Appendix 20
Warner Industrial Park Water Management Scheme

J.Wyndham Prince

May 2009

Warner Industrial Park
Preferred Project Report
Concept Plan and Project Application

Precinct 14 WEZ

Sparks Rd and Hue Hue Rd
Warnervale
May 2009

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Part of the Terrace Tower Group

Peter Andrews + Associates Pty Ltd
architecture planning urban design

WARNER INDUSTRIAL PARK
WATER MANAGEMENT SCHEME
ADDITIONAL INFORMATION

Prepared for:
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May, 2009

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WARNER INDUSTRIAL PARK
WATER MANAGEMENT SCHEME – ADDITIONAL INFORMATION

- DOCUMENT CONTROL SHEET -

Issue No.	Amendment	Prepared By & Date	Checked By and Date	Approved By and Date
A	Draft	GH (12/05/09)	PM (18/05/09)	WY (Date)
B				
C				
D				

WARNER INDUSTRIAL PARK
WATER MANAGEMENT SCHEME – ADDITIONAL INFORMATION

- CONTENTS -

1 INTRODUCTION

This report has been prepared in response to the request for additional information referred to in the Department of Planning letter S07/00717 dated 28 April 2009 and relates to the integration of stormwater *"matters which the Department seeks to be addressed."*

> *"A proper explanation should be provided of the workings of the water management scheme, including location of works, design and treatment e.g. landscaping of works, stability of works and design volumes. A 'water balance' model should be provided showing expected water volumes – water coming onto the site, on-site usage, water discharges – the effect or impacts of these operations should be described and assessed. A description should be provided of the operation of the water management system in high rainfall events* [understood to refer to 1 in 100-year Average Recurrence Interval] *and identification of whether it offers any flood mitigation effect. Ongoing maintenance effort in the maintenance of the water management scheme, responsibilities and cost implications should be discussed and described."*

This document provides a summary and overview of information contained in the various Appendices attached to the Environmental Assessment and the Preferred Project Report in relation to the Project Application, and the Concept Plan. The Concept Plan (the Draft Development Control Plan) provides requirements for the future development of individual lots within the Warner Industrial Park with respect to stormwater, erosion control and water quality management.

The following sub-headings are intended to provide an explanation of each of the elements that make up the stormwater management scheme and are in response to the specific points raised by the Department of Planning.

1.1 Workings of the Stormwater Management Scheme

Porters Creek Wetland has been identified as a valuable natural resource, worthy of protection. A key Threatening Process for the wetland is urban development, and the impact that an increase in impervious area would have on the catchment hydrologic cycle, namely changes to the wetting and drying cycles (hydroperiod) of the wetland. Consequently any development within the Porters Creek catchment will be required to retain the catchment hydrologic characteristics which existed prior to any new development.

In order to quantify these hydrologic characteristics Wyong Shire Council (WSC) engaged Ecological Engineering (EE) to prepare *"Water Sensitive Urban design Solutions for Catchments above Wetlands – Catchment Hydrologic Indices and Urban Water Management Performance Objectives, Nov 2004"* The hydrologic information determined by the EE investigations was then expanded to determine *"Modelling Rationale for the Porters Creek Stormwater Harvesting Strategy, May 2006"* from which an *"Integrated Water Cycle Management Strategy Wyong Employment Zone (WEZ), November 2006"* was prepared.

The criteria from these studies was then adapted by WSC as the basis for the technical information contained in their Draft Development Control Plans *"Wyong Water Sensitive Urban Design (June 2008)"* and *Wyong Employment Zone (February 2008)".* The aim of these criteria is to provide stormwater quality and quantity controls at individual Lot and Precinct level which will comply with the Regional controls necessary to maintain the critical hydroperiod for Porters Creek Wetland.

These criteria have been used as the basis for the Stormwater Management Scheme for Precinct 14 of the Wyong Employment Zone (WEZ), which includes the Warner Industrial Park. Figure 1 shows the location of Precinct 14 in relation to the other WEZ Precincts within the Buttonderry Creek catchment. Buttonderry Creek is a major tributary of Porters Creek and flows along the southern boundaries of Precinct 14, and Precincts 11 and 13 North.

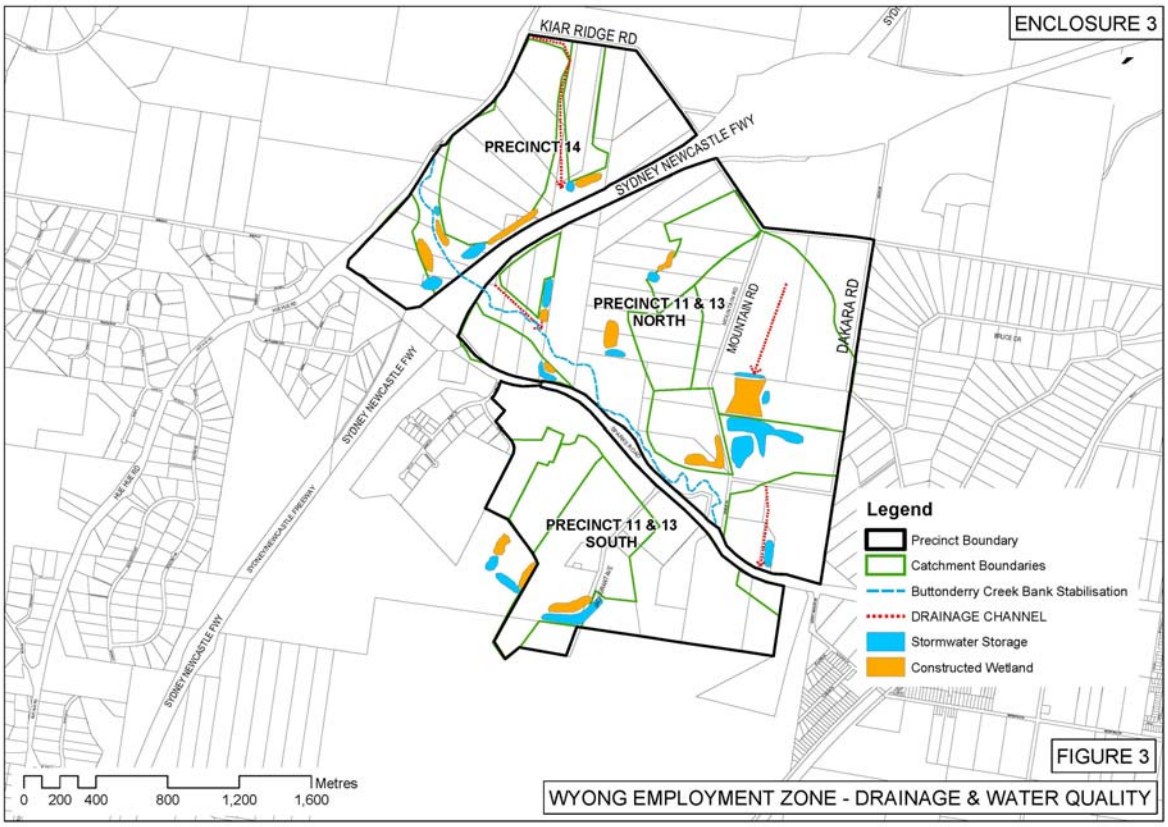


FIGURE 1 Buttonderry Creek and the Precinct Layout for the Wyong Employment Zone
(Source: Draft Section 94 Development Contributions Plan WEZ – WSC Feb. 2008, p.23)

Wyong Shire Council's Integrated Water Cycle Management Strategy (IWCMS) for the WEZ proposes to collect stormwater, which is surplus to maintaining the hydroperiod in Porter Creek Wetland, and diverting it directly to the Wyong River via a dedicated transfer pipeline. Some of the surplus stormwater, including flows from Precinct 14, were proposed to be treated in the disused "brick pits", in Precincts 11 and 13 North. As noted in the Preferred Project Report, the original route of the transfer pipeline, and the extent to which the "brick pits", are used to treat and store water, is under review by Council. The proponent has reached agreement with Council to contribute towards the transfer pipeline, and directly connect to that pipeline once it is constructed. [1]

This arrangement is part of the Voluntary Planning Agreement between the Proponent and Council, which also addresses surplus stormwater flows from Precinct 14 in the event that development of the lots in Precinct 14 occurs prior to the completion of Council's transfer pipeline to the Wyong River. The proposed threshold for the scheme to be fully operational and taking excess stormwater flows through the transfer pipeline is 50% of the ultimate development of the WEZ. Council has identified interim strategies for irrigation of excess stormwater in the unlikely event that the WEZ reaches 50% development before the transfer pipeline to the Wyong River is commissioned. [2]

[1] *pers com Peter Andrews + Associates*
[2] *pers com Peter Andrews + Associates*

1.1.1 Location of Works

WSC has defined the Key Components of the Wyong Employment Zone Integrated Water Cycle Management Strategy (IWCMS) on page 48 of Appendix E, DCP 88. In summary they include:

a Protect the receiving wetlands and waterway ecosystems through:

- *Preservation of both the flooding and drying hydrology from the development area to the natural wetlands.*
- *Preserving the nature of overland flow into adjacent habitats (ie. dispersed sheet flow).*
- *Preservation of the pre-development flows within Buttonderry Creek which influence stream disturbance (3mth and 1.5 year ARI).*
- *Treating urban stormwater runoff as required by Council's Stormwater Management Plan (90% reduction in TSS, 50% reduction in TN and TP).*

b Maximise capture and reuse of rainwater and minimise import of potable water.

