Agency Responses

1. RTA Response

In relation to the RTA's submission in response to the PPR, our comments are as follows:

A. We would concede to removing all access to the Princes Highway. The RTA would have to take responsibility for the evacuation issues associated with future flood events.
B. The expert opinion of Mr. Graham Pindar of Traffix Pty Limited included in PPR as the document entitled Revised Traffic Study Traffix Pty Ltd (see Table 1 below) clearly shows that the existing intersection of the Princes Highway and South Head Road without the proposed development will already result in unacceptable performance, as indicated by Service Level F. It states categorically that "this is due to background traffic levels and is not a result of the proposed development".

table 1. future intersection performance with seasonal increase factor (without development)

Intersection Description	Control	Time Period	Degree of Saturation	Intersection Delay (secs)	Level of Service
Princes Hwy / South Head Rd	Priority	AM	2.170	855.9	F
		PM	1.509	362.1	F

Furthermore it states that:

"The provision of a 'seagull' type intersection arrangement will allow vehicles to undertake a two-stage crossing and will improve the performance of this intersection, particularly for westbound traffic along South Head Road turning north onto the Princes Highway. This was the preferred arrangement as outlined in the previous traffic report. The performance of this intersection arrangement is summarised in **table 2** below with consideration to the redistribution of traffic as a result of the proposed changes".

table 2. future 'seagull' intersection performance with seasonal increase factor (without development)

Intersection Description	Control	Time Period	Degree of Saturation	Intersection Delay (secs)	Level of Service
Princes Hwy / South Head Rd	Priority 'Seagull'	AM	0.601	19.2	B
		PM	0.612	35.0	C

The Traffix Pty Lit report goes on to say:

> "It can be seen from above this intersection will operate effectively in the future with a 'seagull' type arrangement. The performance of this (previously proposed) intersection with the additional traffic associated with the development is shown in **table 3** below".

table 3. future 'seagull' intersection performance with seasonal increase factor (with development)

Intersection Description	Control	Time Period	Degree of Saturation	Intersection Delay (secs)	Level of Service
Princes Hwy / South Head Rd	Priority 'Seagull'	AM	0.781	24.3	B
		PM	1.198	172.0	F

The report goes on to say that as can be seen from table 3 above that in the pm period, the performance of the seagull intersection eventually reaches an unacceptable level of performance and that a roundabout intersection was considered but failed to meet the performance criteria and as such signalisation would be required.

The evidence provided by the Traffix Pty Limited Traffic Study proves that the intersection of South Head Road and Princes Highway will already fail to meet acceptable traffic standards, without the proposed development. As such we reject the RTA's contention that the developer should be made to pay for the required intersection upgrade.

We would be willing to pay a fair share of the costs associated with this upgrade. Contributions should also be made by the other developments on South Head Road both planned and envisaged in the future, and the RTA/Council should contribute in proportion the current volumes of

traffic that exist today and would grow in the future, should our project not proceed.

It is manifestly unreasonable to force the full cost upon our development and those of other proponents, when the intersection already has performance problems.

C. As per point A above, we would be willing to remove this access altogether.

2. Greater Southern Area Health Service Response

In relation to the points raised by the Greater Southern Area Health Service, our comments are as follows:

The Updated Moruya Social Impact Report by Sphere Property Corporation provided with the PPR states that 65% of the future residents of the proposed development are already living within the immediate locality. The secondary catchments for the project are dominated by people who have a long-term association with the area via ownership of holiday accommodation from Canberra. That is to say that approximately 85% of the demand on the current health care infrastructure already exists today.

The Sphere Property Corporation report goes on to say:

> "As an alternative to accessing public health facilities, the project will provide aged care services in the village and thus not only address any shortfall but possibly reduce the load on the existing health care infrastructure in the township. Moruya East Village is proposing to provide a wide range of health related services to its residents. These include GP, physiotherapy, podiatry, occupational therapy etc which will be provided from rooms located in the Village Square precinct. The proposed Dementia Sanctuary will provide high care nursing services to residents primarily residing within the village on a 24 hour a day basis".

In addition, the project is targeted at the next generation of retirees for who health and wellness is a major life priority. The inclusion of the Botanica health and wellness facility that provides a wide range of health, fitness and wellness activities will be a boost to the general health and wellbeing of the residents of the project.

The Social Impact Assessment undertaken by Sphere states:

> "All of the facilities proposed within the Botanica centre are integral to provision of the high quality lifestyle for older people which is the prime objective of the Moruya East Village development. The centre

will play a vital role in development of a cohesive and integrated community.

The provision of the services and facilities as set out above will improve the health and wellbeing of the ageing residents in the Moruya East Village. The improvement will be in terms of physical health and emotional wellbeing due to the engagement with other people within the community. This has proven positive effects upon the utilisation rates of traditional health care services as healthy and happy people use hospital service less.

In summary, the wide range of health and wellness services and facilities provided by and within the Moruya East Village will have a positive impact upon the utilisation rates of the existing and proposed healthcare infrastructure in the township of Moruya."

