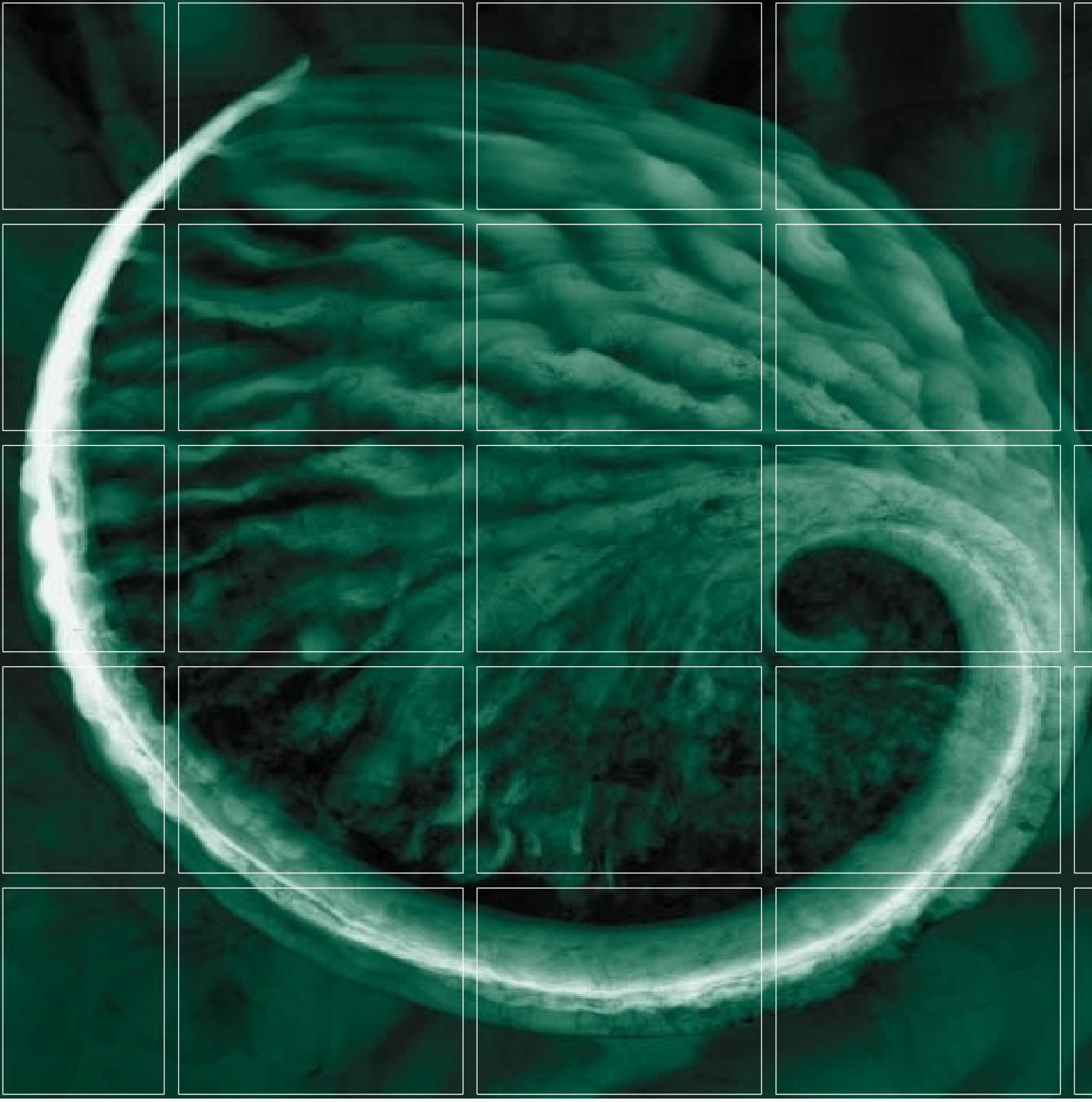

Fern Bay Seaside Village Project Application

Further Response to Submission Report

Aspen Group
0063154 Final
April 2010
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Fern Bay Seaside Village Project Application

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Date:	*7 April, 2010*
Partner:	Paul Douglass

Environmental Resources Management Australia Pty Ltd Quality System

FINAL REPORT

Aspen Group

Fern Bay Seaside Village Project Application *Further Response to Submissions*

April 2010

Reference: 0063154

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CONTENTS

1 INTRODUCTION

This report has been prepared to address additional departmental concerns regarding the preferred project plan for the Fern Bay Seaside Village. In particular, this report addresses submissions from key government agencies as follows:

- Department of Planning letter to Aspen Group dated 15 February 2010 containing Attachment 2 including the following responses:
  - Port Stephens Council letter to Department of Planning dated 01 February 2010; and
  - NSW Office of Water letter to Department of Planning dated 10 February 2010;
- Department of Planning letter to Aspen Group Dated 26 February 2010 containing Attachment 1 including the following response;
  - Department of Environment, Climate Change and Water letter to Department of Planning dated 19 February 2010, including Attachment 1 and 2.

