered under the IUCN threat category C2a (population estimated to be <250 mature individuals and in continuing decline, no subpopulation contains more than 50 mature individuals).

Within its range, Coxen's fig-parrot occurs wherever fig trees are present in lowland and upland forest types, riparian corridors, farmland and urban environments and it feeds primarily on the seeds of figs. The subspecies has declined due, at least in part, to the clearing of lowland subtropical rainforest in SEQ and north-east NSW. The presence of abundant fig trees appears to be an important factor governing the subspecies' occurrence.

### 4.4.2 Impacts of the proposed dam

Forest habitat is already highly fragmented within the region and it is unlikely that the project will result in any further significant fragmentation of foraging habitat (unless birds are reluctant to fly across the open expanse of water).

However, the project will result in clearing and/or inundation of vegetation that contains fig trees; significantly ~60 ha of endangered RE 12.3.1 (simple to complex notophyll vine forest with *Waterhousia floribunda*). Of this, 27 ha are considered to be high quality examples of this RE in good condition (SKM, 2007; p7-71). In addition, the project will lead to the loss of an additional 28 fig trees, which represents approximately 10% of the total of 277 'paddock trees' in the region (EIS p20-40).

### 4.4.3 Mitigation and offset measures proposed

Replanting of at least 56 fig trees is proposed in targeted areas (EIS p20-40). However, the time to mature and produce abundant fruit for this (and other frugivorous species) is unlikely to offset this loss of both fig trees and associated RE 12.3.1 vegetation in the short- to medium-term.

### 4.4.4 Remaining impacts on the population

A 10% loss of critical feeding habitat (with fig trees) will occur in the short- to medium-term.

### 4.4.5 Summary

The further reduction of fig trees within the project region may further compound the availability of critical feeding habitat for this species in what is already a highly fragmented landscape.

## *4.5 Queensland Lungfish*

### 4.5.1 Current status of the population

The Queensland Lungfish (*Neoceratodus forsteri*) has been protected by the Queensland Fish and Oyster Act since 1914 and was formally listed as a vulnerable species under the EPBC Act in 2003. Lungfish are endemic to the Mary and Burnett River systems though are also present as translocated populations in other rivers and impoundments in SEQ. Significant genetic differentiation has been observed both within and between populations of lungfish in the Mary and Burnett Rivers and Frentiu *et al*. (2001) recommended conservation of all populations in the two rivers to protect the total genome.

Mature lungfish were recorded throughout the project area during the EIS and the population was described as “healthy” (p8-65 EIS). A large number of observations of lungfish were made in the proposed inundation area of the main Mary River channel (but not tributary sites) during the EIS survey (SKM, 2007; Fig 9-6), and previous studies have recorded it throughout the Mary River from the Barrage upstream to Conondale (Arthington, 2008). “Healthy” populations of lungfish are suggested to occur in the Brisbane River below Wivenhoe Dam (SKM, 2007; *Executive summary* 2-18).

The evidence presented in the EIS and in other publications, however, suggests the contrary. Nearly 40% of the core habitat for lungfish in its native distribution (main channels of the Mary and Burnett Rivers) is already currently impounded (p8-64). Furthermore, no juveniles were recorded during the EIS fish and turtle surveys and the population appears to be dominated by elderly individuals (Fig 8-16). It is suggested that this is because juveniles are notoriously difficult to sample (*Executive summary* 2-18). However, given the longevity of this species (+70 years), a more alarming interpretation is that there has been little significant recruitment for some time.

Lungfish spawn in macrophyte beds in slow flowing habitat that is sufficiently oxygenated – typically in riffle, run or glide habitats – during August to December when flows are low. Highest densities of early stage embryos are typically associated with intermediate flow velocities, low turbidity, high dissolved oxygen levels, depths of 40- 60 cm and moderate to high densities of aquatic macrophytes 16 – 35 cm in height (Brooks and Kind 2002; cited in Arthington, 2008). Structurally complex plant species (such as *Vallisneria gigantea*) contain higher densities of fertilized eggs than those of simpler growth form.

Existing water entitlements identified in the WRP already impact on EFO’s in the Mary River (notably at Dagun Pocket and Fisherman’s Pocket) during the lungfish spawning season and represent a threat to spawning and recruitment if all allocations are utilised. Further changes to flow regimes (either from water resource development or changing climate), particularly during the spawning season, pose a considerable threat to remaining critical spawning habitat of this species.