In order to achieve the above drainage and water quality objectives WSC has identified the generic Precinct Scale (see Figure 1) and Lot Scale (see Figure 3) locations for the required works. Trehy Ingold Neate have refined the above generic Precinct Scale locations specifically for Precinct 14. The locations of the wetland treatment systems, their surface areas and the stormwater attenuation storage volumes are shown in Figure 2 (surface areas and volumes comply with the EE, Nov. 2006 IWCMS criteria).

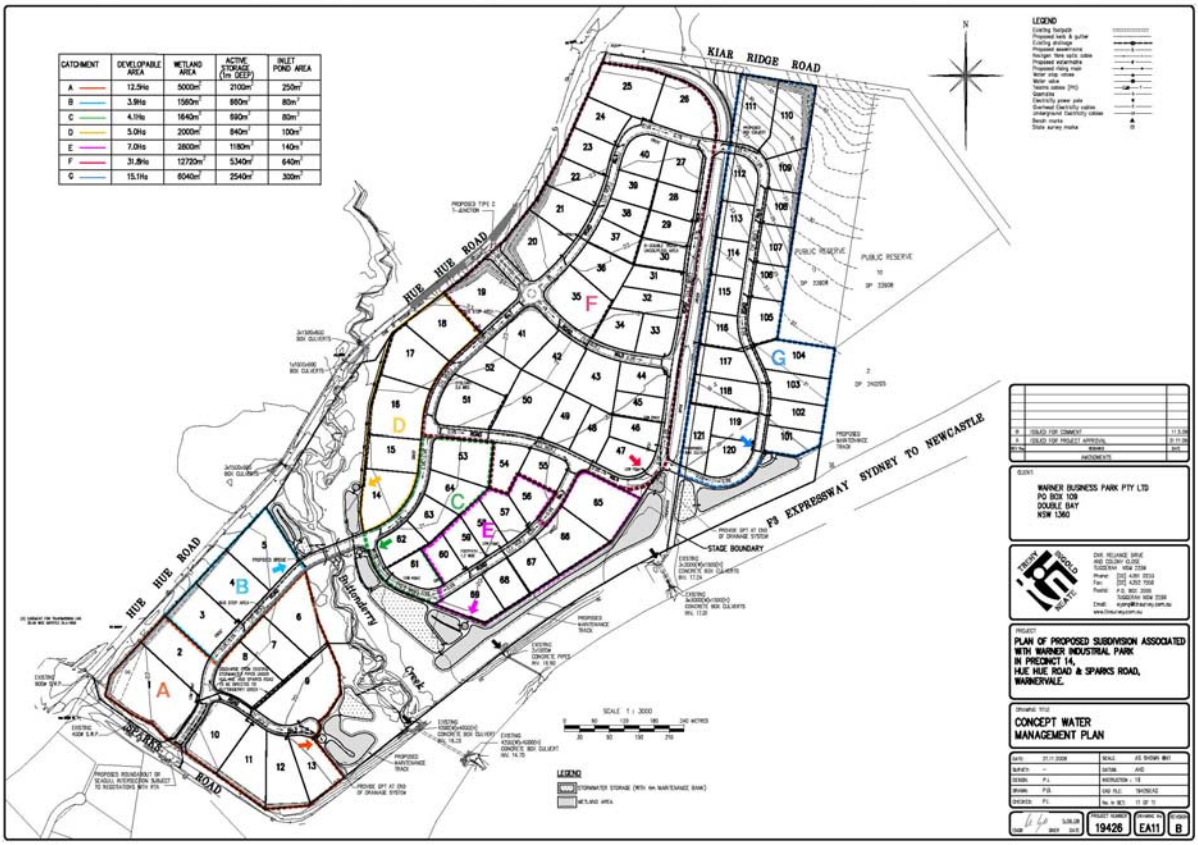


FIGURE 2 Location of the Elements of the Precinct 14 Stormwater Management Scheme
(Source: Trehy Ingold Neate)

The location of the Lot Scale elements will be dependent on the style of development proposed for each Lot, their final dimensions however, will comply with the criteria defined by EE and adopted in Development Control Plan 88 (see Figure 3).

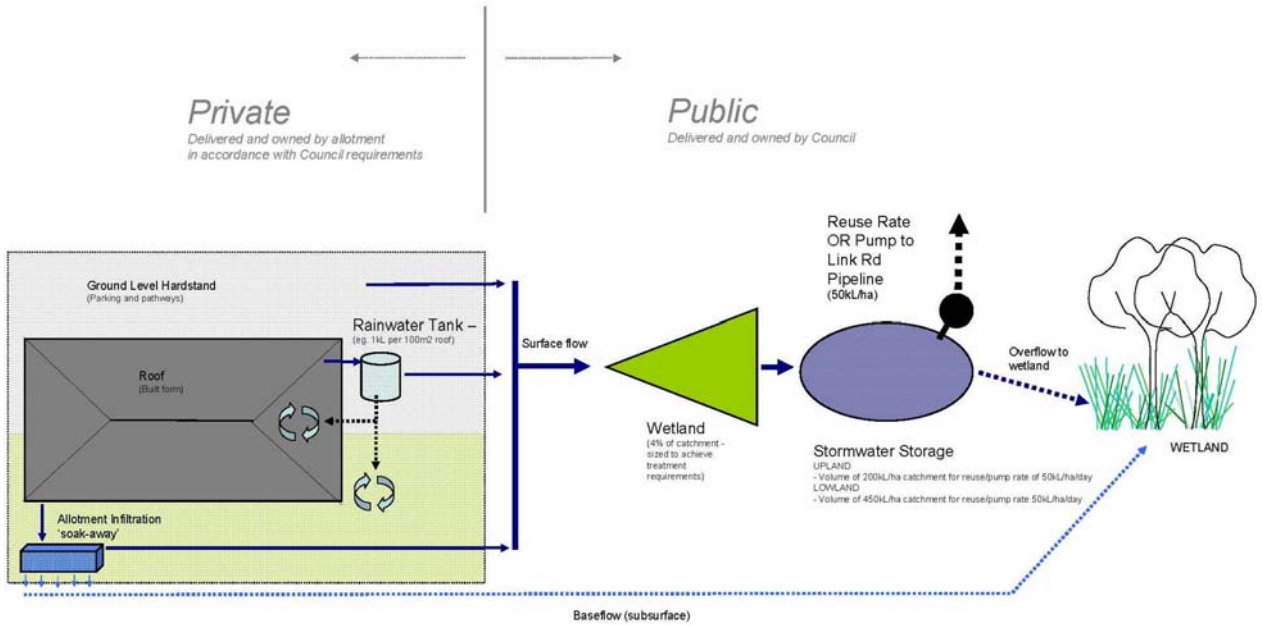


FIGURE 3 Lot Scale Water Quality and Quantity Controls for the Wyong Employment Zone
(Source: Wyong Employment Zone Draft Development Control Plan 88, p.54)

As noted in Section 1.1 a transfer pipeline will ultimately connect the Stormwater Storages in Precinct 14 to to the Wyong River. This connection will be made at the time that the Council's pipeline is commissioned. [3]

1.1.2 Design and Treatment

The key stormwater treatment criteria for any development within the Wyong Employment Zone has been defined in Appendix E of DCP 88. In summary they equate to:

- Preservation of the pre-development flows within Buttonderry Creek for the 3-month and 1.5-year Average Recurrence Interval (ARI) storm events; and
- Reducing the Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) levels in stormwater discharges by 90%, 50% and 50% respectively.

