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RAINBOW BEACH ESTATE, BONNY HILLS

Water Engineering and Environment
DGR Assessments

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RAINBOW BEACH ESTATE, BONNY HILLS

WATER ENGINEERING AND ENVIRONMENT - DGR ASSESSMENTS

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APPENDIX E Construction Environment Management Plan

EXECUTIVE SUMMARY – DGR RESPONSES

This document addresses particular Director General's Requirements (DGRs) for two development applications, namely :-

- MP 06_0085 "Rainbow Beach Concept Plan" (DGR received 10 January 2007)
- MP 07_0001 "Project Application - Open Space Corridor and Constructed Wetland, Rainbow Beach" (DGR received 9 March 2007)

Responses to individual DGR items are summarised in Table 1 below:

Table 1 Summary of DGR Responses

RAINBOW BEACH CONCEPT PLAN (CP)

DGR Item	Topic
CP2.1	Justify the constructed wetland in the context of the IWCM plan proposed for the site (refer to CP3.2).
Response: • The proposed development primarily incorporating end-of-pipe wetlands for stormwater treatment was adopted as the most advantageous overall because it is the only option providing the required residential areas along with satisfactory WSUD solutions whilst remaining economically feasible in terms of minimizing total earthworks which avoids the necessity for imported fill (Section 2.4). • WSUD stormwater treatment only using bioinfiltration (as favoured by Council's IWCM strategy) is not feasible because of the increased volume of earthworks required including large volumes of imported material. • The proposed wetland stormwater treatment was a feasible acceptable option under Council's IWCM assessment which was only discarded on the basis of cost. These costs are avoided under the current development proposals.	
CP2.2	Consider the functioning of the wetland including the responsibility for ongoing management, any potential risk to public safety and potential environmental impacts such as groundwater, water quality and hydrology.
Response: <u>Responsibility for ongoing management</u> The Open Space Management Strategy provides the framework within which the Open Space Corridor is to be managed by the Land Owner as part of the Rainbow Beach Development. Details are provided concerning strategies that have been developed and which are to be implemented by the Land Owner to ensure the construction and occupation of the urban development component of the Rainbow Beach development does not adversely impact upon the values of the Open Space Corridor including the constructed wetland. The landowner has had separate discussions with Port Macquarie Hastings Council regarding the long term ownership of the Open Space Corridor. These discussions are dealt with in detail in Project Application MP07-0001. <u>Risk to public safety</u> The Open Space Management Strategy addresses issues associated with public access and safety within the Open Space Corridor, in respect of providing (Section 2.13.4 and 5.6): • appropriate mechanisms to restrict unauthorised and inappropriate forms of access into the Open Space Corridor by contractors involved in the construction phase of the Rainbow Beach development; • appropriate infrastructure to facilitate controlled public access to and within the Open Space Corridor for passive recreational pursuits compatible with the area's environmental values; and • appropriate infrastructure to facilitate Council access to and within the Open Space Corridor for environmental management purposes. A risk minimisation approach based on the principles of not inviting people to danger and ensuring risk is minimised through reasonable provision of safety measures is to be implemented on the site. The safety measures to be implemented on the site in relation to the wetland areas include the following: • Vegetative barriers – the revegetation program has been specifically designed to create impenetrable	

vegetative barriers to the existing lagoon and proposed constructed wetland. Around the existing lagoon, the vegetative barrier will commence from the terrestrial fringe into the submerged zone of the lagoon. The extent of the barrier has been specifically designed to prevent public access to the water by reducing the likelihood of unintentional entry into the waterbody.

- Physical barriers – no formal access points to either the existing lagoon or proposed constructed waterbody will be provided unless there are appropriate barriers and/or safety benching installed. This will apply to areas where viewing platforms or shared cycle/pathways are situated along the edge of the existing lagoon or proposed constructed water body.

- Signage – signage that complies with Australian standards (AS1742) and is non-obtrusive and highly resistant to vandalism will be installed in appropriate locations around the existing lagoon and proposed constructed waterbody. This signage will incorporate the following elements:
  - the purpose of the wetland (i.e. wildlife habitat and stormwater treatment);
  - significant environmental and ecological features (e.g. waterbird nesting habitat);
  - appropriate public safety warnings; and
  - prohibition of domestic animals such as dogs within the wetland areas.

The overflow embankments will discharge storm runoff in excess of the 5 Year ARI events. Although the embankments are designed to carry these flows with minimal erosion damage, flow conditions on the embankments during these major runoff events will represent high hazard conditions for pedestrians because of the water velocities created. As Some pedestrian walkways are located on these embankments, appropriate signage will be installed at these locations to warn pedestrians and prevent access to these sections of the walkways during major runoff events.

Potential environmental impacts such as groundwater, water quality and hydrology

Potential environmental impacts of the wetland on hydrology, water quality and groundwater are shown to be inconsequential (section 2.6.5) or beneficial (Section 2.10.6)

CP3.1	Address potential impacts on water quality of both surface and groundwater.

Response:

- Historical recorded data show that water quality in the existing lagoon is good and satisfies desirable water quality limits given in Council and ANZECC guidelines to ensure a sustainable appropriate freshwater coastal ecosystem. The data show the existing lagoon is well-mixed and not liable to stratification (Section 2.10.1.4
- The recorded data show that the Sewage Treatment Plant (STP) does not affect existing water bodies on the site (Section 2.10.1.4).
- Water quality in proposed water bodies was predicted by a variety of methods (namely, comparison with existing water bodies, mathematical modelling and comparison with water bodies at other similar sites). The results show that the proposed constructed wetland will exhibit good water quality similar to the existing water bodies (Section 2.10.3). The results also show that conditions in the existing water bodies will not be affected by the proposed development (Section 2.10.3.4).
- The proposed re-direction of flows from the existing lagoons in the “upper” reaches of Duchess Gully into the proposed constructed wetlands will re-establish the original flow path and is expected to improve surface water quality conditions in the “middle” reaches of Duchess Gully (Section 2.10.2
- The effects of the proposed development on groundwater systems were predicted using a calibrated groundwater model (Section 2.11.7). The results show that the proposed constructed wetland does not materially affect the regional groundwater regime or groundwater flow patterns. Groundwater levels are reduced only in some areas local to the constructed wetlands (Section 2.11.9.2). These findings have been corroborated by a separate investigation by the Water Research Laboratory UniNSW.
- The local drawdown in groundwater levels does not expose high-activity potential acid sulfate soils to oxidation. This material remains below the water table (Section 2.11.9.2)
- The proposed constructed wetland does not affect the operation of the STP exfiltration system where groundwater flows are not changed and are not re-directed into the site (Section 2.11.9.2).
- There are no significant adverse groundwater effects during the dewatering operations for the proposed constructed wetland (Section 2.11.10.2). Drawdown is temporarily increased but still confined to areas close to the excavation (Section 2.11.10.2)
- Groundwater impacts will be monitored under a comprehensive monitoring program (Section 2.11.15.2)

Item	Topic
CP3.2	Address and outline measures for Integrated Water Cycle Management (including stormwater) based on Water Sensitive Urban Design principles, including impacts on the surrounding environment.