The comments from the Greater Southern Area Health Service ignore the fact that 86% of the load upon the health services infrastructure attributable to the residents of the proposed development, already exists in the area today.

The response also fails to appreciate that the services that will be provided on-site in addition to the health and wellness infrastructure will moreover reduce the current load of the current health services infrastructure.

The expert advice provided by Sphere Property Corporation concludes as follows:

"The analysis undertaken by SPC concludes that the impact of the Moruya East Village project upon the social and health related services on the township of Moruya will be negligible over time. This is primarily due to the wide range of health and wellness services and facilities being provided on-site and the positive health and emotional dividends that this will deliver for the residents occupying the homes within the project.

Furthermore, a large proportion of potential residents will be drawn from with the catchment area served by the existing healthcare and social facilities. This will have a positive effect by allowing younger families to occupy these homes thereby reinvigorating the social and economic fabric of the township".

3. Department of Environment and Climate Change and Department of Water and Energy Combined Response

The consultants who have contributed to these notes are, in alphabetical order:

- Australian Bushfire Protection Planners (ABPP)
- EDAW
- Evans & Peck (E&P)
- Keystone Ecological

Introduction

These notes provide a consolidated set of responses by the relevant consultants to a range of issues raised in submissions to the Department of Planning (DoP) in relation to the proposed Moruya East Village by:

- Department of Environment and Climate Change (DECC) (letter dated 22 January 2009);
- Department of Water and Energy (DWE) (letter dated 2 March 2009);
- Submission from Lachlan Bain (email dated 18 December 2008).

The submissions referred to above contain some common themes including misunderstanding important aspects of the proposal and the previous documentation provided in the "Preferred Project" documentation as well as some aspects where the project been amended slightly in order to address the key issues in a manner that is consistent with the proposed scale and form of the development.

A common theme that emerges from the submissions by DECC and DWE is that there appear to be misunderstandings as a result of references in the documentation to proposals in a particular location being taken as referring to a different area. To assist in clarifying some misunderstandings, three drawings are appended to these notes. All these drawings are exactly the same as previous drawings submitted with the "Preferred Project" with some minor additions for the sake of clarification:

- ***Concept Plan*** (Drawing 00010154/01.01/01 Rev D, prepared by dKO, 6/3/2009). This drawing shows the masterplan layout for the site with added labelling to designate locations and drainage lines of relevance.
- ***Proposed Riparian Corridors*** (Drawing 06502307/SK14 Rev D, prepared by EDAW, 6/3/2009). This drawing shows the layout of the two proposed riparian corridors within the Southern Precinct and has been amended to show the location of a small farm dam within the Northern Riparian Corridor.

- ***Riparian Corridor Detailed Plan and Perspectives*** (Drawing 06502307/SK3 Rev C, prepared by EDAW, 9/12/2008). This drawing was submitted as part of the "Preferred Project" document set and remains unaltered. It is included here for the sake of completeness and will simply be referred to as ***EDAW Drawing No SK03***.

The proponent has acknowledged earlier submissions by the relevant agencies and has attempted to amend the proposal where possible in order to accommodate the issues raised. These amendments to the proposal seem to have caused some confusion as to the exact nature of the proposal. These notes seek to clarify such issues.

Lowland Grassy Woodland

Tree Removal Adjacent to the Development

DECC is concerned that trees adjacent to the development in Lowland Grassy Woodland will be removed; previous drawings did not show this loss and these are not offset or addressed. This item refers to a number of trees at the interface between some lots and the woodland in the south eastern corner, that are shown in the landscape Concept Plan (Rev E) as destined to be removed (indicated in extract below).

The impact of the loss of these trees and the associated area of Lowland Grassy Woodland were not assessed by Keystone Ecological in any of the impact assessment documents as they lay outside of the footprint of the proposed development

The indication that these trees will be removed is in error. This tree removal is shown only within the landscape Concept Plan and is not supported by any other project document.

Therefore, the trees indicated for removal will remain; importantly this includes all of the hollow-bearing trees in this part of the site. Also, as the proposed lots are large, trees within the lots at the rear may also remain, depending on an arborist's assessment regarding the danger of retaining such a tree and the ability to accommodate the root protection zone within the lot (see below).

In this area of the site, the final developed ground level will be the same as the current ground level and so there will be no change to any soil parameters. Root protection zones according to the British Standard (10 times the diameter at breast height) will be implemented as part of the environmental management during the construction phase.

Requirement for APZs

DECC is unclear as to whether APZs will be required. The requirements for asset protection zones and other bushfire mitigation measures have been further investigated by ABPP.

Of relevance here is the required asset protection zone between the lowland grassy woodland in the south eastern corner of the site and the proposed adjacent lots to the north-west (shown in the figure above). It is proposed that the asset protection zone be 38 metres wide, measured from the buildings, being made up of an inner protection area (IPA) of 23 metres and an outer protection area (OPA) of 15 metres. The fuel reduction activities in the asset protection zone is intended to retain its woodland character with the retention of the existing unconnected canopy, ground layers unconnected with the tree canopy and fine fuel levels low enough so that it is unlikely carry significant fire.