A detailed discussion of the major issues is included in *Chapter 2* with responses to submissions summarised in *Annex A*.

2 DISCUSSION OF OUTSTANDING ISSUES

The following discussion has been prepared to address each major issue as raised in response to the Department of Planning letters dated 15 and 26 February 2010.

2.1 ISSUE 1 - SUBDIVISION LAYOUT AND TRAFFIC

2.1.1 Issue

The Department of Planning has raised concern regarding compliance with the Port Stephens Development Control Plan (DCP) 2007. The Department is concerned with the overall connectivity within the estate and therefore requests that the length of street blocks and connecting pathways and the provision of bus stops be revisited taking into account the response received from Port Stephens Council dated 01 February 2010.

2.1.2 Response

Aspen is committed to developing the Fern Bay Seaside Village to be consistent with the relevant principles with Port Stephens DCP. The Submissions Report (ERM 2009) included Commitment Number 30 (see *Table 2.1*).

Table 2.1 Statement of Commitment Number 30

No.	Item	Commitment	Responsibility	Timing
30	Traffic Management and Access	The design of the internal roads will be generally in accordance with Port Stephens Council Subdivision Development Control Plan. Pedestrian laneways will be included in relevant stages to ensure compliance with Port Stephens Council DCP 2007 B1.C11 that a new block in a residential zone must be no more than 80m deep and 160m long.	Aspen Group Pty Ltd	For the duration of the construction of the subdivision.

Source: Fern Bay Seaside Village – Project Application Submissions Report (ERM 2009b)

To meet this commitment the subdivision plans have been amended to improve connectivity through Stages 4, 5, 9 and 17 as recommended (see *Annex B*).

2.2 *ISSUE 2 – WATER CYCLE MANAGEMENT (STORMWATER, GROUNDWATER AND FLOODING)*

2.2.1 *Issue*

In relation to issue 2, the Department recognises that the Martens Report is a substantial improved assessment. However, a number of design elements require further clarification and analysis which is required to assist in the completion of the project application assessment. These design elements include:

- *2a) Stormwater: the stormwater design, the quantity and quality assessment and the ownership and maintenance of stormwater facilities;*
- *2b) Groundwater: clarification of groundwater issues; demonstration that the quality of the stormwater discharge has an equal or better quality than the underlying groundwater and further consideration of groundwater recharge rates;*
- *2c) Flood Risk Management: provision of an updated Flood Risk Assessment (FRA) taking into account updated flooding reports prepared by Newcastle City Council and the provision of a graphic illustrating likely areas of inundation and minimum habitable floor levels. In addition clarification is required with regard to drainage system design and the management of local overland flooding in accordance with the conveyance requirements for the 100 year ARI event*

2.2.2 *Response*

In relation to issue 2b) 1 of the Departments response regarding groundwater, clarification is provided to resolve the discrepancy between item 3(a) of table A.1 of the Submissions Report (ERM 2009b) and the Martens Report. Item 3(a) should have read *"Infiltration basins are to be constructed in accordance with Amended Water Cycle Management Strategy included in Annex D of the Submissions Report"*. The statement that *"No infiltration or detention basins will be located within the one metre buffer above the highest predicted groundwater table"* was based on previous advice and should have been omitted as it was not consistent with the Martens report. In relation to other issues raised by the Department the Supplementary Water Cycle Management Information Report (April 2010) has been prepared by Dr Martens and responds to outstanding items and issues (see *Annex C*).

2.3 *ISSUE 3 - PROJECT DESCRIPTION*

2.3.1 *Issue*

The Department requires confirmation on the project description (which will be emulated in the final determination) as it is unclear what the exact number of lots for the development actually is.

2.3.2 *Response*

The lack of clarity regarding the exact number of lots has arisen from changes to the lot layout required to consolidate all lots below 500 m² into super lots. To avoid further confusion it is decided that both super lots and integrated housing lots will be henceforth referred to as super lots, as the treatment of both will be the same. Also, the description of lots above 750 m² as duplex lots is considered unnecessary and lots referred to in the submissions report as such will be henceforth included as residential lots. This in no way changes the intended layout and ultimate yield of the proposal beyond changes identified in *Section 2.1*. Instead the preferred project description has been simplified to reflect the lot layout included in amended plan set 29850 A Sheet 1 of 22 (see *Annex B)*. As emphasised earlier the subdivision will be developed largely in accordance with Port Stephens DCP.

The preferred project plan description is to be modified to include a total of 408 residential and 2 commercial lots constituting stages 4 to 20 of the Fern Bay Seaside Village. The subdivision is now proposed to include:

- creation of 370 residential lots;
- creation of 38 super lots (residential);
- creation of two commercial lots;
- creation of one community lot covering all land to be managed by the community association.