According to the EE assessment, commissioned and adopted by WSC, to achieve this criteria it is necessary for each development to:

- Reduce water use by using water efficient appliances;
- Harvest rainwater – tanks to be sized to provide 65%-70% of the non-potable demand (1 kL per 100 m^2 of roof area);
- Irrigation of landscaped areas which should represent at least 25% of the allotment area;

[3] *pers com Peter Andrews + Associates*

- Investigate alternatives to piped drainage systems e.g. roadside swales;
- Stormwater runoff to be directed to wetland treatment systems (WTS) designed to reduce the annual pollutant loads by: TSS (90%); TP and TN (50%). This can be achieved by providing WTS with surface areas representing 4% of their contributing catchment area (see Figure 2)
- Extended detention storage, within the WTS, will have the capacity to attenuate the 3-month, 1.5-year and 100-year ARI storm events. Multi-staged discharge outlets from the WTS will be designed to attenuate the stormwater inflows back to the pre-development peak discharge rates for the respective ARIs;
- Runoff volumes in excess of those necessary to maintain the hydroperod for Porters Creek Wetland will be diverted into the surplus stormwater pipeline as agreed to by WSC. For Precinct 14, which is defined as part of the Upland area of the Porters Creek catchment, this equates to a storage volume of 200 kL/ha of catchment with a pump rate of 50kL/ha/day.

The size and location of the water management elements are shown in Figure 2. Final details of each inlet zone, wetland, detention basin and stormwater storage volumes will be included within the detailed Engineering Designs and will be configured to ensure compliance with the above EE criteria.

Requirements for the treatment of surplus stormwater from individual development lots are contained in Section 5 of the Draft DCP – Warner Industrial Park (Appendix14 of the Preferred Project Report). Heading 5 Environmental Management of this appendix requires individual developments to meet the standards of the IWCMS, with respect to water quality discharge, and Wyong Shire Council's DCP Chapter 67 - Engineering Requirements, with respect to sedimentation and erosion control.

1.1.3 Landscaping of Works

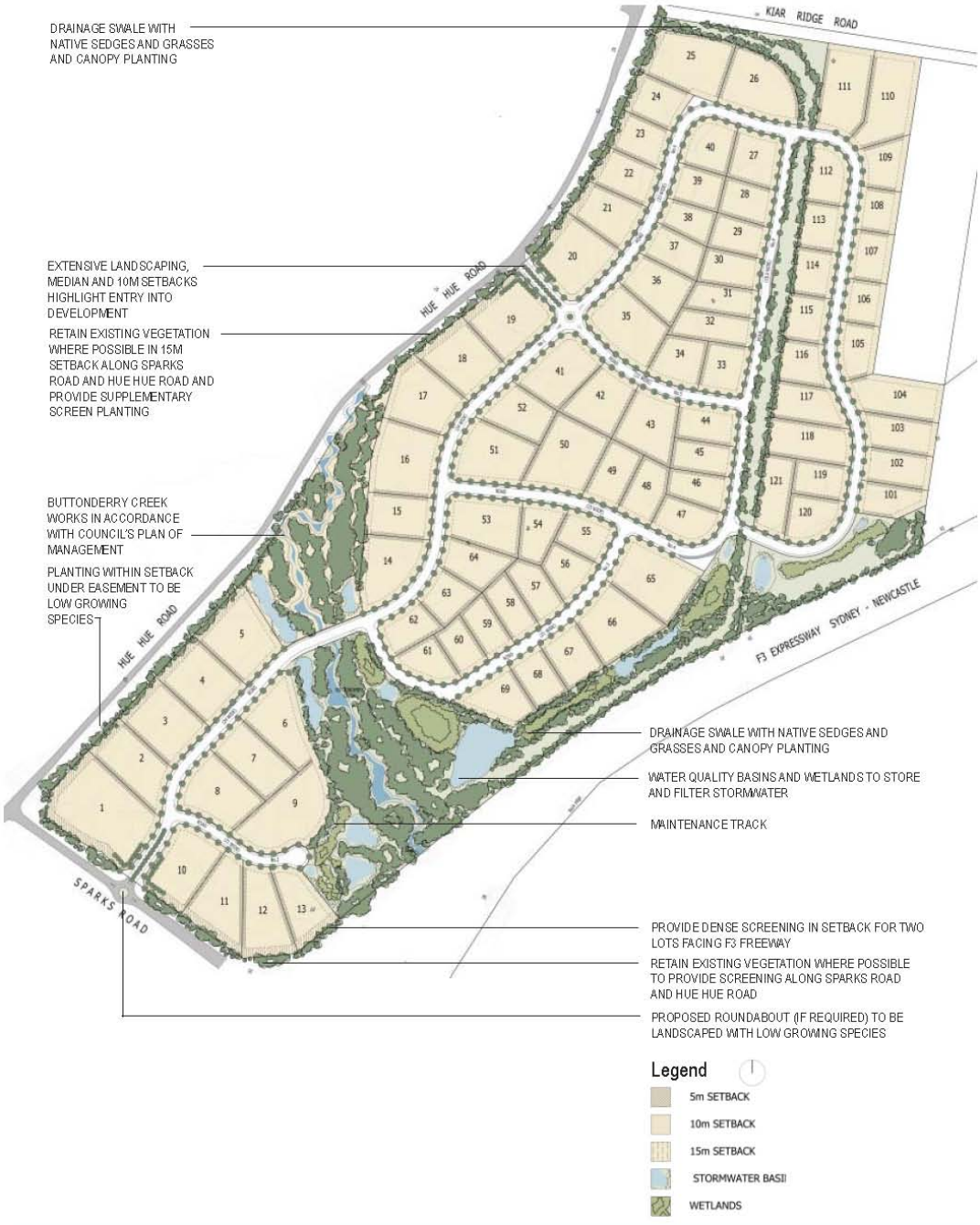
Landscape treatment will aim to provide the development with a distinctive character and link the development to the Riparian Corridor along Buttonderry Creek. The Landscape Masterplan proposed for Precinct 14 will guide the treatment of the public domain, external areas and individual allotments (see Figure 4 and Figure 5). Landscaping of Precinct 14 will comply with the Landscape Masterplan in Section 2 of the Draft DCP – Warner Industrial Park and the Visual Management Strategy. The Draft DCP provides landscape requirements for both the public and private domain, together with guidelines for ongoing maintenance.

The Landscape Masterplan provides recommended species for both the wetlands and riparian corridors. In addition, the Draft DCP - Warner Industrial Park requires that the treatment of the Buttonderry Creek Corridor be carried out in accordance with Wyong Council's Draft Wyong Employment Zone Ecological Plan of Management (February 2008), and the DWE Guidelines for Riparian Zones.

The landscape treatment proposed will reflect an urban landscape around the developed areas within Precinct 14, graduating to a native landscape character along Buttonderry Creek. For additional information related to the landscape treatments refer to Appendix 1 of the Draft Development Control Plan, February 2009 prepared by Peter Andrews + Associates Pty Ltd.