The required management regime of the IPA is fuel reduction by regularly slashing the understorey, perhaps as often as on a monthly basis. Only the aerial parts of plants will be removed, thus maintaining soil processes and ground cover. However, it is recognised that past management of this woodland has resulted in a single age class of largely senescent trees and that if regeneration of the tree layer is not allowed, it will alter its state entirely and become a derived grassland. In recognition of this potential as well as its status as an endangered ecological community, specific management activities will be identified in a Management Plan specific to the asset protection zone that will allow the regeneration of some trees within the IPA. This will be achieved by the retention in the first instance of isolated clumps of regenerating trees. The dominant tree within these clumps will be retained and the others removed in order to deliver the discontinuous canopy as required for an asset protection zone.

The understorey of the OPA is also to be slashed, but less frequently (2 or 3 times per year) and patches of understorey may remain up to a density approved by the bushfire

consultant (usually up to 20% across an OPA). This will allow for the regeneration of some trees to replace the older senescent trees as well as some regeneration of the shrub layer.

It must be noted that the return of a fully structured regenerating woodland is not the main objective of the asset protection zone – it is intended to act as a barrier to fire where fuels (i.e. vegetation) are reduced – although it will serve some conservation objectives. The conservation objectives of the woodland are mainly served by the remainder of the woodland remnant that will be retained and managed for conservation purposes along with areas of open grassland that will be regenerated as woodland across the rest of the site.

Freshwater Wetlands

Presence of Freshwater Wetlands

DECC is concerned that the presence of Freshwater Wetlands and the impact on them by the development remains unresolved. This issue has been investigated by desk top analysis as well as further site assessment. The drainage line in question was floristically surveyed on 5th March 2009.

The vegetation of the drainage line is principally that characteristic of grazed open grassland. The drainage line channel has a longitudinal slope of about 2.5%, carrying water from the surrounding cleared slopes to the floodplain vegetation below.

A small dam has been created in the centre of this drainage line as part of the site's management as a grazing property. The extent of associated moist vegetation around the dam has been determined by hand-held GPS during the site visit of 5th March 2009 by Keystone Ecological and is shown on the ***EDAW Proposed Riparian Corridors*** drawing (06502307/SK14 Rev D). The entire area occupied by this "moist" vegetation is 0.1 hectares.

The small dam is approximately 3 metres wide and has a low bund of excavated soil on its downslope side. This dam is now empty but, as intended, has served to interrupt and slow the natural flow of water down the drainage channel. To this end, some plant species adapted to moist soils grow around this dam, principal among them being the sedge *Carex appressa*. The presence of past moisture is evidenced also by the pugged soil damaged by cattle drinking from the retained water.

Floristic data were collected from a quadrat of 20 metres by 10 metres in this vegetation. This quadrat covered the entire extent of this "moist" vegetation. A species list of all plants observed in this quadrat is provided in Table 1. Of note is the dominance of weed and pasture species.

Family	Scientific Name	Common Name	Q 1
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	1
Apiaceae	*Centella asiatica*	Swamp Pennywort	1
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort	nb
Asteraceae	*Onopordum acanthium* subsp. *acanthium**	Scotch Thistle	1
Asteraceae	*Taraxacum officinale**	Dandelion	3
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort	nb
Cyperaceae	***Carex appressa***	**Tall Sedge**	**4**
Fabaceae	*Medicago polymorpha**	Burr Medic	1
Juncaceae	*Juncus articulatus*	Jointed Rush	1
Juncaceae	*Juncus bufonius*	Toad Rush	nb
Juncaceae	*Juncus continuus*	-	1
Juncaceae	*Luzula flaccida*	-	1
Lamiaceae	*Marrubium vulgare**	-	1
Lythraceae	*Lythrum hyssopifolia*	Loosestrife	nb
Onagraceae	*Epilobium ciliatum**	-	1
Plantaginaceae	*Plantago lanceolata**	Ribwort	2
Poaceae	*Agrostis capillaris*	Browntop Bent	1
Poaceae	*Cynodon dactylon*	Common Couch	3
Poaceae	*Eragrostis curvula**	African Lovegrass	nb
Poaceae	*Holcus lanatus**	Yorkshire Fog	3
Poaceae	*Paspalum dilatatum**	Paspalum	3
Poaceae	*Pennisetum clandestinum**	Kikuyu	3
Poaceae	*Setaria gracilis**	Slender Pigeon Grass	2
Poaceae	*Setaria verticilliata**	Whorled Pigeon Grass	2
Poaceae	*Urochloa panicoides**	Urochloa Grass	2
Polygonaceae	***Persicaria decipiens***	**Slender Knotweed**	**1**
Polygonaceae	*Rumex conglomeratus**	Clustered Dock	1
Rosaceae	*Rubus fruticosis* sp. agg.*	Blackberry	1

Table 1: Flora species observed in quadrat of 200 square metres (10 metres x 20 metres) located in and around small dry dam, centred at grid reference Zone 56 H 237512 E 6020737 N MGA, 5 March 2009. Relative abundance rating is the standard 6-point modified Braun-Blanquet cover scale. nb = recorded nearby but outside of the quadrat. The species that are listed as characteristic of Freshwater Wetland endangered ecological community are shown in bold.