Response:
The proposed development complies fully with Council's IWCM (Integrated Water Cycle Management) policy for Area 14, as amended on 5 November 2007 by incorporating the following features (Section 3.3):

- Use of reclaimed water to dwellings for outdoor use, toilet flushing and laundry cold water.
- Irrigation of district sports fields with reclaimed water sourced from Port Macquarie-Hastings Council.
- Water sensitive urban design (WSUD) in residential areas by incorporating stormwater treatment using vegetated swales, bioinfiltration areas and treatment wetlands (Section 3.4).
- The proposed development using end-of-pipe wetlands for stormwater treatment was adopted as the most advantageous overall because it is the only option providing the required residential areas along with satisfactory WSUD solutions whilst remaining economically feasible in terms of minimizing total earthworks which avoids the necessity for imported fill (Section 2.4).
- WSUD stormwater treatment options using bioinfiltration treatment are not feasible because of the increased volume of earthworks required including large volumes of imported material (Section 2.4).

CP4.3	Identify the presence and extent of acid sulphate soils on the site and if necessary, appropriate mitigation measures.

Response:
Potential acid sulfate soils on the site have been identified by geotechnical survey. ASS and PASS soils occur throughout the area of the proposed constructed wetlands. There is a clear demarcation between surface soils with "low" potential acidity (PASS) requiring little or no treatment and soils at deeper levels with "high" potential acidity requiring management and significant treatment (Section 4.8.2).

Appropriate management and mitigation measures are described (Section 4.8.3) including:

- Excavation for the wetlands will avoid the "high PASS" material which will be left undisturbed.
- Excavation "in the dry" with appropriate dewatering of each excavation stage resulting in minimal acid generation during construction.
- Excavated material will be handled and placed in accordance with an ASS Management Plan complying with statutory regulations for management of acid sulfate soils (see Section 4.8.6 and Appendix A). Lime treatment will be used where required
- Permanent water table levels will be maintained as high as practicable and at least as high as the "high PASS" soil boundary. Water levels within the constructed wetlands will be RL 3.0 mAHD which satisfies this criterion.

CP4.4	Provide an assessment of any flood risk on site in consideration of any relevant provisions of the NSW Floodplain Management Manual. Consider the potential impacts of any filling on the flood regime of the site and adjacent land.

Response:
Flood risk in terms of the NSW Floodplain Management Manual 2005 was assessed using a MIKE11 hydraulic model to simulate storm events for both existing and development conditions. The effect of proposed fill was incorporated in the model. (Section 4.3)

Water levels are not worsened by the proposed development for the 100 year ARI Designated Event except for an increase of 110 mm at the boundary of the adjoining land to the north-east of the site (Chainage 835 DUCH-N). This increase reduces to zero within a short distance further upstream from the property boundary (Section 4.3.8.5).

A number of flow control structures and channel improvements are included in the development proposals. It is demonstrated that these controls comply with safety requirements of the Floodplain Management Manual (Sections 4.3.8 and 4.4)

Proposed hydraulic structures have been designed to minimize storm damage and maintenance costs and enhance ecological functioning including fish migration (Section 4.4).

The possible effects of climate change have been assessed and it is demonstrated that climate change does not adversely affect the development (Section 4.3.9.4)

Floodplain risk management factors have been assessed and it is shown that hazard conditions are low (Section 4.7)

Item	Topic
CP7.1	Describe the potential impacts of the proposal on existing native vegetation (including areas of SEPP 26 littoral rainforest) both within and adjacent to the site and identify measures to minimise impacts on this vegetation (eg. appropriate buffers).

Response:

The orderly development of the site will necessitate direct physical impact on some of the site's vegetation communities and fauna habitat in the form of vegetation clearance and development works (e.g. excavation of fill, modification of the low-lying areas, establishment of a residential subdivision and business/retail centre and associated infrastructure etc). The majority of this disturbance will take place within areas of the site that have relatively low ecological values (i.e. previously cleared pastoral land and disturbed sedge communities). The Open Space Corridor is a prominent feature of the Concept Plan given that it will encompass 80.9 ha or 46% of the site's area and will include the majority of existing, intact native vegetation communities and expanses of regenerating vegetation which will be rehabilitated (Section 2.12.1.2). The extent of disturbance to vegetation and fauna habitat within the Open Space Corridor is to be limited to the loss and/or modification of the following areas of vegetation:

- approximately 7.7 ha of degraded native vegetation for the purposes of establishing the District Sporting Fields; and
- approximately 13.7 ha of pastoral woodland which supports a few scattered native trees for the purposes of excavating fill for the development and establishing the proposed constructed wetland and stormwater treatment wetlands.

Vegetation identified as forming part of broader fauna movement corridors will be retained, rehabilitated and protected within the Open Space Corridor. The extensive rehabilitation works proposed for the Open Space Corridor will enhance the structure and function of these currently degraded communities and hence higher quality fauna movement corridors will be created. The manner in which the Open Space Corridor is to be rehabilitated and managed to enhance its ecological values and function is detailed within the Open Space Management Strategy (refer Appendix D).

It is relevant to note that development of the site will not have any direct impact on adjoining areas of SEPP 26 Littoral Rainforest located to the east. However, it is intended to utilise an existing dirt track adjacent to the southern end of the SEPP 26 Littoral Rainforest as a means of controlled access from the proposed development to the beach. This track is currently an informal pathway subject to potential erosion. It is proposed to upgrade the track to a floating board walk along its existing alignment. The establishment of this formal walkway will not necessitate the removal of any existing vegetation and will essentially reduce the occurrence of degrading processes (e.g. aimless meanderings) by creating a more formal and controlled public access way to the beach (Section 2.12.1.2).

CP7.2	Describe the potential impacts of the proposal on existing aquatic flora and fauna and habitats both within and adjacent to the site and identify measures to minimise impacts on these habitats with consideration of Policy and Guidelines for Aquatic Habitat Management and Fish Conservation 1999.

Response:

The extent of direct physical disturbance to existing aquatic habitats within the site will be limited to:

- realignment of a small section of a constructed drainage line in the western portion of the site for the purposes of establishing the district sporting fields; and
- the removal of a constructed drainage line associated with the north-eastern portion of Duchess Gully for the purposes of establishing the proposed residential subdivision (Section 2.12.2.3).

The remaining water features on the site are to be retained and protected within the Open Space Corridor. A preliminary assessment of the existing lagoon has been completed and the results indicate that the lagoon is currently in a healthy condition as reflected by:

- low density and diversity of introduced aquatic fauna (Section 2.12.2.2);
- acceptable levels of water quality parameters (Section 2.10.1.4);
- the diversity of native species in the macrophyte and submerged zones (Section 2.12.2.1); and
- the diversity of waterbirds utilising the waterbodies for habitat diversity (Section 2.12.2.2).

The only major issues associated with the existing lake system is the predominance of the introduced Torpedo grass (*Panicum repens*) (Section 2.12.2.1) inspections of the macrophyte and submerged zones of the waterbody and a low diversity of benthic fauna.