Draft Development Control Plan Warner Industrial Park
Appendix 1 - Visual and Landscape Management Strategy

Landscape Masterplan
Figure L1



February 2009
Page 6

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FIGURE 4 Proposed Landscape Masterplan for Precinct 14
(Source: Draft Development Control Plan Warner Industrial Park, Feb 2009, Appendix 1 p.6)

Draft Development Control Plan Warner Industrial Park
Appendix 1 - Visual and Landscape Management Strategy

Planting Schedules and Recommended Species

15M LANDSCAPE SETBACK,

10M LANDSCAPE SETBACK,

5M LANDSCAPE SETBACK

TREES	
Callistemon salignus	3m centres
Casuarina glauca	" "
Eucalytus robusta	" "
Eucalytus saligna	" "
Melaleuca quinquenervia	" "
SHRUBS	
Acacia longifolia	2m centres
Callistemon citrinus	" "
Doryanthes excelsa	" "
Leptospermum polygalifolium	" "
Melaleuca ericifolia	" "
Melaleuca nodosa	" "
Szygium australe	" "
Westringia fruticosa	" "
GROUNDCOVERS	
Dianella caerulea	6/m2
Grevillea 'Bronze Rambler'	3/m2
Hardenbergia violacea	3/m2
Lomandra longifolia	6/m2
Pennisetum alopecuroides	6/m2
Poa labillardieri 'Eskdale'	6/m2

SUPPLEMENTARY NATIVE PLANTING

SHRUBS	
Acacia ulicifolia	2m centres
Banksia spinulosa	" "
Dodonaea triquetra	" "
Epacris pulchella	" "
Leptospermum polygalifolium	" "
Melaleuca nodosa	" "
Pimelea linifolia	" "

SUPPLEMENTARY NATIVE RIPARIAN PLANTING

TREES	
Angophora floribunda	3m centres
Eucalytus pilularis	" "
Eucalytus saligna	" "
Glochidion ferdinandi	" "
SHRUBS	
Daviesia ulicifolia	2m centres
Dodonaea triquetra	" "
Melaleuca nodosa	" "
Polyscias sambucifolia	" "
GROUNDCOVERS	
Entolasia stricta	4/m2
Imperata cylindrica	4/m2
Lomandra longifolia	4/m2

WETLAND PLANTING

TREES	
Casuarina glauca	3m centres
Eucalytus robusta	" "
Melaleuca quinquenervia	" "
MACROPHYTES	
Baumea articulata	4/m2
Eleocharis acuta	" "
Gahnia sieberana	" "
Isolepsis nodosa	" "
Juncus usitatus	" "
Schoenoplectus validus	" "

STREET TREES

Corymbia maculata	20m centres
Eucalytus robusta	" "
Eucalytus saligna	" "
Syncarpia glomulifera	" "
Toona ciliata	" "
Tristaniopsis laurina	" "
Watehousia floribunda	" "

EXISTING VEGETATION TO BE RETAINED

Existing vegetation typically includes:
Angophora costata
Allocasuarina torulosa
Corymbia maculata
Eucalytus pilularis
Eucalytus robusta
Syncarpia glomulifera

FIGURE 5 Proposed Schedules and Recommended Species
(Source: Draft Development Control Plan Warner Industrial Park, Feb 2009, Appendix 1 p.7)

1.1.4 Stability of Works

Industrial developments require large level building pads, vehicle turning circles and parking areas. To facilitate these it is necessary to re-configure the contours on the site to match the proposed allotment and road layout. Figure 6 provides guidance on the expected cut and fill that is needed to achieve a landform that is conducive to industrial developments, the final trimming and shaping of individual allotments will not occur until their sale and subsequent Building Approval. Requirements relating to site stability, during any re-grading and the preparation of the site for building construction, will be subject to specific site controls by WSC including compliance with their "Control of Erosion and Sedimentation" Development Control Plan, 2005.

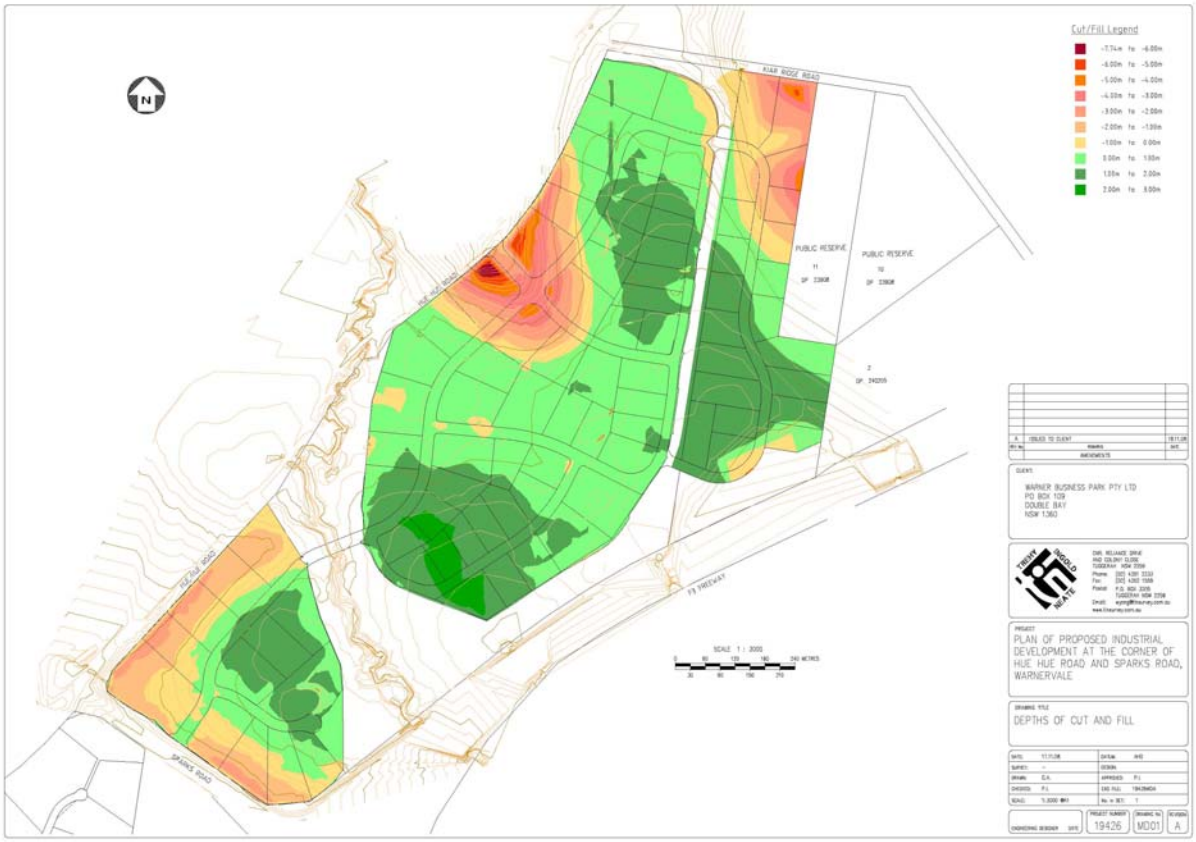

FIGURE 6 Proposed Cut and Fill

(Source: Preferred Project Report, Peter Andrews + Associates Feb 2009, Appendix 13)

A WSC approved Erosion and Sediment Control Plan (E&SCP) will be required as part of the detailed Engineering Designs (see Figure 7) and Construction Certificate documentation. The E&SCP will specifically address the issue of site stability during construction and include such measures as:

- Limiting the amount of site disturbance;
- Diversion of water from outside of the site around the area of works. Particular attention will be given to diverting the discharges from the culverts under Kiar Ridge Rd and Hue Hue Rd into stabilised channels and existing watercourses such that they are conveyed to the F3 Freeway culverts without interacting with any disturbed areas within the site.
- Use of grass lined channels, swales and contour drains to direct surface runoff from within the site to sediment control basins.
- Retention of topsoil and early establishment of vegetation on disturbed areas.