2.4 *ISSUE 4 - STORMWATER FACILITIES IN PROPOSED COMMUNITY CONSERVATION LAND*

2.4.1 *Issue*

The Department requests a redesign of the subdivision layout which relocates Stormwater Basin 6 outside of Community Conservation Lands and within the development footprint due to the extensive amount of excavation and removal of vegetation required.

In relation to Stormwater Basin 1 concern is raised that additional stormwater flows from the development will impact on the Endangered Ecological Community – Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregion (EEC), and threaten its long term viability. The Department therefore requests clarification and evidence which quantifies the additional flows which would be draining into this area and demonstrates the additional flows will have a minimal impact on the remained vegetation community.

2.4.2 Response

In addition to the Department of Planning, the Department of Environment, Climate Change and Water (DECCW) and Port Stephens Council identify placement of stormwater facilities in community land proposed for conservation as an issue to be resolved prior to determination. As noted by DECCW, page 12 of the Environmental Assessment (EA) indicates a key part of the Master Plan process was to establish the ecological footprint of the subdivision. The Master Plan was subjected to significant scrutiny following public exhibition and stakeholder referrals which provided a range of government agencies the opportunity to comment. Following this exhaustive consultation process the Master Plan was approved by the Minister for Planning subject to certain conditions. Having followed this transparent consultation process the Master Plan was considered to provide a sound basis for the formulation of the current Project Application before the Minister for Planning for determination.

Figure 7.2 of the EA illustrates the proposed locations of vegetation to be modified to cater for stormwater infiltration. The approved Master Plan also discussed the necessity for stormwater infrastructure in Section 3.12.3 *Stormwater and Drainage* (ERM 2005). As drainage infrastructure was not included within the development footprint it is inferred through the Master Plan documentation that it would be necessary for this infrastructure to be located outside the footprint.

In response to previous submissions relating to the provision of stormwater infrastructure on proposed community lands the proponent has significantly reduced the scale of infrastructure required. This has lead to a substantial reduction in the level of disturbance outside the development footprint shown in the Master Plan. The following description highlights the reduction in disturbance required for stormwater infrastructure:

- the level of disturbance for Catchment 1 is now approximately 434 m^2 reduced from 2500 m^2. No clearing of Swamp Sclerophyll Forest on Coastal Floodplain community will be required to be cleared for stormwater infrastructure;
- disturbance for stormwater infrastructure for Catchment 4 has been reduced from 10 000 m^2 to 2785 m^2, with 2020 m^2 of batters to be revegetated;
- disturbance for stormwater infrastructure for Catchment 5 has been reduced from 7800 m^2 to 1755 m^2, with 1310 m^2 of batters to be revegetated; and
- disturbance for stormwater infrastructure for Catchment 6 has increased marginally from 6900 m^3 to 7285 m^2, of which 2,850 m^2 will be revegetated.

The total area of disturbance for stormwater infrastructure outside the development footprint endorsed by the approved Master Plan has therefore been reduce by more than half from 27 200 m^2 to 12 259 m^2.

In relation to the ecological impact of the proposed infiltration basin 6, *Annex J* of the Submission Report (ERM 2009b) states that *"Basin 6 requires disturbance of an area of approximately 7285m² for construction of the basin (4500m²) and batters (2785m²). This will clear approximately 7285m² of Coastal Sand Apple-Blackbutt Forest. It should be noted that 2785m² will be rehabilitated and in the long term will not be cleared land"*.

Additionally in keeping with the approved Master Plan development, *Annex E* of the Environmental Assessment Report (ERM 2009a) identifies that the proposal will retain a minimum 200 metre wide ecological corridor along the northern boundary of the site. This area will provide a movement corridor through swamp forest and will prevent threatened species becoming isolated from the currently interconnecting areas of the habitat to the south and to the north. Approval for this corridor will override the existing development consent for residential development thereby ensuring retention of a vegetated link within the Stockton Regional Fauna corridor between the Worimi State Conservation Area and Worimi Regional Park.

The Preferred Project Plan application, including infiltration basins as outlined in amended plan set 29850 A, Sheet 22 of 22 in *Annex B,* delivers greater connectivity in terms of this wildlife corridor over what is envisioned in the Port Stephens Local Environment Plan 2000 (LEP 2000) where a large portion of the corridor between the bare dunes of Stockton Bight and Nelson Bay Road are zoned for Residential 2(a) and therefore urban development is permitted with consent.

The Preferred Project Plan would reduce the minimum corridor width between the already constructed stages 1, 2 and 3 and the dunes from 460 metres to 150 metres. Of this 310 metre reduction 240 metres was endorsed in the approved Master Plan. Detention Basin 6 would reduce the width of the vegetation corridor from approximately 220 metres to 150 metres from the development footprint of the approved Master Plan. Given that the batters of this basin will be revegetated and the location of the basin at the development interface of the corridor, the basin is not expected to further fragment habitats and is not expected to represent a barrier to fauna movements.

The combination of the minimum 200 metre wide corridor along Nelson Bay Road and the minimum 150 metre wide corridor along the active dune system preserves two local corridors providing connectivity between the Worimi State Conservation Area and Worimi Regional Park.