Overall, the extensive revegetation and rehabilitation works proposed for the Open Space Corridor combined with on-going management as detailed in the Open Space Management Strategy (Refer

Appendix D) are expected to enhance existing fisheries habitat value of aquatic features within the site through:

- the removal of weed species from the macrophyte zone (i.e. Torpedo grass) (Section 2.13.2);
- increasing the density and diversity of native plant species in the macrophyte zone (Section 2.13.2);
- the provision of supplementary habitat features such as logs and snags (to be sourced from areas of the site to be cleared) as breeding, roosting and feeding areas;
- increasing the coverage of woody vegetation around the edges of the water bodies to provide cover, litter and debris for aquatic organisms (Section 2.13.2);
- increasing public surveillance of the waterbodies which will reduce degrading activities such as refuse dumping and construction of "cross-overs" using dumped refuse (Section 2.13.2); and
- controlling human and domestic animal access to the waterbodies.

The existing lagoon will connect to the proposed constructed wetland by a control weir. During major storms, when high water levels occur, flow will also continue to discharge from the existing lagoon via the existing "overflow" channel direct to Duchess Gully. The outlet structure will be reconstructed to increase its capacity (Section 2.13.4).

CP7.3	Outline measures for the conservation of flora and fauna and their habitats within the meaning of the Threatened Species Conservation Act 1995.

Response:
Some of the vegetation communities encompassed by the Open Space Corridor are known to support threatened fauna species such as the Koala (*Phascolarctos cinereus*), Wallum froglet (*Crinia tinnula*), Eastern Chestnut mouse (*Pseudomys gracilicaudatus*) and Common planigale (*Planigale maculata*) (Section 2.13.1). In addition, some vegetation communities have also been identified as low to medium quality Endangered Ecological Communities ("EEC's") In this regard, the Open Space Management Strategy (Refer Appendix D) has been prepared with a focus on retaining and enhancing EEC's and habitat for threatened fauna species that occur within the Open Space Corridor. The Open Space Management Strategy (Refer Appendix D) aims to revegetate and manage the Open Space Corridor in a manner that conserves biodiversity values through:

- the protection and improvement to the wetland area that supports a relatively large Wallum froglet population (Section 2.13.1);
- increasing the prevalence of known Koala food trees and other plants with multiple-species values throughout the Open Space Corridor(Section 2.13.1);
- restoring the floristic and structural elements of degraded EECs;
- providing structural complexity and cover for ground-dwelling fauna such as the Eastern chestnut mouse and Common planigale(Section 2.13.1);
- reinstating degraded fauna movement corridor values throughout the Open Space Corridor; and
- removing and managing weed infestations(Section 2.13.1).

CP7.4	Outline measures for the conservation or enhancement of existing wildlife corridors and / or the connective importance of any vegetation on the subject land.

Response:
The Open Space Corridor is a prominent feature of the Concept Plan given that it will encompass approximately 80.9 ha or 46% of the site's area and will include the majority of existing, intact native vegetation communities and expanses of regenerating vegetation (Section 2.12.1.2). In addition to the ongoing protection offered to these areas by their incorporation into the Open Space Corridor, substantial revegetation and rehabilitation works and on-going management measures are proposed to enhance the ecological values of these areas. These revegetation and rehabilitation measures have been specifically designed to more than off-set any loss or modification of terrestrial ecosystems that will result from the proposed plan of development (Section 2.13.1). The Open Space Management Strategy (Refer Appendix D) provides details of management actions that have been designed to:

- ensure the preservation of native fauna species and their associated habitats that currently exist within the Open Space Corridor during both the construction and occupational phases of development;
- enhance vegetated corridors and linkages to improve movement opportunities for native faun residing within or dispersing through the Open Space Corridor; and
- minimise the potential for mortality and/or harm to be inflicted on native fauna as a consequence of domestic pets and vehicular traffic associated with the proposed urban development.

PROJECT APPLICATION – OPEN SPACE CORRIDOR & CONSTRUCTED WETLAND (PA)

Item	Topic
PA2.1	Provide a detailed description of each of the proposed uses across the site and describe the relationship between open space, drainage and habitat functions.

Response:
The land uses under the proposed development are set out fully in Section 1.4.3. Land uses include residential areas located on higher ground on the northern part of the site along Ocean Drive, associated community facilities and a constructed wetlands area located on the eastern part of the site on Duchess Gully the watercourse of which forms an open space corridor.

PA2.2	Describe the proposed ownership and long-term management regime for each component of the site including playing fields, constructed wetland and general open space.

Response:
Ownership of the Open Space Corridor, including district sporting fields, the existing lagoons and other water bodies, the constructed wetland, the stormwater treatment wetlands, drainage swales, the pocket woodland, eastern creek and other open space areas as listed in Table 4 are proposed to pass to Port Macquarie Hastings Council by way of dedication after the successful completion of any development construction maintenance period.

PA4.1	Outline potential impacts on flora and fauna and their habitats (within the meaning of the Threatened Species Conservation Act 1994) across the site and, where relevant, provide conservation measures. Specifically address the impact of the constructed wetland on fish and their habitats. Note: The Department of Primary Industries states that constructed wetlands are inappropriate habitat for fish.

Response:
The orderly development of the site will necessitate direct physical impact on some of the site's vegetation communities and fauna habitat in the form of vegetation clearance and development works (e.g. excavation of fill, modification of the low-lying areas, establishment of a residential subdivision and business/retail centre and associated infrastructure etc). The majority of this disturbance will take place within areas of the site that have relatively low ecological values (i.e. previously cleared pastoral land and disturbed sedge communities). The Open Space Corridor is a prominent feature of the Concept Plan given that it will encompass approximately 81 ha or 46% of the site's area and will include the majority of existing, intact native vegetation communities and expanses of regenerating vegetation which will be rehabilitated (Section 2.12.1.2). The extent of disturbance to vegetation and fauna habitat within the Open Space Corridor is to be limited to the loss and/or modification of the following areas of vegetation:

- approximately 7.7 ha of degraded native vegetation for the purposes of establishing the District Sporting Fields (Section 2.12.1.2); and
- approximately 12.7 ha of pastoral woodland which supports a few scattered native trees for the purposes of excavating fill for the development and establishing the proposed constructed wetland (Section 2.12.1.2).

It is intended to revegetate and rehabilitate the majority of the Open Space Corridor, which will effectively offset the loss of degraded vegetation and fauna habitat resulting from development of the site. In this regard an integrated Open Space Management Strategy has been prepared that seeks to provide management specifications that will protect and enhance the ecological values and functions of the Open Space Corridor whilst facilitating public access and use of designated recreational areas (Section 2.13.1). More specifically, the Open Space Management Strategy (OSMS) (Refer Appendix D) aims to:

- enrich the current native biodiversity of existing vegetation within the Open Space Corridor;
- enhance the existing corridor values of vegetation along Duchess Gully;
- create better movement opportunities in an east-west direction for native wildlife;
- reduce the extent of existing weed infestations within the Open Space Corridor;
- protect and enhance aquatic habitat values within existing and to be constructed waterbodies within the Open Space Corridor; and
- provide an appropriate interface between native vegetation and wildlife habitats within the Open Space Corridor and adjacent areas of urban development (Section 2.13.1).