*The Mary River lungfish represents a geographically distinct regional population of a vulnerable threatened species, as defined under the EPBC Act. It can also be considered as an ‘important population’ that is necessary for the species’ long-term survival and recovery, given that many other populations (especially those in impoundments) show little evidence of breeding and recruitment, and that the populations are considered necessary for maintaining genetic diversity.*

### 4.5.2 Impacts of the proposed dam

Nearly 40% of the core habitat for lungfish in its native distribution (main channels of the Mary and Burnett Rivers) is already currently impounded (SKM, 2007; p8-64). The proposed Traveston Crossing Dam will inundate a significant proportion (36.5 km – about one fifth[3]) of the main channel habitat for lungfish within the Mary River, as well as the lower reaches of several tributaries. This includes a high proportion of riffle and run habitats, critical for spawning and recruitment. The proposed inundation zone is dominated by deeper pools, with a high proportion of large woody debris (SKM, 2007; p5-76) whereas pools upstream tend to be short and shallow (p5-75).

[3] Note – Stage 2 is expected to inundate 50.7 km.

Although it is claimed that lungfish can successfully spawn and recruit in impoundments, the available evidence suggests this is rarely the case. Catches from Wivenhoe and North Pine dams suggest that these impoundments may promote good condition in larger specimens but do not support smaller lungfish (Hydrobiologia, 2007). Furthermore, no documented evidence has been provided of successful spawning within the Paradise Dam impoundment on the Burnett River (noted in SKM, 2008a; p 20-87). Without such evidence, it can be assumed that impoundments provide suitable conditions only for growth and survival of adult lungfish. They do not provide the requisite conditions for spawning and recruitment – essential to long-term persistence of populations. In this respect, impoundments cannot be expected to retain lungfish populations in the long-term unless recruitment and dispersal can occur from un-impacted spawning beds upstream or downstream.

As indicated in 4.1.2, the dam will significantly alter habitat conditions downstream (at least to Fisherman's Pocket, 35 km downstream), through modification to flow regimes and associated water quality. Substantive changes will occur to low to medium flows in the river downstream of the proposed dam, which already appear to be significantly affected by existing entitlements during the dry season. The proposed dam will result in significantly longer periods of low flow and shallow water and significantly shorter periods of medium flows and depths at Dagun Pocket and Fisherman's Pocket, though optimisation may be able to offset this during July-October (see 4.5.3). During the summer months in particular, with high temperatures, high algal and macrophyte production and high water residence time, water quality in pools is likely to become a significant limiting factor for aquatic species. This area downstream of the dam (Gympie zone; SMK, 2007; Section 5.3) is dominated by pool habitats (5-78). Low flow conditions suitable for spawning (August-December) are already impacted by existing entitlements in the Mary but may not be further impacted by the proposed dam if downstream flows can be optimised (SKM, 2008a,b – see 4.5.3).

*The combination of loss of critical habitat through inundation, and downstream reduction of pool habitat and associated reduction in habitat (water) quality for extended periods of time is likely to lead to a long-term decrease in the size of the Mary River lungfish population, to the extent that the species is likely to decline.*

The degree to which the proposed dam will fragment the Mary River lungfish population into two populations will ultimately depend on whether fish are able to successfully move through the proposed fish lock (and/or other mitigation measures, including translocation are effective). The significance of this potential barrier to overall population viability requires a more detailed knowledge of population genetic structure. In the absence of high levels of connectivity and dispersal, however, the risks of local extinction (e.g. from poor water quality events) are likely to be very high.
It is noted that several exotic species of fish (mostly small-bodied species) are currently present in the Mary River system and that two others (carp and Tilapia) are also known to occur in the region. In the case of the latter, it is also noted that the risk of it spreading to the Mary River and its tributaries is considered high (SKM, 2007; p8-37) and it is likely that both species will find their way into this storage as they have in other SEQ impoundments (especially if recreational fishing is promoted) and ultimately spread up- and downstream. *There is a potential threat that these invasive species will become established in the lungfish's habitat and predate on eggs and juveniles.*

### 4.5.3 Mitigation and offset measures proposed

*Optimisation of downstream flows.* "Healthy" populations of lungfish are suggested to occur in the Brisbane River below Wivenhoe Dam (*Executive summary* 2-18) and leads to the conclusion that "… regulated flow regimes are known to favour lungfish" (SKM, 2007; Executive summary p2-27). Base flows in the Brisbane River below Wivenhoe are elevated well above natural dry season flows as the channel is used to convey water to Mt Crosby. Given the likely operation of Traveston Dam, it is not safe to assume that regulation of flows downstream will favour lungfish in the way they are claimed to do in the Brisbane River (8-64).