Annex E of the Environmental Assessment Report (ERM 2009a) recognised that during peak flow (ie storm events) nutrients and fine sediment removal in the bio-retention swales may not be as effective as during low flow periods. However, during these events the nutrients were expected to be more diluted and swamp soils are generally highly effective at removing nitrogen. The swamp forest near Nelson Bay Road is characterised by a sparse cover of sedges and reeds and is generally inundated with standing water for extended periods.

While prolonged periods of elevated water levels may result in alterations to the floristic characteristics of these communities and weed invasion, this level of inundation is expected to occur infrequently (associated with a 1 to 100 year rainfall event) and is unlikely to alter community structure significantly. For the majority of the time infiltration of water and nutrients higher in the catchment are expected to replicate existing water cycle conditions. The Environmental Assessment has accounted for the proposed discharge of water to this area and did not consider it as significant.

3 *CONCLUSION*

All responses issues raised by the Department of Planning have been considered and this *Further Response to Submissions Report* represents a response to all concerns or issues raised. A number of modifications have been made to the project proposal and they are detailed in the previous chapter and further summarised in the attached *Annex A*. The proposed amendments will assist in mitigating any adverse environmental impacts associated with the proposed development and enhance the achievement of sustainable urban outcomes on the site.

As a result of amendments to the project plan it is considered that the development as proposed through the preferred project plan represents an improved outcome which should be supported by the Department of Planning.

REFERENCES

Environmental Resources Management Australia (ERM) (2009a) **Fern Bay Seaside Village Environmental Assessment.** Aspen Group Pty Ltd. February 2009.

Environmental Resources Management Australia (ERM) (2009b) **Fern Bay Seaside Village Submissions Report.** Aspen Group Pty Ltd. December 2009.

Environmental Resources Management Australia (ERM) (2005) **Fern Bay Seaside Village Master Plan.** Winten Property Group and Continental Venture Capital Limited.

Port Stephens Council (2000) **Local Environment Plan 2000.** Prepared by Port Stephens Council

Annex A

Summary Of Authority Issues

Table A.1 Summary of Authority Issues

Agency	Issue	Issue Reference Number	Page Numbers
Department of Planning (DoP)	Subdivision layout and traffic	1	A2
	Water Cycle Management	2	A2
	Project description	3	A7
	Stormwater facilities on Community Conservation Lands	4	A7
Port Stephens Council	Strategic Planning	5	A9
	Traffic	6	A9
	Stormwater Management	7	A9
	Infiltration facilities and Basins	8	A11
	Surface water hydrology	9	A12
	Drainage and overland flow and water quality	10	A14-
NSW Office of Water (NOW)	Comments	11-17	A15-A17
Department of Environment, Climate Change and Water (DECCW)	Zoning provisions	18	A17
	Infrastructure impacting on Conservation Lands	19	A17
	Asset Protection Zones	20	A19
	Cut and Fill	21	A19
	Responsibilities of Community Association	22	A20
	Developer Access Rights	23	A20
	Aboriginal Cultural Heritage	24	A20

Table A.2 Response to Departmental Issues

Authority	Issue Raised	Issue Ref	Submission	Response
Department of Planning	Subdivision layout and traffic	1	Port Stephens DCP 2007 requires a maximum street block length of 160 m (B1.C11). There are a number of proposed street blocks (within Stages 4,5,9 and 17) that do not comply and exceed the required street block length by up to 120m. The subdivision plan should be amended by reducing block lengths and providing additional connecting pathways (within Stages 4,5,9 and 17), which will assist in achieving compliance and also ensure pedestrian access/connectivity to open space and proposed bus stops are within 400m walking distance from any proposed lots. Please refer to submission from Port Stephens Council dated 01 February 2010, which provides suggested design amendments which could address this issue.	Subdivision plans have been amended to comply with Port Stephens DCP 2007 (see sheet 1 of 22 amended plan set 29850 A attached in *Annex B*).
	Water Cycle Management	2	The 'Amended Water Cycle Management Strategy prepared by Martens Consulting Engineers dated December 2009 ('Martens Report'), provides an amended assessment of the management of the water cycle on the site relating to surface water and ground water. It is recognised that the Martens Report is a substantial improved assessment. However, a number of design elements require further clarification and analysis which is required to assist in the completion of the project application assessment. **a) stormwater** 1. Clarify whether any traditional stormwater pits and pipes will be provided in the proposed drainage system. 2. It is assumed the site is to be drained via a network of 'roadside swales' which have both a bio-retention component and a flood conveyance component which conveys flows up to the 100 year ARI. This drainage system has been inferred from the plans and document. Clarify whether this is a correct description of the proposed drainage	Please refer to Section 2.2 and amended report (April 2010) prepared by Dr Martens (*attached in Annex C*). This report responds to outstanding items and issues raised by the Department of Planning.