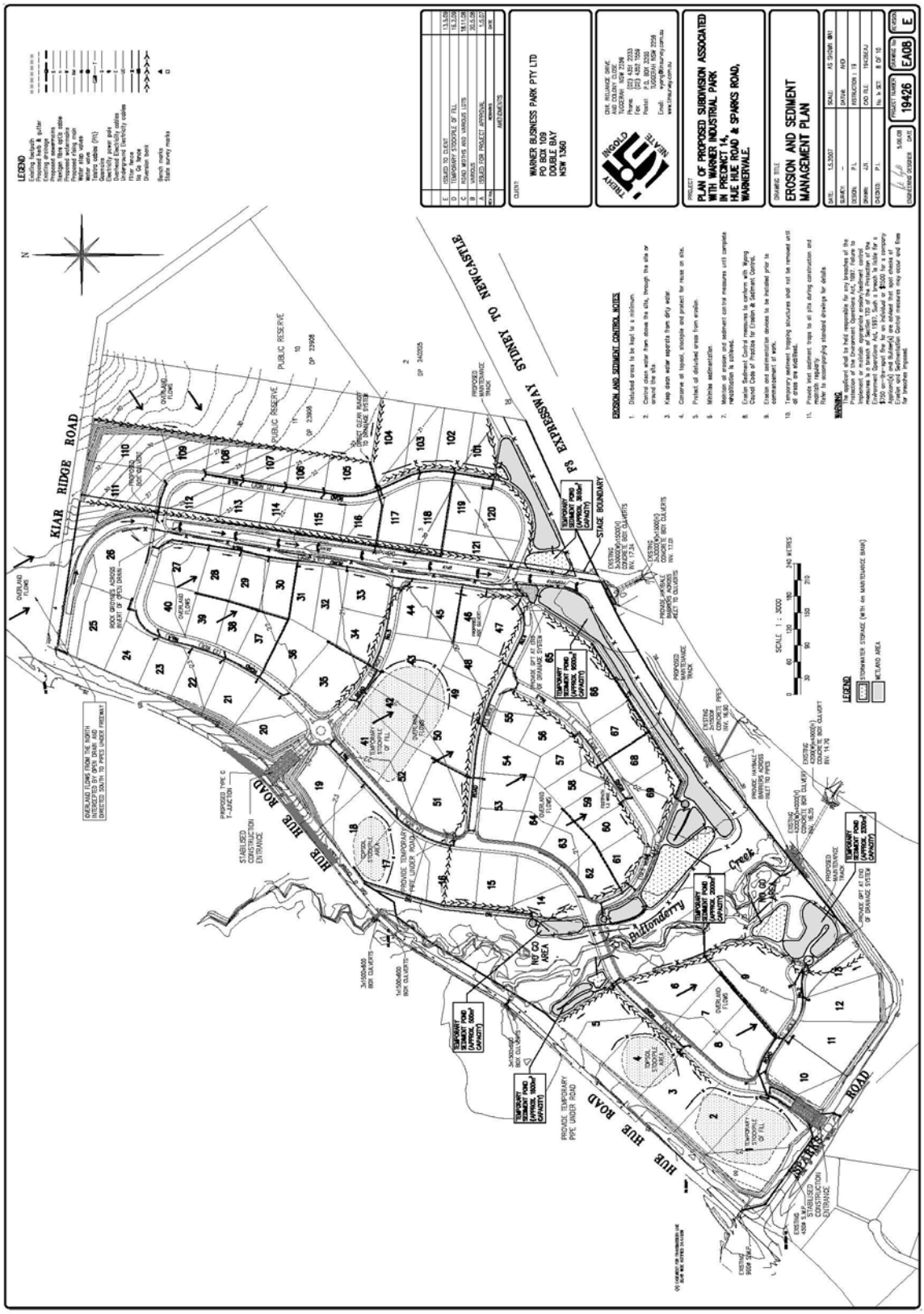

FIGURE 7 Proposed Erosion and Sediment Management Plan
(Source: Treahy Ingold Neate)

- Control of run-off and sediment movement close to its source.
- Progressive revegetation of the site wherever possible during construction to reduce the area exposed to erosion.
- Construction of sediment basins in accordance with WSC E&SC requirements.
- Filtering of sediment from runoff prior to its release to the receiving environment.

Major earthworks necessary for the construction of the Trunk Drainage, Flood Attenuation and Water Quality controls will be subject to strict design and construction controls issued by WSC. In particular the structural integrity of any earth fill embankment, designed to retain water, will be verified by a Geotechnical Engineer. All outlet pipe works that pass through the embankments of these basins will be constructed with seepage collars to ensure that preferential flow of stored water does not occur along the pipeline and that the structural integrity of the embankments is maintained. The location of the basins, which are integral elements of the Precinct 14 Stormwater Management Scheme are shown on Figures 2 and 4.

1.1.5 Design Volumes

Ecological Engineering has prepared an Overview of the Integrated Water Cycle Management Strategy for Precinct 14 in their report dated November 2006. This Overview includes the estimated surface areas and depths for each of the Stormwater Storages required to control runoff from various sub-catchments within Precinct 14. Figure 5.2 and Table 5.2 from the EE report are included below for reference purposes.

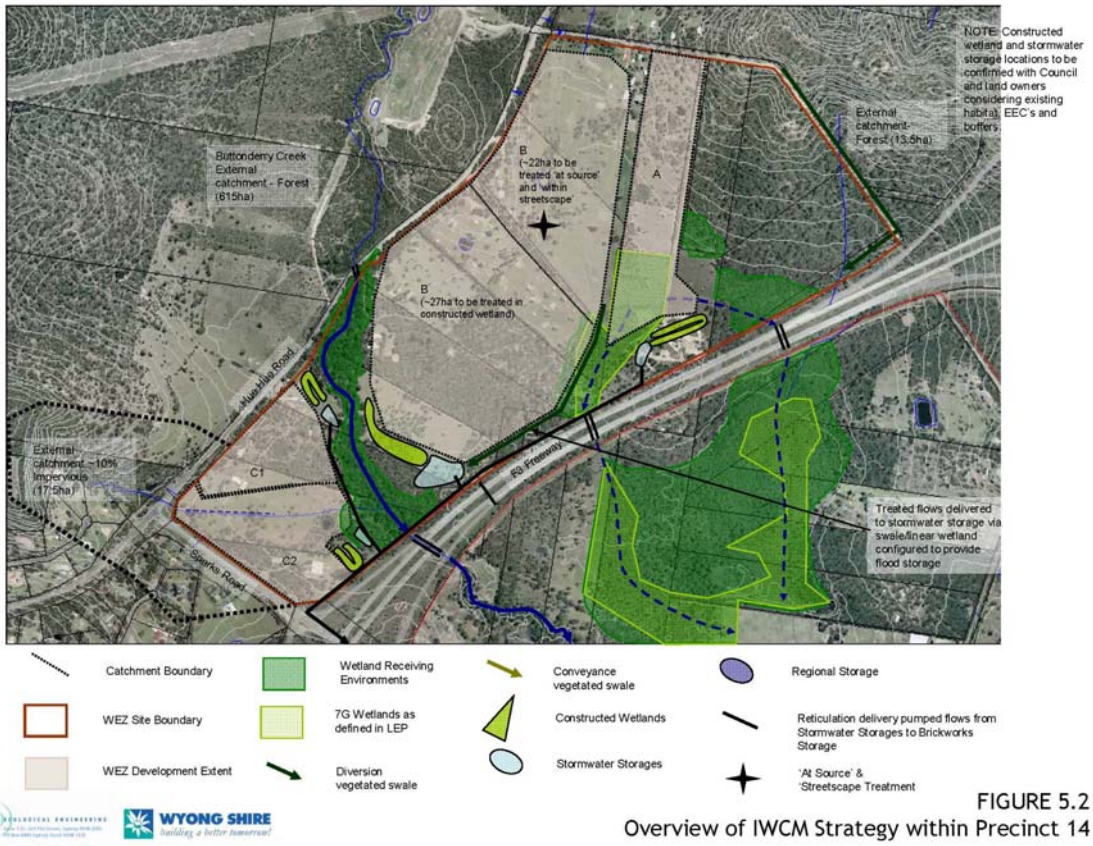

FIGURE 5.2
Overview of IWCM Strategy within Precinct 14

ECOLOGICAL ENGINEERING

Table 5.2 Summary of WEZ IWCM Strategy

CATCHMENT ID	Catchment Area (ha)	Development Area[1] (ha)	Constructed Wetland (ha)	Stormwater Storage	
				Area (ha)	Active Storage Depth (m)
Precinct 14					
A	12.3	12.3	0.49	0.21	1.0
B	49.0	49.0	1.08[2]	0.83	1.0
C1	7.0	7.0	0.27	0.12	1.0
C2	10.0	10.0	0.40	0.17	1.0
Precinct 11 & 13					
D	10.1	10.1	0.41	0.17	1.0
E	7.0	7.0	0.28	0.31	1.0
F	17.1	17.1	0.68	0.29	1.0
G	19.6	19.6	0.79	0.33	1.0
H	17.2	17.2	0.69	-[4]	-[4]
I	66.4	49.6	3.40	3.0	0.65
J1	4.3	4.3	-[3]	0.10	0.75
J2	22.4	22.4	-[3]	0.50	0.75
Ext A	42.3	42.3	1.69	-[4]	-[4]
Supplier Park – Stage 1					
K	11.1	8.0	0.33	0.4	1.0
Supplier Park – Stage 2					
L	26.4	13.2	0.59[5]	0.59[5]	1.0
Airport Lands – Stage 3					
M	49.6	43.6	1.76	1.96	1.0
Sparks Road South					
N	3.2	3.2	-[3]	0.08	0.75

1. Area of catchment to be developed as part of WEZ (and future development) with runoff managed within WEZ
2. Approximately 27ha of Catchment B to be treated via constructed wetland with remaining ~22ha treated 'At Source' and within 'Streetscapes'
3. Stormwater treatment to occur 'At Source' and within 'Streetscapes'
4. Stormwater Storage for this catchment provided in 'Catchment I'
5. Constructed Wetland and Stormwater Storage for Catchment L can be combined with Catchment M to create a single wetland and storage system

NOTE: – Catchments E, K, L and M considered to be 'Lowland' catchments whereas as the remaining catchments are 'Upland'
– Constructed wetland and stormwater storage sizes subject to change as a result of catchment area and development area change. If development does not occur in accordance with catchment/development areas list above then redesign of the constructed wetland and stormwater storage required.