As part of the Open Space Management Strategy (Refer Appendix D) it is intended to revegetate and manage the existing and proposed waterbodies in a manner that provides high quality aquatic habitat through:

- the removal of weed species from the macrophyte zone (i.e. Torpedo grass)
- increasing the density and diversity of native plant species in the macrophyte zone (Section 2.13.2);

- the provision of supplementary habitat features such as logs and snags (to be sourced from areas of the site to be cleared) as breeding, roosting and feeding areas;
- increasing the coverage of woody vegetation around the edges of the water bodies to provide cover, litter and debris for aquatic organisms (Section 2.13.2);
- increasing public surveillance of the waterbodies which will reduce degrading activities such as refuse dumping and construction of "cross-overs" using dumped refuse; and
- controlling human and domestic animal access to the waterbodies (Section 2.13.2).

PA4.2	Provide a vegetation management plan that describes the proposed vegetation and regeneration works across the site. Consider the role of the revegetation in the provision of habitat for threatened species including the Koala (with reference to Hastings Council's Area 14 Koala Plan of Management).

Response:
An Environmental Land Use Management Plan (ELUMP) has been prepared in conjunction with the Open Space Management Strategy (Refer Appendix D). A key focus of the ELUMP and Open Space Management Strategy is the reinstatement of the ecological values and functions of degraded vegetation contained within the Open Space Corridor (Section 2.13.1). As such, due consideration has been given to floristic and structural elements of vegetation communities to be rehabilitated within the Open Space Corridor, in particular the following measures have been included:

- the use of trees species that provide a variety of forage (i.e. foliage, pollen, nectar, fruits) nesting and roosting resources to a range of native fauna species;
- providing for a minimum percentage (i.e. 50%) of known Koala habitat trees to be used within revegetation areas (Section 2.13.1);
- identifying potential fauna movement corridors and enhancing vegetation in these areas to facilitate fauna movement in a north-south and east-west direction (Section 2.13.1);
- enhancing existing aquatic habitats through the removal of existing weed infestations and increasing the coverage of native aquatic vegetation (Section 2.13.2);
- creating a diversity of aquatic habitats in the proposed waterbody to encourage colonisation (i.e. the provision of snags, logs, boulders etc within submerged environments);
- structural complexity of vegetation to facilitate the survival of ground dwelling organisms, with specific reference to the habitat requirement of the Eastern chestnut mouse and Common planigale that have both been recorded within the Open Space Corridor (Section 2.13.1);
- protection and enhancement of known Wallum froglet habitat within the Open Space Corridor.

Given the above, the revegetation works proposed for the Open Space Corridor have been designed to reinstate habitat values with a particular emphasis on improving habitat of threatened fauna species as well creating new habitat fauna movement opportunities.

PA4.3	Address the potential for the constructed wetland to harbour aquatic weeds and where necessary, identify measures for their management.

Response:
Many recognised aquatic weed species have been bought into Australia for ornamental purposes (i.e. water features, aquariums etc) and have escaped into natural and constructed waterbodies as direct result of seed/propagules dispersal and/or irresponsible disposal of plants into storm water drains. In this regard, wetlands constructed to manage storm water runoff, such as the proposed constructed waterbody, have the potential to support high levels of nutrients and hence can provide ideal conditions for the proliferation of aquatic weed species (Section 2.12.2.4).

In the first instance, consideration must be given to the fact that existing waterbodies on the site do not currently support any significant weed infestations even though:

- they have been receiving run-off from surrounding pastoral land for at least 20 years (Section 2.12.2.4);
- storm-water run-off from residential development to the south has also been directed into the waterbodies; and
- substantial numbers of water birds, which are important dispersal agents for aquatic plants, utilise the waterbodies on a regular basis (Section 2.12.2.4).

The above facts and circumstances suggest that:

- the existing waterbodies do not support conditions that are favourable to the growth of aquatic weeds;
- there are no source populations of aquatic weeds within dispersal distance of the water bodies; and
- residents in the locality have not been disposing of aquatic weed material in an inappropriate fashion (Section 2.12.2.4).

Notwithstanding the above, aquatic weed introduction and infestation is a serious issue and the potential for the constructed and existing waterbodies to harbour weed infestations has been given due consideration in the design of the wetland system and on-going management of the Open Space Corridor (Section 2.12.2.4).

The storm-water "treatment train" that will include vegetated swales and retention areas will also serve as preventative weed management system in that the majority of escaped or dumped weed material should be "collected" within these structures prior to entering the waterbodies. As such, regular monitoring and maintenance of the "treatment train", especially after rainfall events, will function as an effective weed prevention system (Section 2.12.2.4). The Open Space Management Strategy (Refer Appendix D) provides specifications for the control and management of aquatic weed infestations should they develop within the waterbodies.

PA5.1	Address and outline the measures for Integrated Water Cycle Management (including storm water) based on Water Sensitive Urban Design principles with reference to 'Area 14 Integrated Water Cycle Management Plan' (report to Hastings Council, 2006). Specifically describe the function of the constructed wetland within the larger IWCM plan for the site.

Response:
The proposed development complies fully with Council's IWCM (Integrated Water Cycle Management) policy for Area 14, as amended on 5 November 2007 by incorporating the following features (Section 3.3):

- Use of reclaimed water to dwellings for outdoor use, toilet flushing and laundry cold water.
- Irrigation of district sports fields with reclaimed water sourced from Port Macquarie-Hastings Council.
- Water sensitive urban design (WSUD) in residential areas by incorporating stormwater treatment using vegetated swales, bioinfiltration areas and treatment wetlands (Section 3.4).

The adequacy of the proposed residential area stormwater treatment systems is demonstrated using MUSIC modelling to show that these systems comply with Port Macquarie Hastings Council's adopted criteria in accordance with Council's IWCM policy of September 2006 as amended in November 2007 (Section 3.3)

The integrated functioning of the proposed constructed wetland as part of an appropriate overall freshwater ecosystem with protection and enhancement of aquatic habitat values within the existing and constructed wetlands in the Open Space Corridor is described (Section 2.12).

PA5.2	Assess the impacts of the proposal on surface and groundwater hydrology and quality. Specifically address any impacts on Duchess Gully and the ongoing management of the waterway and its riparian zone. Describe any potential impacts to the existing exfiltration system attached to the Bonny Hills Sewerage Treatment Plant.

Response:

- Catchment runoff will be maintained after the proposed development with some small increases in runoff volumes (Section 2.6.3).
- The existing lagoon will be maintained as a continuing permanent feature of the surface water system with water levels close to full most of the time except for occasional drought periods when water levels may be reduced by up to 0.9 metres (Section 2.6.3).
- The proposed constructed wetland will similarly become a continuing permanent feature of the surface water system with water levels close to full most of the time except for occasional drought periods when water levels may be reduced by up to 0.9 metres (Section 2.6.3).
- Low flows will be re-directed through the original flow path of the middle reaches of Duchess Gully with benefits to the ecosystems of Duchess Gully. (Section 2.6.3)
- The proposed constructed wetland is expected to be filled by catchment runoff within one year after construction (Section 2.6.4).
- Potential climate change effects will not affect the surface water hydrology or stream characteristics (Section 2.9).