Authority	Issue Raised	Issue Ref	Submission	Response
			system and the relationship between bio-retention and flood conveyance. 3. The Martens Report indicates that there will be no on-site detention required and that the infiltration basins are not being relied upon to achieve water quality load reduction targets. As such, the infiltration basin are more appropriately considered infiltration areas or receiving waters in the case of 'existing basins'. To confirm this assumption, please provide a proposed stormwater treatment train schematic for each of the six overall catchment systems. 4. The Martens Report does not appear to address the altered lot size arrangements (including number of lots and impervious areas) presented in the Daly Smith plans (annex 2 of the PPR) in its description of the proposed development. Provide clarification that the Martens Report considers the amended lot size arrangements. 5. Stormwater Quantity Assessment (DRAINS Modelling) a. A sensitivity analysis of the DRAINS model must be provided with a changed soil type, AMC-3, and a lowered depression storage assumption (to 10mm). Clarify whether this sensitivity analysis warrants a change in the proposed stormwater design. b. Concern was raised by Port Stephens Council on the assumed initial starting conditions in the proposed infiltration basins in the DRAINS model. Clarify the likely recovery rate of the basin water level following a 100 year ARI storm event. If the basins are unlikely to recover to their initial water level over a period of a few days, then a sensitivity analysis of the 'embedded storm approach' should be undertaken.	

Authority	Issue Raised	Issue Ref	Submission	Response
			6. Stormwater Quality Assessment (MUSIC Modelling) a. Provide a copy of the MUSIC modelling files to allow for review and inspection of the assumptions made with respect to the proposed bioretention systems. b. The Martens Report states that the MUSIC model excludes areas that drain to the proposed treatment facilities from the pollutant generation calculations. However, it is considered that these residual areas can contribute to flows and affect the performance of the proposed treatment system. As such, the analysis should be amended to consider these additional flows. c. The MUSIC modelling does not meet the stated objectives for Total Nitrogen (TN) and will need reconsideration of the size of the proposed treatment systems. 7. The ownership and maintenance of proposed stormwater facilities is still unclear and requires clarification. Item 1(g) in Annex A of the PPR indicates that the existing and proposed basins will be owned by the Community Association and managed by Council. However, Item 12 (m) of annex A states that unless the drainage structure is in the road reserve then it will be owned and managed by the community association. Provide clarification as to the long term ownership and maintenance of the proposed stormwater facilities outside of the road reserve, particularly how these will be managed by Council (if not owned by council) and whether Council have agreed to this. **b) Groundwater** 1. Item 3(a) of table A1 of the PPR states that "no infiltration or detention basins will be located within the one (1) metre buffer above the highest predicted groundwater table".	Ownership and maintenance arrangements have been agreed during the previously approved stages. Council did not and have not raised any issue with these arrangements therefore arrangements will remain as previously agreed.

Authority	Issue Raised	Issue Ref	Submission	Response
			However, the results in the Martens Report indicates that the one metre buffer required from the invert/lowest operating level of the infiltration basins is not provided generally for both existing groundwater conditions and under climate change scenario of a 1m increase in the ground water level in response to sea level rise. Please provide clarification on this discrepancy. Provide adequate justification if a one metre buffer between the infiltration areas and the highest predicted groundwater table can not be achieved. That is, it should be demonstrated that the stormwater will be treated upstream of the infiltration basins and that the quality of the stormwater discharge has an equal or better quality than the underlying groundwater. 2. Concern has been raised by Council and the Department's consultant (Cardno Lawson Treloar) that recharge rates adopted for the groundwater modelling in the Martens Report may be under representative of those that may occur in the developed case. The groundwater modelling should be amended to adopt recharge rates (for the developed conditions) in the MODFLOW analysis that are benchmarked using information from the MUSIC model to better align the assessments. As a result, this may require a more conservative recharge rate being adopted in a sensitivity analysis in the MODFLOW model. If the sensitivity analysis shows substantial change then inputs to the DRAINS model may need to be altered and the model re-run and the outcome and design updated. An addendum report should be provided which outlines the results of this analysis.	

Authority	Issue Raised	Issue Ref	Submission	Response
			c) Flood Risk Management Reference is made to earlier comments provided by Cardno Lawson Treloar on flood risk management (letter from Department dated 9 July 2009, Attachment 1). The PPR does not address the previous issues related to flooding and an updated flood risk assessment (FRA) addressing the following is required: 1. With respect to regional flooding, the flood assessment should be re-evaluated on the basis of newer information available including updated flooding reports prepared by Newcastle City Council. Where appropriate, a re-evaluation of the site arrangements and emergency management is required in light of information relating to Probable Maximum Flood level. 2. Provide a map showing likely areas of inundation due to flooding by the 100 year ARI (under sea level rise of 0.9m by 2100 and a catchment rainfall increase of 20%) and the Probable Maximum Flood event associated with the Hunter River. As a result of the additional mapping, provide an indication of the minimum habitable floor level for the development and advise on emergency response approaches to be adopted. 3. Clarify how the proposed drainage system will manage local overland flooding and confirm whether the drainage system within the development meets conveyance requirements for the 100 year ARI event. For instance, will a traditional stormwater pit and pipe system be provided in the proposed drainage system of just bioretention swale (which are currently depicted on stormwater plans provided in the Martens Report and in the Daly Smith drawings (annex B of	