69

Table 1 below lists the storage volumes for each of the combined wetland treatment systems and stormwater storage basins proposed for Precinct 14. The location of each wetland and storage basin, and their contributing catchment boundaries are shown on Figure 2.

TABLE 1 Proposed Storage Volumes for Precinct 14 (per Figure 2)

Catchment	Area (has)	Wetland Surface Area (m^2)	Active Storage Vol. (m^3)
A	12.5	5,000	2,100
B	3.9	1,560	660
C	4.1	1,640	690
D	5.0	2,000	840
E	7.0	2,800	1,180
F	31.8	12,720	5,340
G	15.1	6,040	2,540

1.2 Water Balance

Ecological Engineering has undertaken a comprehensive Regional and Precinct Water Balance for the WEZ based on the requirement of maintaining the hydroperiod in Porters Creek Wetland. The parameters upon which this Water Balance has been based, have been included as part of the Stormwater Management Scheme for Precinct 14. It will be extended down to an Allotment level through individual development controls on each building as part of the Building Approval process administered by Wyong Shire Council.

1.2.1 Expected Volumes

a. Water Coming onto the Site – from upstream catchments enters through separate road culverts – three (3) separate reaches of Buttonderry Creek under Hue Hue Rd, to the west of Precinct 14, and one (1) under Kiar Ridge Rd on the northern boundary of the proposed Warner Industrial Park. All of these catchments have little impervious area and have been considered by Ecological Engineering in their calculations as having a Volumetric Runoff coefficient equivalent to a Forest. Consequently we have used the following parameters to estimate the average annual volumes of runoff entering the Warner Industrial Park from the two (2) upstream catchments:

Average Annual Rainfall – 1174 mm
Volumetric Runoff coefficient – 0.12

Hue Hue Rd Catchments (Buttonderry Creek)
626 ha. = 882 ML/yr

Kiar Ridge Rd Catchment
108 ha = 152 ML/yr

The above volumes, from upstream of the Warner Industrial Park, will be directed around the site specific Stormwater Management Scheme and into Buttonderry Creek before discharging downstream through the F3 Freeway culverts.

b. On-site Usage – to be determined on the basis of the final development form for each site. However it is intended that each building will harvest its own roof water (rainwater tanks to be sized on the basis of 1kL of storage per 100 m^2 of roof area – see Figure 3) which will then be used for internal toilet flushing, washing and irrigation. Each allotment will be required to maintain at least 25% of its surface area in a pervious state and an average irrigation rate of 0.5 m per year should be applied to the designated landscaped area. Due to the relatively impermeable nature of the soil in Precinct 14 (i.e. hydraulic conductivity <3.6 mm/hr) infiltration is not considered necessary to maintain baseflow. (EE Nov 2006, p.74).

c. Water Discharges – Rain falling on the Warner Industrial Park will be intercepted by the major/minor stormwater drainage system and directed to either: a stormwater harvesting system for reuse; detention basins for flood attenuation; wetlands for water quality control; stormwater storage to maintain the hydroperiod in Porter Creek Wetland; or combinations of all four (4). This series of treatment options will control stormwater discharges from the site in such a manner that they will comply with the criteria established by Ecological Engineering in their *"Integrated Water Cycle Management Strategy Wyong Employment Zone (WEZ), November 2006"* and DCP 88 *"Wyong Employment Zone Draft Development Control Plan"* prepared by WSC.

1.2.2 Discussion of Expected Impacts

The objective of the Integrated Water Cycle Management Strategy, developed by Ecological Engineering for WSC, is to ensure *"that all forms of development incorporate water sensitive management controls to minimise any impact on Porter's Creek Wetland and hydrologically sensitive ecosystems. Any development should aim to promote sustainable and integrated management of land and water resources for the benefit of both present and future generations."* (EE 2006, p.1)

The stormwater management parameters defined by EE have been adopted by WSC and incorporated into their draft DCP 88. These same parameters have been incorporated into the water management scheme for the Warner Industrial Park. It follows then that once the site specific stormwater management controls are implemented "any impact on Porter's Creek Wetland and hydrologically sensitive ecosystems" attributed to the development of the site, will be minimised.

A Soil and Stormwater Management Plan is included as part of the Preferred Project Report (Appendix 1), and the proposed Erosion and Sediment Plan is included at Figure 7 and described in Attachment 1. A site specific Erosion and Sediment Control Plan (E&SCP) will be prepared (in accordance with WSC DCP Chapter 67 - Engineering Requirements) as part of the Construction Plans and approved by WSC prior to the commencement of any physical works on site. Adherence to this E&SCP is intended to minimise the impact of the works on the receiving environment and operate as a surrogate for the stormwater management scheme until its critical elements are operational.

The IWCMS provides a threshold of 50% development of the WEZ before the transfer pipeline to Wyong River has to be operational. Wyong Council has identified interim strategies for dealing with surplus stormwater flows in the unlikely event that development of the WEZ reaches 50% before the pipeline is commissioned. [4]

Appendix 7 of the Preferred Project Report addresses potential impacts with respect to climate change.

1.3 Operation of the Scheme in High Rainfall Events

The internal Warner Industrial Park catchments total approximately 138 ha, whilst the external catchments that discharge under Hue Hue Road into the site total approximately 734 ha (Matrix Flood Study, 2005). DHI, 2006 have undertaken 100-year ARI Flood Studies of Buttonderry Creek through Precinct 14. The flood levels and flood extents of this investigation are documented in Appendix 16 "Hydraulic Flood Modelling" contained in the Warner Industrial Park Preferred Project Report.

Internal management of these flows has been accounted for in the proposed stormwater management system and complies with the WSC "Stormwater Drainage Design (April 1999)" through the implementation of a major/minor drainage network.

- The **minor** drainage network relates to the street gutter and pipe network, which convey the runoff from storms up to the 20-year ARI rainfall intensity, directly to the stormwater treatment, detention and storage facilities. These facilities are designed to attenuate the peaks in the 3-month and 1.5-year ARI events back to the pre-development peaks as recommended by the EE investigations.

[4] *pers com Peter Andrews + Associates*

- The **major** system refers to the overland flow paths which convey runoff in excess of the minor drainage system into the detention and storage facilities. These facilities are designed to attenuate the peak 100-year ARI discharge, from the site, back to the pre-development peak discharge rates. The surplus runoff will be retained in the temporary storage and pumped to the surplus stormwater reticulation scheme designed as a regional system to manage the hydroperiod in Porters Creek Wetland.

1.3.1 Flooding (prepared by Buzz Engineering and Environmental Solutions)

a. Overview – The design of the floodplain development strategy for Precinct 14 considered the following key drivers:

- Extents of filling;
- Location of the bridge crossing;
- Location of stormwater treatment areas and integration with compensatory storage;
- Formalization of a smaller watercourse;
- Integrity of the Freeway Embankment and surrounding roads; and
- Environmental Constraints.

These key drivers were balanced to ensure that the floodplain development strategy was in accordance with Ecologically Sustainable Development principles. The extents of filling, bridge crossing and stormwater treatment areas were the main development components that effect flood flows, levels and velocities.

The batters surrounding the floodplain are situated in the existing flood fringe or on the edge of flood storage. The result of this is that the floodwaters are shallow and generally slow moving with low risk of significant damage to the new development in major flooding events.

The bridge crossing was carefully located based on the form of Buttonderry Creek and its environmental sensitivity. Hydrology and hydraulic analysis of this structure showed that it did not impact on the 1% AEP flood behaviour (DHI, 2 May 2007) see Attachment 2.