- Potential climate change sea level rises will not affect the proposed surface water flow control structures (Section 2.9)
- The effects of the proposed development on groundwater systems were predicted using a calibrated groundwater model (Section 2.11.7). The results show that the proposed constructed wetland does not materially affect the regional groundwater regime or groundwater flow patterns. Groundwater levels are reduced only in some areas local to the constructed wetlands (Section 2.11.9.2).
- The local drawdown in groundwater levels does not expose high-activity potential acid sulfate soils to oxidation. This material remains below the water table (Section 2.11.9.2) even during drought periods.
- The proposed constructed wetland does not affect the operation of the STP exfiltration system where groundwater flows are not changed and are not re-directed into the site (Section 2.11.9.2).
- There are no significant adverse groundwater effects during the dewatering operations for the proposed constructed wetland (Section 2.11.10.2). Drawdown is temporarily increased but still confined to areas close to the excavation (Section 1.11.10.2)

PA5.3	Provide an assessment of any flood risk on site in consideration of any relevant provisions of the NSW Floodplain Development Manual (2005). Consider the potential impacts of any filling on the flood regime of the site and adjacent lands.

Response:
Flood risk in terms of the NSW Floodplain Management Manual 2005 was assessed using a MIKE11 hydraulic model to simulate storm events for both existing and development conditions. The effect of proposed fill was incorporated in the model. (Section 4.3)

Water levels are not worsened by the proposed development for the 100 year ARI Designated Event except for an increase of 110 mm at the boundary of the adjoining Milland land to the north-east of the site (Chainage 835 DUCH-N). This afflux reduces to zero within a short distance further upstream from the property boundary (Section 4.3.8.5).

A number of flow control structures and channel improvements are included in the development proposals. It is demonstrated that these controls comply with safety requirements of the Floodplain Management Manual (Sections 4.3.8 and 4.4)

Proposed hydraulic structures have been designed to minimize storm damage and maintenance costs and enhance ecological functioning (Section 4.4).

The possible effects of climate change have been assessed and it is demonstrated that climate change does not adversely affect the development (Section 4.3.9.4)

Floodplain risk management factors have been assessed and it is shown that hazard conditions are low (Section 4.7)

PA6.3	Identify the presence and extent of acid sulphate soils on the site and if necessary, appropriate mitigation measures.

Response:
Potential acid sulfate soils on the site have been identified by geotechnical survey. ASS and PASS soils occur throughout the area of the proposed constructed wetlands. There is a clear demarcation between surface soils with “low” potential acidity (PASS) requiring little or no treatment and soils at deeper levels with “high” potential acidity requiring management and significant treatment (Section 4.8.2).

Appropriate management and mitigation measures are described (Section 4.8.3) including:

- Excavation for the wetlands will avoid the “high PASS” material which will be left undisturbed.
- Excavation “in the dry” with appropriate dewatering of each excavation stage resulting in minimal acid generation during construction.
- Excavated material will be handled and placed in accordance with an ASS Management Plan complying with statutory regulations for management of acid sulfate soils (see Section 4.8.6 and Appendix A). Lime treatment will be used where required.
- Permanent water table levels will be maintained as high as practicable and at least as high as the “high PASS” soil boundary. Water levels within the constructed wetlands will be RL 3.0 mAHD which satisfies this criterion.

Item	Topic
PA8.2	Provide an assessment of the potential impacts of the constructed wetland on public safety and liability and provide, where relevant, appropriate management measures.
Response: The safety and liability issues for the proposed development are set out and dealt with fully in Section 5.6 (Public Access and Safety Review).	
PA9.1	Provide an assessment of the potential impacts during construction of the proposal. The assessment should include, but not be limited to, consideration of: • Truck movements required and traffic routes proposed for use; • Impacts on traffic and pedestrians; • Impacts on the amenity of adjoining properties including noise, dust and sediment, and erosion controls; • Where relevant, mitigation measures to manage identified impacts.
Response: • No regular truck movements are necessary external to the site (apart from infrequent deliveries) since fill is sourced from the site and there will be no importing of fill to the site. • There will be a single entry point to the site from Ocean Drive with construction traffic directed away from established residential areas. • Traffic volume increases on adjacent roads will be minor associated with arrival and departure of workers in peak hours. There will be no impact on pedestrian facilities. • Powered mechanical equipment and transport vehicles will be used for earthworks internal to the site. Vehicles will be fitted with noise controls such that noise increases at adjoining properties will be within allowable limits. Operations will only be carried out during normal allowable working hours. • Dust nuisance will be avoided by implementing measures required by Port Macquarie Hastings Council AUSSPEC Construction Specifications including restriction to designated haul routes, sealed pavements, covering truck loads, water spraying and revegetation of exposed surfaces. • Erosion and sediment movement at construction sites will be avoided by control methods required by Port Macquarie Hastings Council AUSSPEC Construction Specifications including diversion drains, sediment traps, sediment fences and revegetation of surfaces. • The mitigation measures above will be implemented by means of a Construction Environmental Management Plan incorporated into construction contracts.	

1. SCOPE OF DOCUMENT

1.1 Development Application Identification

This document deals with particular Development Applications as follows:

MP 06_0085	Rainbow Beach Concept Plan	"Concept Plan" (CP)
MP 07_0001	Project Application - Open Space Corridor and Constructed Wetland, Rainbow Beach	"Project Application" (PA)

The document addresses particular matters raised in the Director-Generals Requirements (DGRs) issued in connection with those applications. This document should be read in its entirety as a response to the matters raised in the DGRs relating to water engineering and environment.

1.2 Scope of Part 3A Development Applications

The first application ("**Concept Plan**") seeks consent for:

- The delineation of the limits of the residential subdivision;
- The location of the three adopted intersections with Ocean Drive;
- The location of an additional intersection with Ocean Drive currently under investigation by Port Macquarie Hastings Council;
- The delineation of the extent of the future school sites;
- The general location of the Greater Lake Cathie Bonny Hills Village Centre
- The delineation of the site for future eco-tourist development;
- The delineation of the extent of the Open Space, Drainage and Wildlife Habitat Corridor.

The second application ("**Project Application"** – Open Space Corridor and Constructed Wetland) seeks consent for the following elements:

- Open Space, Drainage and Wildlife Habitat Corridors;
- Earthworks required for Constructed Wetlands and to create filled areas;
- Stormwater Treatment and Management;
- District Sporting Fields and Facilities.