Authority	Issue Raised	Issue Ref	Submission	Response
			the PPR)	
	Project Description	3	It is unclear as the exact number of lots for the development as the text in PPR suggests a total of 409 lots to be created in Stages 4-2, but the Site and Staging Plan prepared by Daly Smith Pty Ltd (Sheet 1 of 22 in Annex B) indicates a total of 410 lots in the table on the plan, of which, 38 are super lots (rather then 36 super lots). Provide confirmation on project description (which will be emulated in the final determination).	The preferred project description has been simplified to reflect the lot layout included attached in *Annex B* (see sheet 1 of 22 of amended plan set 29850 A). As stated in *section 2.3 t*he subdivision will be developed largely in accordance with Port Stephens DCP. To clarify, the preferred project description will be modified to include a total of 408 residential and 2 commercial lots constituting stages 4 to 20 of the Fern Bay Seaside Village. The subdivision is now proposed to include: • creation of 370 residential lots; • creation of 38 super lots (residential); • creation of two commercial lots; and • creation of one community lot covering all land to be managed by the Community Association.
	Stormwater facilities located on Community Conservation Lands	4	Reference is made to proposed stormwater basin 1 and 6 outlined on plans provided in Attachment E of Amended Water Cycle Management Strategy' prepared by Martens Consulting Engineers dated December 2009 ('Martens Report') and Concept Site Drainage plan provided by Daly Smith (Annex B of the PPR, Sheet 15 of 22). Stormwater basin 6 will require an extensive amount of excavation, removal of 7285 sqm of vegetation and is located in proposed community conservation	See discussion in *section 2.4* of this report and amended report (April 2010) prepared by Dr Martens (*attached in Annex C*). This report responds to outstanding items and issues.

Authority	Issue Raised	Issue Ref	Submission	Response
			lands' within the development. The conservation of vegetation in this area is considered to be vital in maintaining the vegetative link within the Stockton Regional Fauna corridor between the Worimi State Conservation Area and Worimi Regional Park. The Department requests a redesign of the subdivision layout which relocates stormwater basin 6 outside of community conservation lands and within the development footprint. This may require a reduction in development lots (such as proposed lot 80 and 81). Stormwater basin 1 is also located within vegetation which forms part of the Stockton Regional Fauna corridor. Excavation works will not be required for its construction as the basin will be located in an existing low lying area of the site. However, proposed stormwater flows from the development will drain into an area comprising an Endangered Ecological Community – Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregion (EEC). As such, concern is raised that additional stormwater flows from the development will impact on the EEC and threaten its long term viability. The department requests clarification and evidence (such as modelling outputs) which quantifies the additional flows which would be draining into this area and demonstrates the additional flows will have a minimal impact on the remained vegetation community. If minimal impact can not be demonstrated, the subdivision design in this locality must be amended to divert stormwater flows to within the development footprint.	

Authority	Issue Raised	Issue Ref	Submission	Response
Port Stephens Council	Strategic Planning	5	A monetary contribution are to be paid to Council, pursuant to section 80A(1) and 94 of the Environmental Planning and Assessment Act, 1979 towards the provision of the following public facilities (on a per lot basis):- • Civic Administration – ($377) • Open Space, Parks – ($2046) • Recreation – ($4821) • Cultural and Community Facilities – ($2424) • Roadwork's – ($1368) • Fire and Emergency Services – ($188) • Bus Shelters – ($132)	Agree to abide by these contribution requirements.
	Traffic	6	As previously advised, the port Stephens DCP 2007 requires a maximum street block length of 160m (b1.c12). There are a number of proposed street blocks that do not comply and require re-design to achieve adequate choice and connectivity. Best practice also suggests that street blocks should be orientated towards destination points such as shops, parks, bus stop routes etc. The response document mentions several times that no residence will be further that 400m from a bus stop. This does not appear to be possible without reducing the block lengths and the provision of connecting pathways that will improve connectivity and reduce walking distances. An example of how this can be achieved has been provided by council.	Subdivision plans have been amended to comply with Port Stephens DCP 2007 (see sheet 1 of 22 amended plan set 29850 A attached in *Annex B*).
	Stormwater Management	7	The modelling that has been undertaken is very basic and not properly considered the representation of the existing site. The modelling does not appear to provide estimates of the maximum predicted groundwater level under various conditions. It is not clear what data was used to determine the maximum groundwater levels. Was the data used in the modelling representative of prolonged and significant rainfall conditions that would be required to achieve maximum groundwater levels? Summary of site groundwater level monitoring data for period between Jan	An Additional assessment of stormwater management for the Fern Bay site has been undertaken by Dr Martens and is included in *Annex C*. This report responds to all issues by the Department of planning regarding Stormwater management on site. While all concerns raised by Port Stephens Council are not