The batters of the constructed wetlands and stormwater storages are generally located in the flood storage area. The peak velocities in this part of the floodplain are expected to be lower than 2 m/s in the 100-year ARI event and with appropriate vegetation there is a low risk of significant damage to the new development in major flooding events.

The DHI WEZ Additional Flooding Assessment (Nov 2006) describes the existing flooding as "*broad, shallow overland flows*" in Figure 4 of their report.. The report then states "*the approach to accommodating flooding within Precinct 14 development area is generally sound*" and provides the developed 100-year ARI flood extents in Figure 5 of their report. Detailed hydrologic and hydraulic model calculations can be found in the Appendices of the DHI flooding assessment. Figures 8 and 9 (Treahy Ingold Neate) provide more detailed plans of the flood extents in Precinct 14.

b. Operations and Effects – The operation of the developed floodplain will differ to the existing floodplain. The original shallow broad flows are reduced in width and depths are increased slightly. Floodplain management measures have been established to minimize the changes, which include compensatory storage with the

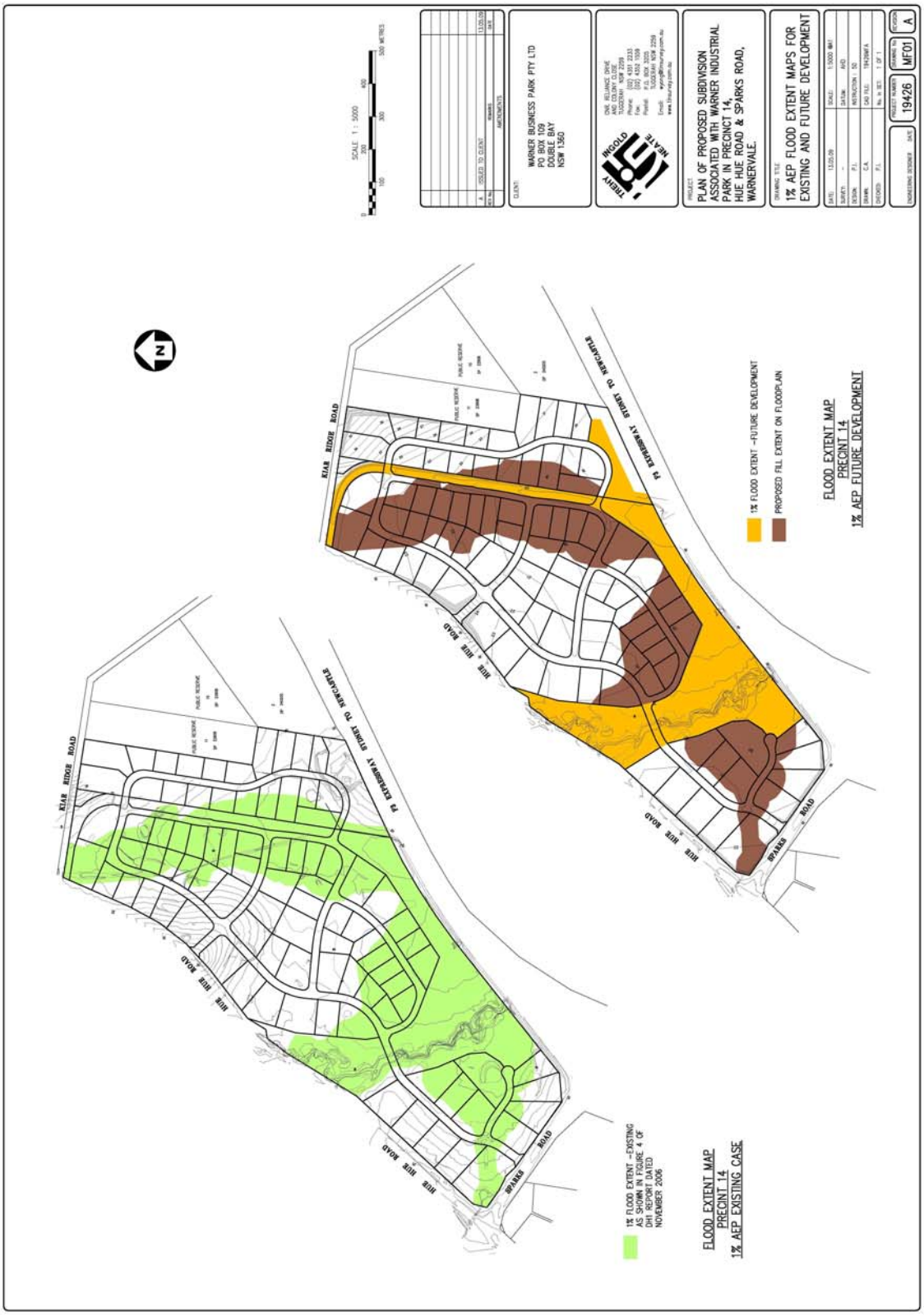

FIGURE 8 Pre and Post development Flood Extents
(Source: Treahy Ingold Neate)

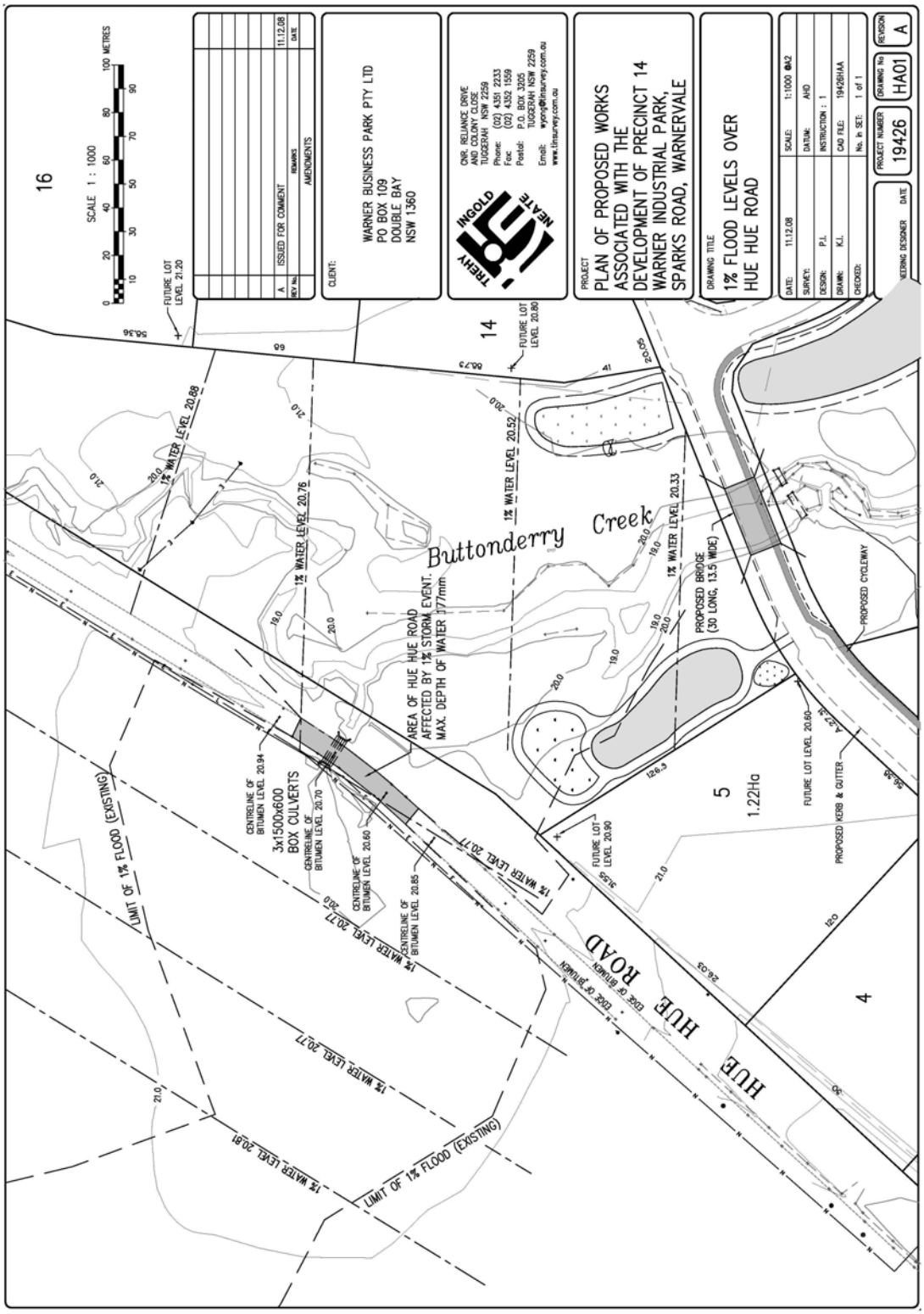

FIGURE 9 Existing Flooding Extents in Buttonderry Creek at Hue Hue Road
(Source: Treahy Ingold Neate)

majority of the required storage, integrated with the constructed wetlands and stormwater storages.

c. Impact Assessment – The proposed floodplain development strategy (Precincts 11, 13 and 14) has been "*assessed to negligible impact on the 1% AEP* [100-year ARI] *flood levels in most areas in terms of peak flood levels, average peak velocities and peak flow rates*" (DHI, Nov 2006).