The pattern of the "moist" vegetation in this area indicates that it is driven by the presence of the dam: dense sedges occurred in a circular pattern centred on the excavated low point, quickly narrowing to a metre wide (maximum) dry channel down

which water flows during wet times. The water would overtop and flow around the dam.

The issue at hand is whether this constitutes an area of the endangered ecological community Freshwater Wetland. This issue has been explored in previous correspondence prepared by Keystone Ecological, namely 9 October 2008 and 9 December 2008.

The endangered ecological community Freshwater Wetlands have been defined by the NSW Scientific Committee. Such vegetation communities are defined by a number of factors, including species composition, landscape position, soil characteristics and disturbance history. To further aid in their recognition, identification guides have been published by DECC.

One of the important characteristics of wetlands is that they occur in flat areas, where water will lie for periods of time. Freshwater wetlands within the southern rivers region are characterised by DECC and other experts as reasonably large open water bodies: "*Typical freshwater wetland types on the south coast include areas of more or less permanent standing water like Waldron's Swamp …*" (*Recognition and Management of Endangered Ecological Communities in the South East Corner of N.S.W.,* Miles 2006).

This is demonstrably not the case for the drainage line in question, except in the area where the small dam has been excavated. Water runs freely and quickly down the slope to the marshy low lying area, unless impeded temporarily by high tides in Racecourse Creek.

Keystone Ecological conducted detailed floristic survey of the site on two occasions during late spring 2006 and early autumn 2009. On each occasion, very few species were observed that are listed as characteristic of Freshwater Wetland. The recent survey specifically sampled the drainage line within which DECC reported the presence of many characteristic species; only two such species were observed by Keystone Ecological (see Table 1 above).

DECC reported the presence of many species characteristic of Freshwater Wetlands during their site inspection. However, no species list, relative abundance data or locational information have been provided.

All of the reference material and newly-acquired data reinforce Keystone Ecological's previous opinion that while some species present in the drainage line are characteristic of Freshwater Wetland, they are commonly occurring species that will grow wherever moisture is available. It is obviously an artificial situation brought about by the excavation of a very small dam and the associated moist vegetation is restricted to approximately 0.1 hectares.

This is a trivial example of wetland vegetation and does not constitute an example of the Freshwater Wetland endangered ecological community. It is not appropriate to classify highly degraded shallow excavated depressions on slopes in grazing paddocks as Freshwater Wetlands.

Future Management of Freshwater Wetland

Notwithstanding our interpretation that the area in question does not constitute an example of the Freshwater Wetland endangered ecological community, the area occurs wholly within the proposed Northern Riparian Corridor (as shown on the ***EDAW Proposed Riparian Corridors*** drawing). Therefore, in order to satisfy DECC's concern regarding Freshwater Wetland, this part of the riparian corridor will be actively managed and rehabilitated with vegetation appropriate to that vegetation community from local provenance material. The buffer from the development footprint provided to the area occupied by the small dam and its associated vegetation is adequate to protect it from edge effects and other indirect impacts.

Offsets

The issue of offsets has been addressed by Keystone Ecological in previous correspondence and is reiterated here. The proposal will avoid impacting on 4.3 hectares of Lowland Grassy Woodland, which will be retained on site and managed for conservation purposes, less the area of asset protection zone. This will, of itself, produce an improvement in the status of this endangered ecological community on site. The areas to be lost for the development footprint have been minimised (see above) and totals 2.3 hectares in fair to poor condition. The unavoidable losses have been offset on site by the proposed rehabilitation of 6.34 hectares of habitat that once supported this vegetation community.

Thus, for the loss of 2.3 hectares of Lowland Grassy Woodland, the proposal provides the opportunity to retain and manage 4.3 hectares and restore a further 6.34 hectares, thus providing a total on-site offset of 4.6:1. The areas to be restored are also strategically located as they will restore connectivity that has been broken by past clearing.

These offset areas are those that support vegetation types 1 and 5 (i.e. above the floodplain) that occur outside of the proposed development footprint.

The ability to offset losses with rehabilitation actions is a cornerstone of the Government's recent initiatives for conservation on private lands, namely the Property Vegetation Plan tools underpinning the Native Vegetation Act and Regulation and the BioBanking Assessment Methodology underpinning the new amendments to the Threatened Species Conservation Act.