Authority	Issue Raised	Issue Ref	Submission	Response
			1992 and Dec 2002 (table 3 Appendix D), November 2007 (single measurement) and September 2009 are considered as very short period for calibration purpose. Are these data obtained during &after significant events? I believe that it is not. Groundwater level of the site varies from 1.5-16 AHD. However the majority of the groundwater data collected from the area below 4 AHD (natural ground level). This may give lower values for predicted highest water levels. Also, calibration of the model with assumed parameters may not be sensitive to the data obtained from low ground levels. Ground water levels from higher ground may be higher than the lower areas and therefore, it is important to consider these data for modelling purpose. Recharge rate: the site is considered as high infiltration area and more than ninety percentage of the stormwater currently infiltrates through the soil. Using a recharge value of 260mm/year (24% of the median annual rainfall) to obtain highest groundwater level is unsatisfactory. This may provide the result lower than the average groundwater heights. It can be easily from the modelled results which are lower than the observed data for short period. Surface Water Hydrology report indicates that 100% stormwater generated from all storm events (including prolonged wet and significant events) will be infiltrated into the ground. This is contradictory with the groundwater modelling recharge rate. (Table) 3.4.5 Modelled groundwater levels- maximum groundwater level has been obtained as 1.7m AHD at the divide (probably at the highest location- ground level is approximately 16AHD and no monitoring data available for this location). But there are number of locations within the site, higher groundwater levels have been observed (from monitoring data). This observed monitoring data in not the maximum groundwater levels. This is raising concerns over the parameters used and validity of the model used to obtain the maximum groundwater levels. Comparison of Table 4,9,13 and Figures 17-22	individually addressed the report presents further modelling results and refined information and management strategies based on assumptions and scenarios required by the Department of Planning.

Authority	Issue Raised	Issue Ref	Submission	Response
			• Observed levels are higher than the predicted modelled results (boreholes BH101-107) for existing and proposed conditions. • Design invert levels of the basins are within the 1m buffer zone of maximum groundwater levels (1m buffer is required by DECCW). Fig 17-22 has been obtained from average annual rainfall for the year (1950-2009) and not the prolonged wet and significant storms for particular year. Higher groundwater levels could be monitored for prolonged wet period in a particular year, but it was not represented by this modelled results. Hydraulic Conductivity: Slug Tests were carried out by adding or withdrawing 20 L of water to the aquifer. The Hydraulic Conductivity has been obtained from the slug test which is not the correct representative actual storm events. Infiltration rates must be obtained from appropriate method which is outlined below (not outlined below)	
	Infiltration Facilities and Infiltration Basins	8	Use of water sensitive urban design (WSUD) philosophy for the stormwater management is an encouraging sign to promote the sustainable development. However, it is important to notice that there is so many factors need to be addressed for the proper implementation of WSUD. Usage of infiltration facilities for managing major storm events (up to 100 year ARI storm events) require more field data and better management practices. The following factors are considered significant for the infiltration facilities. Infiltration rates can vary several orders of magnitude within the narrow range of material types. Determining infiltration rates for stormwater management (100 year ARI flooding) is not an easy task and one that many in our industry take altogether too light. Majority of the infiltration rates provided in the geotechnical reports are initial infiltration rates and they are normally very high for sand and low for clay soil. Therefore, it is important to obtain the appropriate infiltration rates for each sub-catchment infiltration basin area (steady state infiltration rates) to use for the stormwater management. Once the steady state infiltration rates for the site is obtained in several	An Additional assessment of infiltration facilities and basins required for the Fern Bay site has been undertaken by Dr Martens and is included in *Annex C*. This report responds to all issues raised by the Department of planning regarding water cycle management on site. While all concerns raised by Port Stephens Council are not individually addressed the report presents further modelling results and refined information and management strategies based on assumptions and scenarios required by the Department of Planning.

Authority	Issue Raised	Issue Ref	Submission	Response
			locations, Designer must use a suitable factor of safety (clogging factor). The infiltration rate is a parameter that may change with time due to clogging or lack of maintenance. A minimum factor safety of 3-5 must be used for steady state infiltration rate, if the designer can provide excellent pre-treatment facilities. When considering large areas and large infiltration facilities like this development, it is important to consider large scale pilot infiltration pit tests to find out the infiltration rates. Designing a successful infiltration facility includes acknowledging that groundwater mounding can affect facility performance, collecting necessary data to properly evaluate mounding potential and developing a stormwater management approach that accounts for the limitations presented by mounding.	
	Surface water hydrology	9	It is not clear that stormwater catchment in this report has taken into consideration of already developed catchment which are discharging into the new development area. By looking at the plan "Concept site drainage plan – proposed swale and swale basins", the existing development area has been left out from calculations. Table 15 – Summary of catchment details- Total impervious area used in the model seems to be low and need(s) proper checking. Table 16 – Summary of pervious and impervious area – impervious areas for commercial space should be 90 % and not 60%. Also, there are some super lots within this subdivision and the impervious area for these super lots needs to be 70%. 4.2.5 Model approach – Soil type 1 was used in the model for sandy soil. But almost all development area will be replaced with top soil and this will reduce the surface infiltration of the area. Soil type 2 is more appropriate value for the developed catchment. Also, it hasn't specified what antecedent moisture content (AMC) was used in the modelling. AMC3 was most appropriate value	The existing development is not assessed in this proposal. Surface water hydrology for existing stages has been address in previous approvals and is managed accordingly. An Additional assessment of surface water hydrology required for the Fern Bay site has been undertaken by Dr Martens (April 2010) and is included in *Annex C*. This report responds to all issues raised by the Department of Planning regarding water cycle management on site. While all concerns raised by Port Stephens Council are not individually addressed the report presents further modelling results,