Consent for the two Part 3A applications identified above and completion of the physical works which are the subject of those consents will advance the project to the point where:

- The layout (Concept Plan form) of the development, consistent with Port Macquarie Hastings Council's strategic planning objectives is approved and established;
- Future urban and residential development areas are filled to elevations above inundation levels and appropriately protected and vegetated;
- The open space, habitat and drainage corridor areas of the site are rehabilitated with locally-sourced indigenous coastal habitats appropriate to the location and the incorporation of passive recreational facilities (pathways, cycleways, park seating, children's playgrounds and picnic areas); and
- District Sporting Fields are filled, vegetated and readied for transfer to Port Macquarie Hasting Council.

Urban and residential development will then be completed in a series of stages, each of which will be the subject of future applications.

1.3 Director General's Requirements (DGR)

The DGR issues and the section of the document where each respective matter is addressed are summarised Table 2. The table shows the references ordered by document Section number and by DGR Item number respectively.

Table 2 DGR Item References Addressed in this Assessments Document

ORDERED BY DOCUMENT SECTION

Section	Description	DGR Items Addressed (* See Note)
1	Introduction	-
2	Waterways	CP2.1, CP2.2, CP3.1, CP7.1, CP7.2, CP7.3, CP7.4 PA4.1, PA4.2, PA4.3, PA5.2
3	Water Cycle Management	CP3.2 PA5.1
4	Hazard Management	CP4.3, CP4.4 PA5.3, PA6.3
5	Open Space Corridor Operational Management	CP2.2, PA2.1, PA2.2, PA8.2
6	Construction Management	PA9.1

*Note **CP** Concept Plan DGR (MP 06_0085 "Rainbow Beach Concept Plan")

PA Project Application DGR (MP 07_0001 "Project Application Open Space Corridor and Constructed Wetland, Rainbow Beach")

ORDERED BY DGR ITEM NUMBER REFERENCE

CP Item	Description	Document Section
2.1	IWCM	2
2.2	Wetlands	2, 5
3.1	Water quality	2
3.2	IWCM, WSUD	3
4.3	Acid sulfate soils	4
4.4	Flooding	4
7.1	Native flora	2
7.2	Aquatic habitats	2
7.3	Conservation	2
7.4	Wildlife corridors	2

PA Item	Description	Document Section
2.1	Land use	5
2.2	Land ownership	5
4.1	Fauna and fish populations	2
4.2	Vegetation	2
4.3	Aquatic weeds	2
5.1	IWCM	3
5.2	Hydrology	2
5.3	Flooding	4
6.3	Acid sulfate soils	4
8.2	Public safety	5
9.1	Construction phase	6

1.4 Site Description

1.4.1 Location

The site is located on Part Lot 123 DP 1106943 and Lot 5 DP 25886 within the downstream reaches of Duchess Gully eastward of Ocean Drive at Rainbow Beach, Bonny Hills. The location and the boundaries of the site are shown in Figure 1.

1.4.2 Existing Conditions

The site consists of the low-lying relatively flat area adjacent to Duchess Gully which drains the area then flows north to south along the eastern site boundary. Duchess Gully then continues to the south for about a kilometre as a long land-locked lagoon whose outlet to the ocean is controlled by a sand bar. A tributary of Duchess Gully flows from west to east through the site. The site is bounded on the north and west by low hills. The total development site area is approximately 177.4 hectares.

An existing urban subdivision of approximately 21 hectares occupies the southern part of the site. This original development incorporated a lagoon of about seven hectares in area located on Duchess Gully. This existing lagoon intercepts surface drainage from west of the site, and overflows into the lower reach of Duchess Gully. To the south-east of the development area there is a wastewater treatment plant alongside Duchess Gully which operates an effluent disposal system based on pumped recharge of groundwater in the coastal dune hills on the east bank of the creek.

These features are shown in Figure 2. A recent aerial photo of the site is shown in Figure 3.

1.4.3 Proposed Developments

The proposed development consists of residential areas located on higher ground on the northern part of the site along Ocean Drive, associated community facilities and a constructed wetlands area located on the eastern part of the site on Duchess Gully the watercourse of which forms an open space corridor of about 80.9 hectares. Features of the development are shown in Figure 4. The areas of each proposed land use are shown in Table 3 and Table 4.

Table 3 Proposed Development Land Use Areas

Land Use	Area (ha)
Residential Area (including SW1, SW2, SW3)	67.8
Open Space, Drainage and Habitat Corridor	**80.9** (seeTable 4)
Village Centre	4.8
Northern School Site	5.0
Southern School Site	9.7
Eco Tourism Site	7.6
Northern Ocean Drive 10m Buffer	1.6
TOTAL	**177.4**

Table 4 Proposed Open Space Corridor Component Areas

Component	Area (ha)
CENTRAL CORRIDOR:	
District Sporting Fields	7.7
Existing Lagoons, Water Bodies and Wetlands	6.3
Proposed Constructed Wetland	10.5
Stormwater Treatment Wetlands (W1)	1.9
Stormwater Treatment Wetlands (W2, W3)	1.3
Central Open Space	47.5
TOTAL CENTRAL CORRIDOR	**75.2**
OTHER (OUTSIDE CENTRAL CORRIDOR):	
Eastern Creek and Swale	3.2
Stormwater Treatment Wetlands (W4A & W4B)	0.4
Pocket Woodland	2.1
TOTAL – OUTSIDE CENTRAL CORRIDOR	**5.7**
TOTAL – OPEN SPACE CORRIDOR	**80.9**

Low-lying parts of the residential areas will be raised using fill material sourced from the excavation of the constructed wetlands. Excavated material will also be used to fill parts of the northern school site located in the north-west corner of the site.

Stormwater runoff from the residential areas will drain to, and be treated in accordance with WSUD principles in swales and wetlands.

Runoff in the “upper” reaches of Duchess Gully and the Upper Tributary will continue to flow into the existing lagoons. Outflow from these lagoons will then be diverted through the constructed wetlands flow zone by means of a control weir installed between the two water bodies as part of the constructed wetlands development so as to re-establish the natural flow path of the “middle” reaches of Duchess Gully. During major storms, when high water levels occur, the two water bodies will interconnect so part of the discharge overflows direct to Duchess Gully via the existing outlet drain downstream of the existing lagoons.

1.5 Assessment Methodologies

The methodologies adopted for assessments in this document were derived through consideration of the water engineering and environmental objectives and strategies for the two development applications which are summarised in Table 5.

Table 5 Development Applications - Objectives & Strategies

	Objectives	Strategies
Concept Plan	• Create high-quality minimum-impact residential precincts with community facilities and easy access to typical coastal aquatic environment	• Secure appropriate elevated land suitable for community and residential facilities with minimal disturbance to amenity and maximum retention and enhancement of indigenous coastal ecosystem values and features • Implement water-sensitive, low-energy design features • Maximise retention of existing watercourses and riparian corridors • Optimise environmental amenity by appropriate rehabilitation • Minimise long-term maintenance and enhance sustainability by appropriate design features
Project Application - Open Space Corridor & Constructed Wetland	• Create an open space corridor with aquatic features • Establish appropriate ecosystems and habitats early in the development process • Create reclamation areas suited to future residential development • Create district sporting facilities • Minimise disturbance to existing environments and existing residents	• Complete the reclamation earthworks in a single operation to minimise disturbance • Create reclamation areas for community and residential use at minimal cost and minimal disturbance to adjacent land owners • Incorporate rehabilitation and re-vegetation of the open space corridor early in the reclamation operation • Implement stringent construction management procedures

These strategies incorporate measures which adequately address the issues raised in the DGR listed in Table 2 (see Section 1.3).