Riparian Corridors

Rehabilitation of Riparian Corridors

Rehabilitation works are proposed within the Northern and Southern Riparian Corridors (these areas are labelled on the site ***Concept Plan*** and shaded green on the ***EDAW Proposed Riparian Corridors*** drawing). Both riparian corridors contain ephemeral watercourses, with there being little or no evidence of any defined banks. These are first order streams located at the top of their catchments and are characterised as little more than grassy swales in their upper reaches, transitioning as the grade becomes more gentle to a marshy, low-lying character, incorporating a few minor impoundments of water, a more meandering swale, and defined in the main by a relatively lush growth of reeds and other low riparian vegetation within it.

These riparian corridors have been defined as "Category 3" by DWE. The proposed measures to rehabilitate these riparian corridors have been developed with the specific aim of achieving the functional objectives for "Category 3" riparian corridors, namely maintenance of bank stability and enhancement of water quality. As set out in previous documentation, the proposed rehabilitation of will include the following key elements:

- Minimal disturbance within the riparian corridors;
- Works will essentially be restricted to replanting, and some minor reshaping including the incorporation of ephemeral wetlands and the provision of scour protection at stormwater outlets;
- There may be some need for minor re-routing of the existing naturally formed swale where it comes close to the development edge. This work can be readily undertaken without impacting upon the required functions of achieving bank stability and water quality, or compromising the ecological values of the corridor;
- The works within the riparian corridor will be characterised by their soft engineering nature;
- The character and intent of the proposed works are illustrated on ***EDAW Drawing No. SK03Riparian Detail Plan*** (copy attached).

In the context of the above, it is considered that the level of information provided is sufficient to characterise the intended works for purposes of project approval. Further detail of the extent and nature of these works will be documented during detailed design following project approval.

Gabions and Pathways in Riparian Areas

As illustrated on ***EDAW Drawing No. SK03Riparian Detail Plan***, gabions have been proposed primarily to fulfil a scour protection function at drainage outlets. It should be noted that a total of only eight stormwater drainage outlets are proposed (three in the northern corridor and five in the southern corridor). The intent is that the scour protection will be designed as sculptural elements compatible with the surrounding urban landscape. It is recognised that the reasons for not using gabions within riparian corridors are often cited as their propensity to become weed infested, and the potential for damage to occur to the watercourse if they fail in the future. These concerns can be seen as valid for watercourses that are unlikely to be well maintained. However, within the context of the proposed medium density, highly urbanised setting within which the riparian corridors are proposed, minor interventions of this nature do not pose a threat in this regard. The riparian corridors will be subject to regular weed management, and if a gabion basket were to fail at some point in the future, the problem would be quickly identified and rectified. Notwithstanding, other forms of scour protection at drainage outlets could be considered during detailed design.

With regard to the issue of pathways, and the need for these to be "*outside the minimum riparian corridor widths*", we confirm that these structures are outside the Core Riparian Zone as defined in the letter from EDAW dated 10 December, 2009, as follows:

> *EDAW AECOM Drawing No. SK03C provides a typical detail plan of the riparian corridor. As can be seen from this, the CRZ is defined within a pathway system running down both sides of the corridor (as seen downstream of the bridge), and varies in width. The Department's total CRZ requirement (i.e. 20 metres wide x the length of the watercourse) will be exceeded.*
>
> *The perspective view on the same drawing indicates the nature of the natural community to be restored, the structural character of which will be consistent with the nature of an ephemeral watercourse.*

Management of Riparian Corridors

The Northern and Southern Riparian Corridors will comprise a CRZ and a buffer edge. Both the CRZ and the buffer edge planting will be managed in different ways, as follows:

- The CRZ will be managed to maintain both:
  - an open ephemeral watercourse community with a character similar to that illustrated in the perspective view on ***EDAW Drawing No. SK03Riparian Detail Plan***, and also

  - a reduced bushfire hazard fuel loading, including a breaking up of connectivity along its length, e.g. by means of ephemeral ponds and rock beaching.

- The buffer edge will comprise of plant species complementary to the CRZ, and will be managed primarily to reduce bushfire fuel loadings.

It is recognised that fuel management of the CRZ within a Category 3 watercourse is not in keeping with the preferred position of DWE. However, in the context of the overall development (i.e. where more than a 1/3 of the site area is to be managed primarily for conservation), the proposed level of vegetation within the riparian corridors will:

- More than adequately address the requirement of '*the critical role of riparian vegetation for stabilising the bed and banks of watercourses and filtering catchment run-off and the contribution this makes to overall catchment health and retention of land (e.g. protection of property and assets)*'.

- Provide substantial habitat qualities well beyond those currently present on the site, and

- Be visually in keeping with highly urbanised setting in which they are situated.