It is also claimed (SKM, 2007; Executive summary 2-18) that the downstream flow environment is "likely to suit lungfish because it will stimulate macrophyte growth and the dam will prevent sediment infilling of pools". As indicated in 4.1.3, the supplementary hydrological analyses (SKM, 2008b; addressing DEWHA questions 2 & 4) suggest that flow optimisation can address impacts to median flows, low flows and medium flows but only for the months July – October. Although this is timed to provide critical flows for spawning, it will not address the major changes to low – medium flows during the summer and autumn months. There will still be significantly longer periods of low flow and shorter periods of medium flows downstream of the proposed dam during this period, and the risk of poor water quality and loss of habitat for adult and juvenile fish in pools remains high.

The detailed hydrological simulation (SKM, 2008b, 5.1 & 5.2) also suggests that the proposed optimisation cannot offset impacts to low flows and medium flows in all years. There apparently will be significant periods of extended low-flow without flushing events below the dam (on occasion for up to 3 years) under the proposed optimisation scenario. This will undoubtedly have major consequences for all aquatic species in the main channel of the river downstream of the dam.

It is worth noting that this detailed simulation does not include the pre-development scenario – only the 'existing entitlement' scenario – and the effectiveness of the optimisation scenario also needs to be considered in this light. The Mary River WRP acknowledges that environmental flow objectives are not met for most of the JASON month flows under the existing entitlement scenario. A review of existing entitlements and the degree to which these represent actual use (rather than sleeper/dozer licences) would be recommended to reduce the risk to spawning and recruitment of lungfish.

*Provision of spawning habitat within the reservoir.* There is little doubt that macrophyte beds play an important role for lungfish (spawning and juvenile habitat). This has led to some speculation in the EIS as to the potential benefits of the proposed impoundment. It is argued that (i) the impoundment is likely to develop fringing macrophyte beds (though this will depend on a range of operational and water quality factors); (ii) that macrophytes are important for lungfish – "… the primary limitation to potential lungfish breeding is the maintenance of a suitable macrophyte population"; and, as a consequence, (iii) lungfish may breed in the storage (SKM, 2007; *Executive summary* 2-18). As noted above, no evidence of successful spawning and recruitment has been recorded within the Paradise Dam impoundment or elsewhere where the species has been translocated. Recent surveys of lungfish from Wivenhoe and North Pine dams suggest that these impoundments do not support smaller lungfish (Hydrobiologia, 2007).

*Effectiveness of proposed mitigation of barrier effects.* Evidence is needed to provide confidence that lungfish can safely move through the proposed fishway, including data on the effectiveness of the downstream fishway on Paradise Dam, which was completed in 2005. The proposed fall-back option for mitigation is to catch and move lungfish to overcome barrier effects (Executive Summary, p2-20). It is not clear who would do this and how would it be resourced over the longer term. I consider this to be a high-risk mitigation option if the fishway fails.

A captive breeding program is also recommended as one of the goals of the proposed Freshwater Species Conservation Centre. While it is known that lungfish can be successfully reared in captivity, the consequences of reintroduction of captive-reared fish to population viability are unknown. Availability of critical habitat is likely to still pose a major constraint to recovery in the wild.

### 4.5.4 Remaining impacts on the population

Flow optimisation will not address significant changes to low and medium flows during summer and autumn months that are likely to have major impacts on the presence and quality of aquatic habitat for lungfish downstream of the proposed dam. Extended periods of low-flow are likely during this time and will be accompanied by high temperatures, high aquatic plant production and low water quality events (including DO extremes).

Flow optimisation cannot meet flow needs during the spawning months (July – October) in all years and detailed simulations suggest that there will be extended periods of low flow in the river – longer than would be experienced under the existing entitlement scenario[4]. This will undoubtedly impact on the persistence and quality of available habitat downstream.

Existing water entitlements identified in the WRP already impact on EFO's during the spawning season and represent a threat to spawning and recruitment if all allocations are actually utilised (i.e. there may be sleeper/dozer licences).