FIGURES SECTION 1

Figure 1 Locality Plan

Figure 2 Existing Site Plan

Figure 3 Site Aerial Photo 2008

Figure 4 Concept Plan

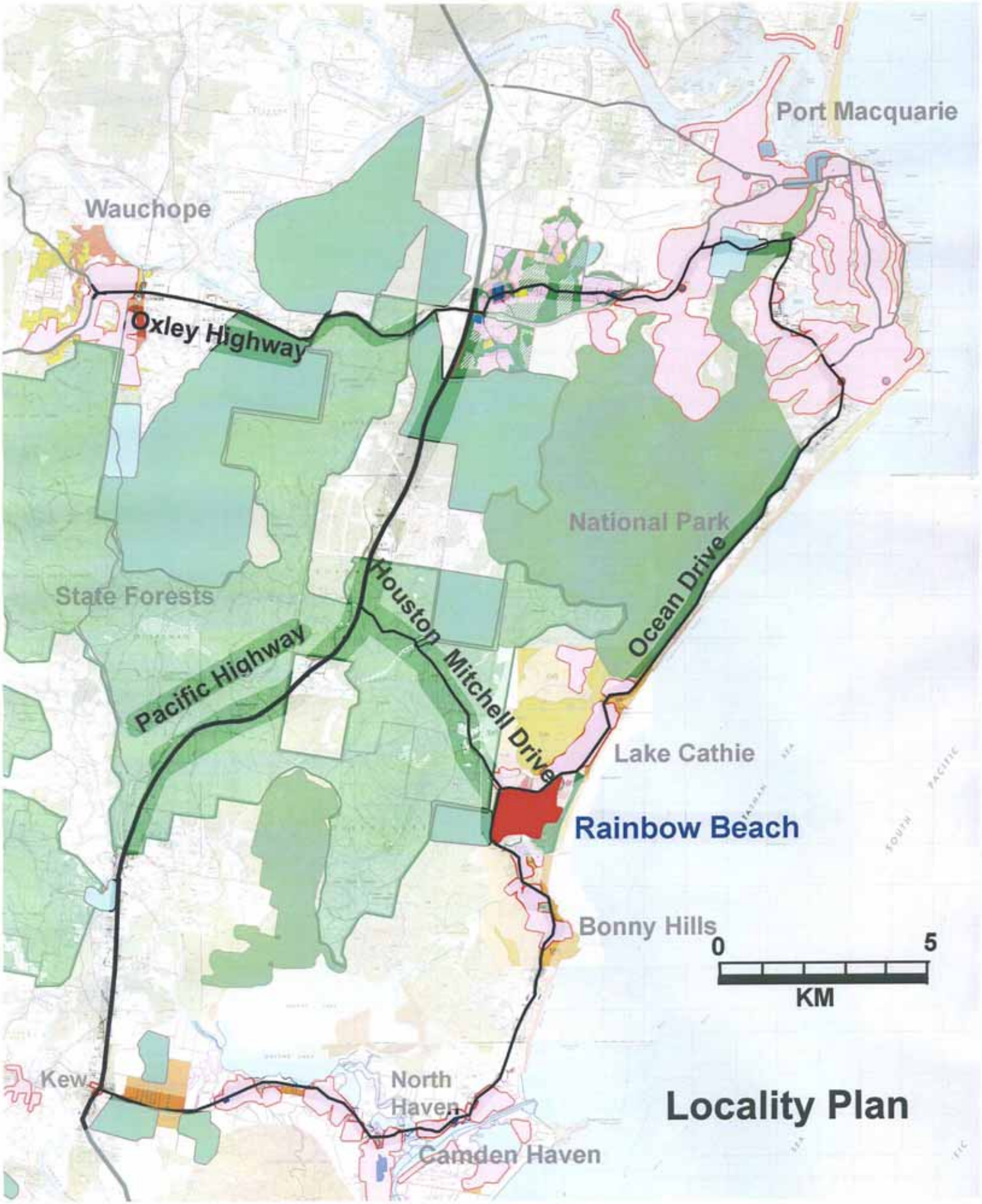

FIGURE 1 LOCALITY PLAN

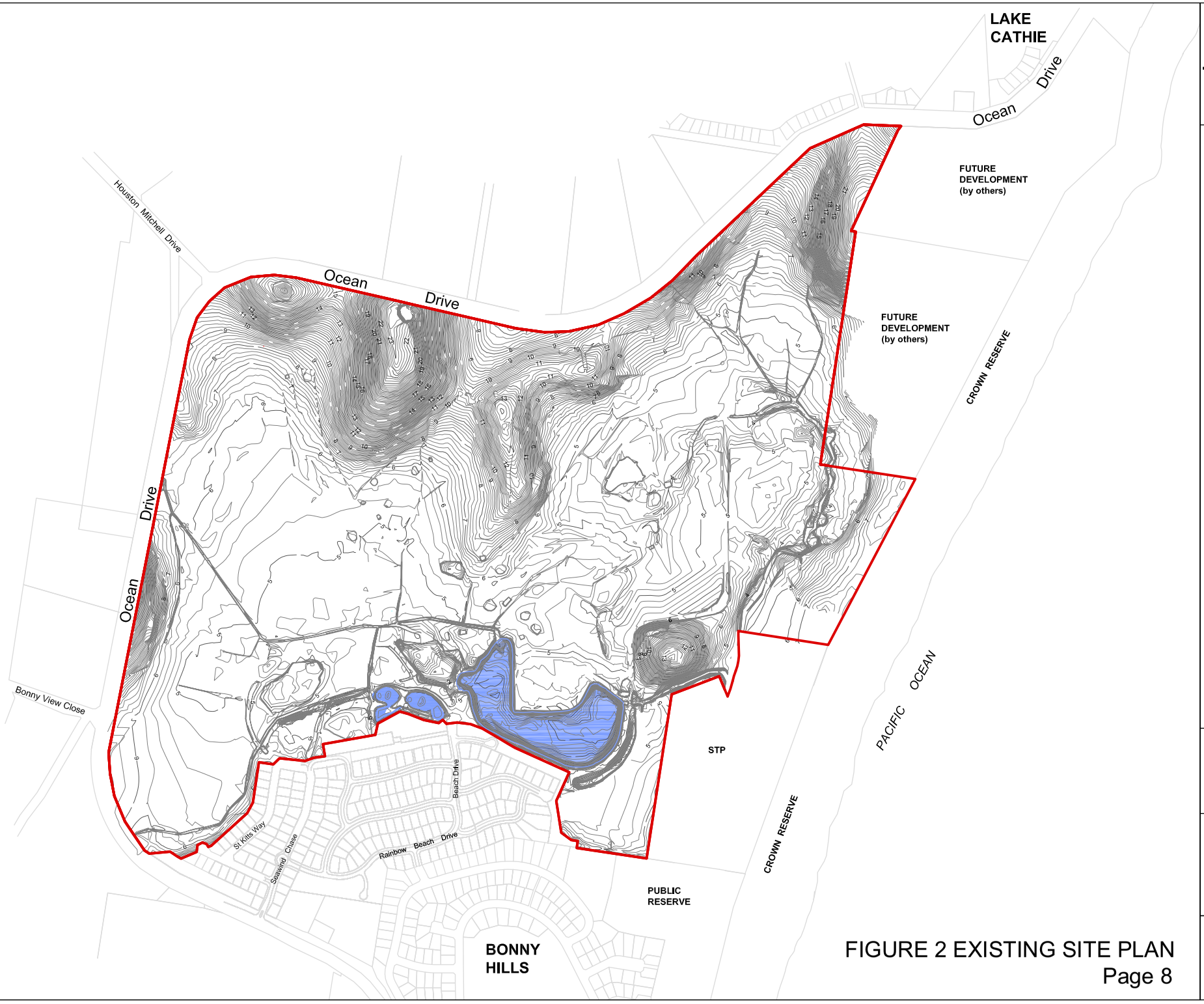

FIGURE 2 EXISTING SITE PLAN
Page 8

EXISTING TERRAIN MODEL
Plan E1

Surveyed by -
Luke & Company Surveyors
Property: 'Part' Lot 123
DP1106943 and Lot 5
DP25886
Datum: AHD
(MGA Ground Distance)

SUBJECT LAND

EXISTING CONTOURS
0.20 METRE
INTERVALS

REVISIONS
A: 15.1.08
E: 22.4.08
G: 17.9.09
H: 29.10.09

Rainbow Beach Estate
Concept Plan Application Set
Job. No. 4509:ND Dwn: CM
Luke and Company Pty Ltd

Scale:
1:8000@A3 1:4000@A1
The stated scale of this drawing maybe altered by copying. The scale should be verified prior to deriving measurements from this drawing

0 20 40 100 200 400(M)