1.4 Maintenance of the Scheme

A detailed Operation and Management Manual (O&M) will be required as part of the Development Approval. Maintenance issues to be addressed by the O&M will be finalised as part of the engineering details for the infrastructure and will include issues such as:

- Cleaning of water quality control facilities (GPTs, wetlands, swales etc);
- Embankment stability;
- Weed control and re-vegetation;
- Regular inspections;
- Reporting

The Draft DCP Warner Industrial Park, provides guidelines for landscape maintenance and requires that the management of Buttonderry Creek Corridor is to be in accordance with Wyong Council's Draft Wyong Employment Zone Ecological Plan of Management (February 2008). The Proponent will be responsible for maintenance for 3 years after the completion of each stage of the initial subdivision. The Riparian Zones including water quality ponds will be transferred to Wyong Shire Council upon completion. Wyong Shire Council has acknowledged it has an ongoing maintenance obligation in its IWCMS. [5]

1.4.1 Responsibilities

- Individual Allotment Owners – the operation and management of the site based stormwater management facilities (demand management, rainwater harvesting and reuse).

- Proponent – to enter into an arrangement with incoming land purchasers and developers for the operation and management of the public domain infrastructure.

The Riparian and Freeway Corridors will be rehabilitated, re-vegetated and transferred to Wyong Shire Council.

1.4.2 Cost Implications

In accordance with clause 5.3 of the Draft DCP - Warner Industrial Park, the proponent proposes to enter into an arrangement with individual lot purchasers/developers, to secure funding for the ongoing implementation of the O&M to ensure that the maintenance of the stormwater management scheme is carried out and the system remains operational.

Funding arrangements will be formalised between the proponent and WSC for the ongoing management of the Riparian Corridor and the surplus stormwater reticulation scheme.

[5] *pers com Peter Andrews + Associates*

2 CONCLUSION

The proposed stormwater management scheme has been sized and configured as a "Treatment Train" in accordance with the criteria identified in the Ecological Engineering *"Integrated Water Cycle Management Strategy Wyong Employment Zone (WEZ), November 2006" (IWCMS)* and required in DCP 88 *"Wyong Employment Zone Draft Development Control Plan"* prepared by WSC. The principle objective of both of these documents is to manage the post-development hydrology such that it replicates the pre-development hydrology and has minimal impact on the environmental health of Buttonderry Creek and Porters Creek Wetland.

Stormwater runoff, surplus to the environmental health criteria, is intended to be stored and pumped to the Wyong River to augment the reticulated potable water supply for the area. The ultimate goal being to increase the viability of the Wyong Gosford water supply system by harvesting surplus stormwater, on a regional basis, treating it and making it available for reuse in the potable water supply.

The stormwater management scheme as proposed incorporates all the elements of what is described as Water Sensitive Urban Stormwater Design.

- Demand Management as part of the building controls and DCP 88 represent Source Control;
- Rainwater harvesting and reuse at an allotment level provides a reduction on the potable water demand and promotes base flow conditions similar to those that existed pre-development;
- Wetland treatment systems provide stormwater pollution control in accordance with the DCP requirements;
- Stormwater detention attenuates the 100-year peak flows and controls the peaks from the lesser storms (3-month and 1.5-year ARI) which have been identified as Key Threatening processes with aquatic ecosystems;
- Storage and removal of the surplus stormwater protects the hydroperiod in Buttonderry Creek and Porters Creek Wetland and increases the viability of the local potable water supply.

The major functional elements of the Stormwater Management Scheme, including sedimentation basins, constructed wetlands and stormwater storages have been configured (sizes, levels and maintainability) using the criteria defined in the IWCMS, Nov. 2006 (see Figure 2). These criteria have been determined by Ecological Engineering as capable of mitigating the effects of the development of Precinct 14 on Buttonderry Ck, and when combined with downstream measures in other Precincts of the WEZ should reduce the hydrological impacts on Porters Creek Wetland

3 ATTACHMENT 1 – EROSION & SEDIMENT CONTROL DURING CONSTRUCTION

(Prepared by Treahy Ingold Neate)

Water Management during bulk earthworks will be undertaken in accordance with Wyong Shire Development Control Plan 2005 Chapter 67, Appendix A – Control of Erosion and Sedimentation. On-site bulk earthworks are to be undertaken to the north and south of Buttonderry Creek.

The following list provides a summary of the staging of water management works for bulk earthworks construction:

Staging of Works - North of Buttonderry Creek

1. Construct stabilised construction entrance with shaker ramp at Hue Hue Road.

2. Place haybale barriers across culverts under F3 Freeway.

3. Construct north/south open drain and stabilise drain invert and batter with vegetation. Place rock groynes at suitable intervals across drain invert.

4. Direct clean water from north of Kiar Ridge Road along open drain to existing pipe/culvert crossings under F3 Freeway.

5. Construct silt fence outside of work area as shown on Trehy Ingold Neate drawing EA08 Rev. D. (see Figure 7)

6. Construct storage and wetland areas to serve as temporary sediment basins to achieve 250m^3 of storage for every 1 Ha of disturbed area in accordance with Wyong Shire Development Control Plan 2005 Chapter 67.

7. Construct diversion drains downstream of disturbed areas to direct overland flows from site to temporary sediment basins.

8. Provide inlet sediment traps around all pits during drainage works and maintain during construction.

9. Adjust diversion drains as required during construction phase.

10. Stockpile areas of topsoil and imported fill to be provided with a silt fence constructed on the downstream side as required.

11. Progressively rehabilitate areas after placement of topsoil to keep disturbed areas to a minimum.

12. Progressively remove sediment control structures from site only after upstream area is stabilised.

13. Reinstate and landscape temporary sediment basins to function as stormwater storage and wetland areas.

Staging of Works – South of Buttonderry Creek

1. Construct stabilised construction entrance with shaker ramp at Sparks Road.

2. Extend existing pipe under Hue Hue and Sparks Roads through site to redirect clean runoff away from work area to Buttonderry Creek. Place silt fence downstream of disturbed area during construction.

3. Construct silt fence only outside of work area as shown on Trehy Ingold Neate drawing EA08 Rev. D. (see Figure 7)

4. Construct storage and wetland areas to serve as temporary sediment basins to achieve 250m^3 of storage for every 1 Ha of disturbed area in accordance with Wyong Shire Development Control Plan 2005 Chapter 67.

5. Construct diversion drains downstream of disturbed areas to direct overland flows from site to temporary sediment basins.

6. Provide inlet sediment traps around all pits during drainage works and maintain during construction.

7. Adjust diversion banks as required during construction.

8. Stockpile areas of topsoil and provide silt fence on the downstream side as required.

9. Progressively rehabilitate areas after placement of topsoil to keep disturbed areas to a minimum.

10. Progressively remove sediment control structures from site only after upstream area is stabilised.

11. Reinstate and landscape temporary sediment basins to function as stormwater storage and wetland areas.

In summary, it is intended to carry out the bulk earthworks as follows:

- Separate clean and disturbed stormwater flows by redirecting existing clean flows around the bulk earthwork areas by means of the ultimate piped and open channel systems.

- Runoff from disturbed areas to be directed to the storage/wetland areas. These areas will act as temporary sediment basins during civil construction.

- Progressively rehabilitate filled area.

- Storage/wetland areas to be reinstalled to function as stormwater storage and wetland areas after rehabilitation of bulk earthwork areas.

4 ATTACHMENT 2 – PROPOSED BRIDGE CROSSING OF BUTTONDERRY CREEK

(Prepared by Treahy Ingold Neate)