Factors that have been taken into account in developing a drainage strategy that specifically address the bank stability and water quality objectives set down by DWE for "Category 3 " watercourses are:

Bank Stability

- As noted previously, the existing watercourses largely comprise broad grassy swales with minimal occurrence of a small defined bank. This character will be maintained in the development;

- The watercourses will be situated within a highly urbanised and visually open setting which will be regularly managed in accordance with the requirements of a Vegetation Management Plan, as required by Condition 9 of DWE's draft Conditions of Approval. If any the banks do become unstable, these locations will be quickly identified through the normal process of corridor maintenance, and the problem rectified promptly;

- Apart from minor overland flow from a few building lots that back onto the riparian corridors, all stormwater drainage will be directed to stabilised outlets;

- As indicated in the perspective sketch in ***EDAW Drawing No. SK03Riparian Detail Plan***, much of the vegetation along the length of the watercourse will comprise of swathes of sedges and rushes to the ephemeral zones of the bed

and edges – plant associations of this nature are highly effective at stabilising the bed and banks of ephemeral watercourses.

Water Quality

- Apart from a few building lots that will drain directly to the riparian corridors, the overwhelming majority of the stormwater entering the watercourses will have already been subject to water quality control by means of 198 "rain gardens" through which all road drainage will be directed. Subsequent treatment by gross pollutant traps (located immediately upstream of the stormwater pipe outlets) will ensure that any litter and oil is also removed. The analysis presented in the *Water Cycle Management and Flooding Report* (Evans & Peck, June 2007) and supplementary analysis in the letter report by Evans & Peck (11 September 2008) indicates that the proposed treatment system will lead to lower levels of stormwater pollutants reaching the watercourses than occurs under existing conditions. This treatment will be achieved regardless of the level of vegetation management within the riparian corridor;
- As indicated in the perspective sketch in ***EDAW Drawing No. SK03Riparian Detail Plan***, and as described above, the proposed sedge and rush plant associations that will inhabit much of the banks of the watercourses, are substantially effective at filtering and bio-remediating pollutants – this will occur as an unsolicited beneficial passive environmental service naturally provided by the plant association, and provides an additional water quality polishing function to those intentionally employed within the development.

The proposed vegetation management regime for the Southern and Northern Riparian Corridors has been reviewed by ABPP and is considered to be consistent with the earlier assessment that these corridors are to be managed to the extent that they will not present a bushfire threat.

Disturbance to Riparian Areas

DECC has expressed concern that there is lack of clarity in relation to the level of disturbance in riparian areas. In order to help clarify any misunderstanding, the attached ***Concept Plan*** has been annotated to define a number of different riparian areas where the proposed development involves different levels of management:

Marshy Low Lying Area

This area comprises the land located generally along the western boundary of the site which lies beneath the 100 year ARI flood level. The original proposal for management of this area involved removal of *Juncus acutus* by excavation which would leave shallow depressions in which surface water would accumulate. In view of objections

to this proposed means of weed control expressed by the Agencies, this procedure is no longer proposed. The letters from EDAW (10/12/2008) and Evans & Peck (5/12/08) are both consistent and clear in this regard. No excavation or engineering works are proposed in this area.

Tennis Court and Swimming Pool

The proposed locations of a tennis court and swimming pool on the edge of the marshy low lying area have always been features of the proposed development. In relation to the water courses, these proposed facilities are located as follows:

- **Swimming Pool**: minimum of 50 m east of the Racecourse Creek tributary and outside the 20 m wide riparian corridor defined for the Northern Riparian Corridor (see the ***Concept Plan*** drawing for naming convention and the ***Proposed Riparian Corridors*** drawing for location of watercourses);
- **Tennis Court**: minimum of 75 m east of the Racecourse Creek tributary and outside the 20 m wide riparian corridor defined for the Northern Riparian Corridor.

These locations are considered to be sufficiently offset from the watercourses to lead to minimal potential impact on the functioning of the adjoining riparian areas. Notwithstanding, Silver Spirit Partners are prepared (if required) to remove the tennis court from the proposal. In the case of the swimming pool, it is an integral part of the "Botanica" facility. It is considered that the pool will have no adverse impact by way of runoff from the pool area (see Section 0 below).

Surface and Groundwater Quality

Stormwater Treatment

There are no proposals for stormwater treatment facilities in any defined riparian areas:

- The *Water Cycle Management and Flooding* report, subsequent supplementary reports prepared by Evans & Peck and the stormwater drainage plans prepared by Hyder Consulting only identify stormwater treatment facilities located within the development footprint of the Southern Precinct and the Braemar Farm Precinct. Any small water bodies located outside the boundaries of the formal development footprint (such as the "Farm Dam" within the Northern Riparian Corridor) are for aesthetic or ecological purposes only. There is no intention for stormwater treatment functions to be fulfilled in any riparian area. Any water quality improvement that occurs within the riparian corridors will

occur purely as a result of rehabilitation undertaken in order to address DWE's objectives for bank protection and water quality.

- The original landscape Concept Plan showed a number of areas of open water within the marshy low lying area. These were intended to represent minor depressions remaining after excavation to remove *Juncus acutus*. These areas had no formal water treatment function. As explained in **Section 0** above, control by excavation is no longer proposed. Accordingly, the landscape Concept Plan that formed part of the "Preferred Project" documentation (Drawing 06502307 SK01 – Rev E) does not show any open water areas within the marshy low lying area. There are no proposals for stormwater treatment facilities within the marshy low lying area.