AERIAL PHOTO

REVISIONS
A: 21.10.08

Rainbow Beach Estate
Property Management Plan Series
Job. No. 4509:ND Dwn: RM
Luke and Company Pty Ltd

FIGURE 3 SITE AERIAL PHOTO 2008

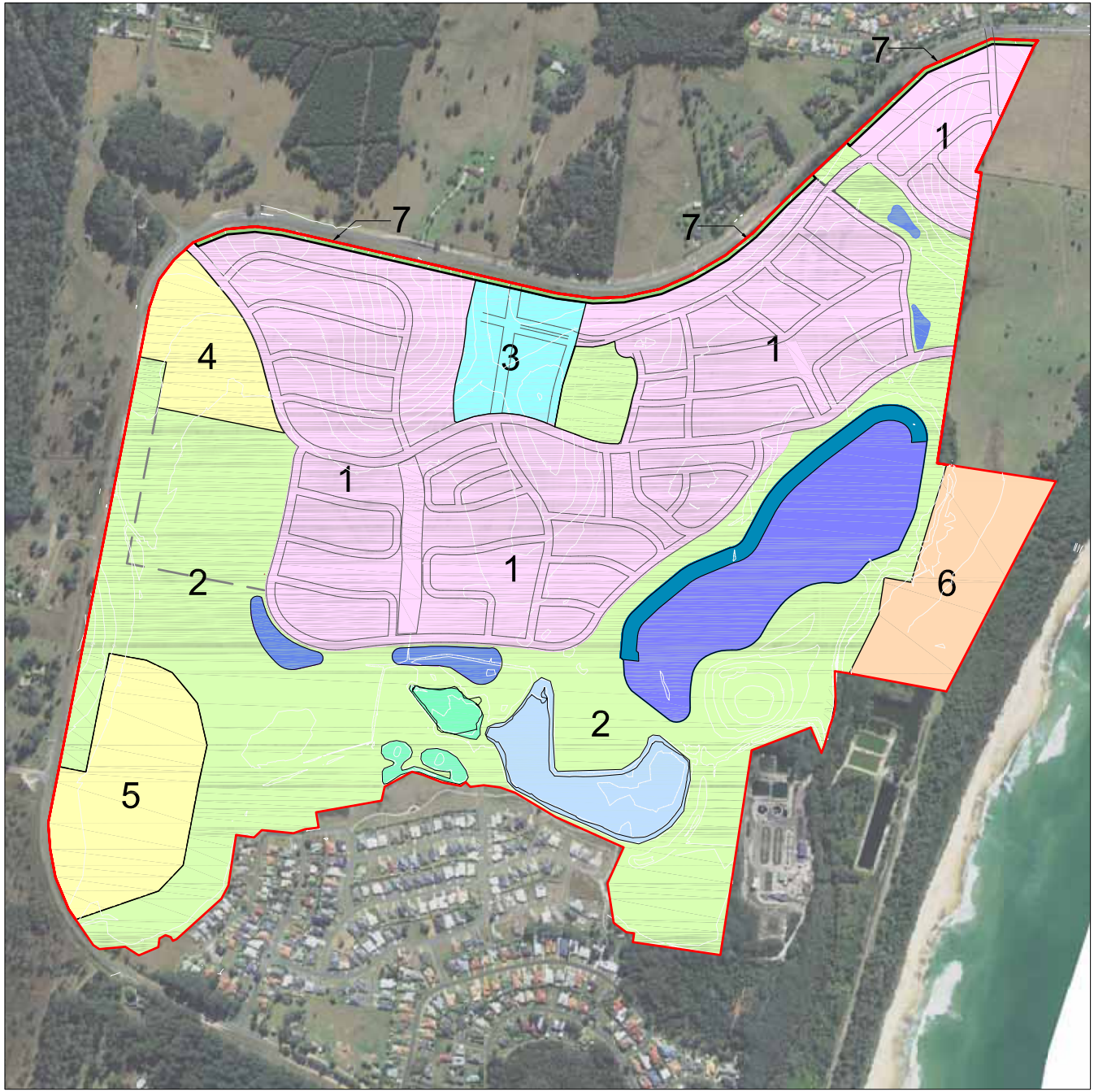

FIGURE 4 CONCEPT PLAN

CONCEPT PLAN DEVELOPMENT AREAS

PLAN B1

CONCEPT PLAN BREAKDOWN

1.	Residential Area	67.8
2.	Open Space, Drainage & Wildlife Habitat Corridor	80.9
3.	Village Centre	4.8
4.	Northern School Site	5.0
5.	Southern School Site	9.7
6.	Eco Tourist Site	7.6
7.	Ocean Drive Buffer (10m wide strip)	1.6
	TOTAL	**177.4**

* Subdivision layout is conceptual only & shown for clarification

REVISIONS:
A: 15.01.08
N: 18.12.09
O: 21.01.10
P: 10.02.10

Rainbow Beach Estate
Property Management Plan Series
Job. No. 4509:ND Dwn: CM
Luke and Company Pty Ltd

SCALE:
1:8000@A3 1:4000@A1

0 20 40 100 200 400(M)