The establishment and persistence of extensive macrophyte beds in the proposed impoundment (assuming reservoir operation and water quality permit this) is unlikely to provide additional spawning and recruitment opportunities to offset losses in habitat downstream and in the area of inundation.

Contrary to the summary statement of the EIS Supplementary Report (SKM, 2008a; 20.6.5):

- the proposed storage area will inundate critical habitat for lungfish.
- while adult lungfish will be able to utilise the impounded area, it is highly unlikely that they will breed in the storage.
- the downstream (optimised) flow regime may provide stable base flows during the spawning season, but it is likely to lead to significant water quality problems in pool habitats at other times that will not favour lungfish.
- there is a high risk that the impoundment will fragment existing populations and there is no evidence that the interaction between upstream and downstream populations was "naturally limited" (p 20-111).

[4] Noting that detailed hydrological graphs for the pre-development scenario were not available for comparison.

- the need for movement between small, isolated subpopulations would actually be expected to be high compared with larger subpopulations because the risk of inbreeding and chance local extinction is higher.
- even if lungfish can be successfully bred in the proposed Freshwater Species Conservation Centre, availability of critical habitat post-impoundment may be too low to sustain viable populations in the wild.

### 4.5.5 Summary

The Mary River lungfish represents a distinct regional population of a vulnerable threatened species, as defined under the EPBC Act. It is also an 'important population' that is necessary for the species' long-term survival and recovery, given that many other populations show little evidence of breeding and recruitment, and that the populations are considered necessary for maintaining genetic diversity. It is very long lived and this can lead to the impression that populations (primarily comprised of large adult fish) are in good health, despite little evidence of successful recruitment. This, together with the combination of loss of critical run and riffle habitat through inundation, and downstream reduction in availability and quality of spawning and pool habitat for extended periods of time is highly likely to lead to a long-term decrease in population size of the Mary River lungfish. Proposed mitigation strategies, including flow optimisation, are unlikely to address these issues.

## *4.6 Other species of concern*

A second cloacal breathing turtle – the White-throated snapping turtle (*Elseya albagula*) – has only recently become known to science (2006) and has been assessed as a high priority for conservation management by the Queensland EPA's 2006 Back on Track prioritisation framework.

This species is likely to be affected in similar ways to the Mary River Turtle.

# 5 Concluding remarks

The likely impacts of the proposed Traveston Crossing Dam on the species of concern identified in this report should be considered in the context of the reported need for the additional water supply. As discussed in my interim report (May 2008):

- Traveston Dam (Stage 1) is likely to meet only 7-12% of the projected total demand by 2051, depending on the population growth scenario.
- Projected water demand in SEQ is based on a "high water savings scenario" of 230 L per capita, and it is suggested this would be difficult to achieve. This level of residential water consumption can hardly be regarded as sustainable under current (and certainly future) climate conditions in most Australian cities. A demand management target of less than 200 L per day per capita would offset the need for the proposed Traveston Dam.
- Stormwater harvesting (other than rainwater tanks) is not considered as a viable alternative, yet recent work in other Australian cities suggests that this could cost-effectively supply 20% of their water needs (in addition to rainwater tanks, as part of water sensitive urban design).

It is evident that significant impact to low- to medium flows will be associated with the Traveston Crossing (Stage 1) Dam, regardless of the proposed flow optimisation strategies, and that this will undoubtedly affect several of the species of concern. Although low flow EFOs are not mandatory under the Mary River WRP, it is evident that there is failure to meet these requirements in most of the low flow months (July to November) with the existing entitlements. Given the significance of these flows to the availability and quality of critical habitat for several species of conservation concern, recovery plans will need to address this even without the construction of the dam.

It is clear that several species of concern are also threatened by factors other than those directly associated with the construction and operation of the Traveston Crossing Dam. These include stock access and trampling of stream banks, degradation of riparian zones, channel erosion, and direct predation. Urgent action is required to address these other threatening processes.

The establishment of a Freshwater Species Conservation Centre and support of research on these threatened and endangered aquatic species is a laudable goal. However, if populations cannot be sustained in the wild because of loss of critical habitat then this Facility will be little more than a museum.

Finally, it is important to note that the consideration of impacts of Traveston Crossing Dam in this report is based entirely on scenarios for the construction of Stage 1. No information has been provided on the implications of Stage 2 of this proposal – other than that the storage area will be significantly larger. One can only assume that the effects of inundation and degradation of downstream habitat will also be more significant than reported here.

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