Fertilisers, Pesticides, etc

DECC has expressed concern that the indirect impact of the use of garden fertilisers, pesticides, herbicides and pool chlorine associated with the development have not been adequately quantified and the potential impact have not been adequately assessed.

The stormwater management system developed for the site is consistent with "best practice" stormwater management practice and the industry standard modelling software (MUSIC) has been used to assess the effect of the development on stormwater quality. With the possible exception of some runoff from the yards of a few houses that directly adjoin the Northern and Southern Riparian Corridors, all excess roof runoff and all surface runoff will have to travel through some form of bio-retention system before it reaches the riparian areas. These systems are effectively small stormwater filters that rely on filtration and the uptake of water (and associated plant nutrients) by plants in order to reduce the mass of water borne pollutants. Because these systems rely on both filtration and biological uptake, they can also be expected to capture herbicides, pesticides, etc. The MUSIC modelling package contains algorithms that represent the processes of transport and retention of three key pollutants (total suspended solids [TSS], total phosphorus [TP] and total nitrogen [TN]) that are considered to be of most concern to the environment and are representative of a wider suite of pollutants that might be present in stormwater. The modelling undertaken for this study demonstrates that proposed treatment facilities will reduce sediment (TSS)and fertiliser (TN and TP) annual loads compared to existing conditions. Because nitrogen is a dissolved pollutant, the modelling also demonstrates that other dissolved pollutants that have not been specifically analysed, will also be retained in the treatment systems.

The development site lies near the junction of Racecourse Creek and its main un-named tributary. The catchments of these creeks contain large areas of farmland and, in the case of Racecourse Creek, a golf course. The volume of runoff and loads of associated fertilizers and herbicides/pesticides from these catchment areas are likely to far exceed that which will come from the proposed development. Accordingly, the runoff from these areas has posed in the past, and will continue to pose, a much more significant threat to the vegetation in marshy low lying areas of the site than future runoff from the development. Notwithstanding this pre-existing and ongoing threat, and the direct impact of cattle grazing over many years, vegetation has survived. It is likely that the effect of the exclusion of cattle, the proposed management of existing vegetation to remove weeds and promote regrowth of species that are representative of the various ecological communities together with the high standard of stormwater treatment within the development will, in fact, have a significant beneficial effect on the ecology of the marshy low lying area.

In common with standard swimming pool design, all overflow and filter backwash water from the swimming pool will be directed into the sewerage system. The only potential source of chlorine from the pool reaching the environment would be as a result of water dripping from swimmers onto the pool surrounds. This will not pose a threat to the vegetation in the area adjoining the pool for a number of reasons. Firstly, the volume of water dripping from swimmers as they exit the pool is relatively small and, secondly, any residual chlorine will rapidly diffuse into the atmosphere as the water evaporates. It follows that only trivial quantities of chlorine, if any, are likely to be present on the surface of the pool deck at a time when there is sufficient rainfall to cause runoff. And people are unlikely to be swimming in the rain!

Stormwater Treatment Modeling

Mr Bain provided a submission that questioned a number of aspects of the stormwater treatment modelling undertaken by Evans & Peck. The issues raised concern the assumed pollutant reduction effectiveness for GPTs, the time-step adopted for modelling and location of GPTs downstream of bio-retention systems. Responses to each of these issues are set out below.

Gross Pollutant Trap Effectiveness

Although quotation marks are used in the submission, the precise words quoted by Mr Bain have not been identified in the quoted report (Walker, TA, Allison RA, Wong, THF, and Wootton, RM [1999] *Removal of Suspended Solids and Associated Gross Pollutants by a CDS Gross Pollutant Trap*, CRC for Catchment Hydrology, Report 99/2).

In this instance, the focus of the modelling by Evans & Peck was on the annual pollutant loads not the concentrations during a particular storm event. Relevant aspects of the CRC report that were taken into account in the stormwater modelling were:

- "*The CDS unit effectively reduced TSS concentrations levels above 75 mg/L with an estimated mean removal efficiencies of 70%. TSS removal efficiency was more variable for inflow concentrations below 75 mg/L*" (Discussion, Paragraph 2).

- The effectiveness of a treatment system in reducing the annual load of a pollutant is a function of the relative proportions of annual runoff volume that occur during light or heavy rainfall, the increased pollutant loads that occur as a result of heavy rainfall and the effectiveness of the treatment system at different flow rates. The analysis reported in the CRC report took account of the fact that much higher pollutant concentrations could be expected in heavier rainfall (which accounts for the majority of the total volume of annual runoff) as well as the reduced effectiveness for TSS concentrations of less than 75 mg/L. The result of taking account of all those factors was an average annual pollutant load removal efficiency for TSS of 65% (Table 4). (Note that Evans & Peck only assumed 20% effectiveness.)

- The CRC report noted that "*The estimated removal efficiency of TP above the background concentration of 0.5 mg/L is approximately 30%.*" (Section 5.5, Paragraph 2). In a similar manner to the analysis for TSS efficiency, the report analysed the combined effects effect of varying TP with rainfall, the relative contributions of different storms to the volume of annual runoff and the effectiveness of the GPT at different flow rates. On the basis of this analysis, the CRC report showed that the GPT would reduce annual load of TP by 21% (Table 4).

- The CRC report quotes "*The mean removal efficiency for TN was calculated to be approximately 13%*" (Section 5.6, last paragraph). No analysis was undertaken to convert this average storm event removal to an average annual removal efficiency.

In view of the fact that the CRC report included modelling analysis that converted storm event pollutant removal efficiency to an average annual load removal efficiency, the approach adopted by Evans & Peck to account for GPT effectiveness is considered valid.

Model Time Step

The hydrologic component of the MUSIC model is derived from the Australian Water Balance Model (AWBM) model that was originally developed for analysis of runoff on a daily basis. While it has been adapted to model short duration runoff events using 6 minute rainfall, many of the underlying processes such as groundwater recharge and base flow are fundamentally modelled on a daily basis.

Evans & Peck have been using MUSIC since it was first developed and provided significant feedback and comment to the developers during the first 2-3 years after it was originally developed. Our experience is that there are many other much more important factors than rainfall in developing a robust MUSIC model for a project. In particular, the adopted representation of catchment soils and impervious surfaces is much more important to the model results than the modelling time-step. In addition, it is often more important to model the effect a range of different years (27 years in the case of the study for the Moruya East Village) rather that focus on a single "average" year of 6 minute data.

We have conducted a number of studies, where we have assessed stormwater treatment using both daily and 6 minute time steps. Our experience is that there is no significant difference in the resulting treatment efficiencies from models run for both daily and 6-minute time steps where the same statistical rainfall year is utilised.

To illustrate this point, the MUSIC model for the site has been run using Sydney 6 minute data for an average rainfall year (1959 - data on hand for comparative purposes). The analysis confirms our previous experience and shows that, compared to the use of 6 minute data, the use of daily rainfall data slightly underestimates the reduction of TN (2.5%) and slightly overestimates the reduction in TP (1.5%) and TSS (5.0%). These differences in the estimates are not considered significant and confirm that the proposed treatment system for the Moruya East Village will:

- Meet Council's treatment objectives for reduction of TN and TP. In practice, because the modelling has assumed only 20% reduction in TSS for the GPTs (compared to 65% quoted in the CRC report – see above) the system would also meet Council's objective for TSS reduction;
- Fully comply with the objective of reducing pollutant loads compared to existing conditions.

Location of Gross Pollution Traps

Mr Bain is critical of the use of Gross Pollutant Traps (GPTs) located downstream of the rain gardens. His criticism fails to take account of the practicalities of the site and the landscape design. In this instance the landscape design calls for street trees along

all significant streets. With the intent of making the site as self sufficient in water as possible, the site will include rainwater tanks on all dwellings as well as "rain gardens" watered by stormwater runoff direct from the street. As described in the *Water Cycle Management and Flooding* report and illustrated in a figure at the end of that report, these rain gardens will vary between 5 m^2 and 24 m^2 depending on the road width. Runoff from the road and any rainwater tank overflow will be directed into the rain garden where it can pond up to a depth of 100 – 150 mm before overflowing into a pit that is connected to the piped stormwater drain. The ponded water retained in the rain garden will infiltrate and be available for uptake by the trees and other vegetation. Excess deep drainage will drain into the piped stormwater drainage system via sub-soil drains.

Given that there are proposed to be 198 rain gardens, it would clearly be impractical to locate GPTs upstream of each. However, even though each rain garden will have a grated inlet pit to take any overflow, there is still a possibility that garden litter could get washed into the piped stormwater drainage system. Accordingly, and in order to ensure compliance with Council's requirement for 100% capture of litter, placement of GPTs at each storm water outlet was adopted as a final litter receptacle in the system. Any effect of the GPTs in providing a marginal additional reduction in TN or TP removal is purely coincidental.

Conclusions

The above extensive and detailed responses from Australian Bushfire Protection Planners (ABPP), EDAW, Evans & Peck (E&P) and Keystone Ecological to the issues raised by DECC, DWE, and Mr Bain demonstrate the seriousness with which these issues have been considered.

The responses demonstrate that there is a high degree of certainty that the development will provide substantial benefits in terms of ecological, riparian and water quality objectives even though, in some aspects, it is unable to achieve all the outcomes deemed desirable in the submissions from the agencies.

Overall, the proposed project seeks to achieve a balanced outcome that provides substantial environmental benefits while accommodating the relevant site constraints including bushfire and flooding risks and recognising that the site is zoned for urban purposes and is currently a working farming property.