Authority	Issue Raised	Issue Ref	Submission	Response
			for prolonged wet and significant rainfall event. Depression storage of 20mm grassed areas) for all catchment is too high for developed catchment. DRAIN model recommended 10mm as an appropriate value for this. Changing these parameters will change the flow rate and typical sections of the swales, pipes sizes etc. Almost all the infiltration basins are located in the low lying area of the catchment which receives groundwater flows and surface water flows in a prolonged wet period. Perched water table could be seen in these locations in particularly basin 1 & 4 after heavy and prolonged wet season. Using these areas as infiltration basins may need thorough investigation in regards to the water table (for wet season), infiltration capacity, storage capacity, ponded water prior to storm burst etc. Basin size should be designed based on this information. It must be acknowledged that design storm event in AR&R represents only the design "burst" and not complete storms. There could be some previous storm events before the burst and all infiltration basins could be partially full at the commencement of the design burst. Accordingly, a conservative initial water level must be adopted for all basins and the storage volume for the basin must be considered from the initial water level and not the invert level of the basin. Excessive cutting and excessive filling may alter the entire hydrological and hydrogeological regime. For example, excessive filling may raise the groundwater level within the entire catchment and consequently impact the infiltration system. That mean, the infiltration facilities (infiltration basins and infiltration trenches) provided in the proposed subdivision would not work as per design. This could cause flooding problems within the catchment. Basin No 1: As per proposed subdivision (catchment area 1) layout, part of low lying area will be filled and the stormwater from the developed area will be dispersed onto the ponded area. The designer has claimed that there is no change in the volume as a result of the development. But during prolonged wet	refined information and management strategies based on assumptions and scenarios required by the Department of Planning.

Authority	Issue Raised	Issue Ref	Submission	Response
			period this storage area may be full with perched groundwater. Also, designer has used this area as an infiltration area. As this area is considered as low lying perched water table area, I believe that it should not be designed as an infiltration basin. Rate of infiltration in this area would be very minimal during prolonged wet period. I also believe that this area requires more investigation on stage-storage, inflow, outflow, groundwater level for prolonged wet period etc. A suitable drainage system should be designed for this catchment based on these investigations. Also, Council has occasionally receives flooding complaints from the owner of Caravan Park (property located southern side of this proposed development). This clearly indicates that dispersing additional stormwater in this low lying area would not assist to reducing flooding problem for caravan park area. Basin No 2, Catchment area 2: similar problem as basin 1 Basin No 4, Catchment area 4: similar problems as basin 1 and 2 but, this is large catchment contributing runoff to low lying area. Need detailed investigation on water levels for prolonged wet period within low lying area and how this increased water level will impact the Nelson Bay road pavement.	
	Drainage and overland flow path and water quality	10	All swales must be designed with 300mm freeboard All culverts or pipe drainage system to carry flows from one side of the road to the other side must have invert levels higher than the swale's invert levels.	Swales will be designed in accordance with Port Stephens DCP and where additional freeboard is required this will be included in the detailed design drawings. All culverts or pipe drainage systems will be designed in accordance with Port Stephens DCP and required invert levels will be included in the detailed design drawings. An Additional assessment of surface water hydrology required for the Fern

Authority	Issue Raised	Issue Ref	Submission	Response
			Table 24 - % of impervious area for residential is too low and is not the representation of actual site development. 60% impervious area should be adopted for this development.	Bay site has been undertaken by Dr Martens (April 2010) and is included in *Annex C*. This report responds to all issues by the Department of Planning regarding water cycle management on site. While all concerns raised by Port Stephens Council are not individually addressed the report presents further modelling results, refined information and management strategies based on assumptions and scenarios required by the Department of Planning
NSW Office of Water (NOW).	Comments	11	In general terms NOW considers that the assessment and groundwater monitoring program in the 'report are technically sound and satisfactory.	Noted
		12	Table A.1 Fern Bay Seaside Village Response to Submissions page A27 of the 'report states that no infiltration or detention basins will be located within one meter buffer above the highest predicted groundwater table. The 'report' proposes that all stormwater will be treated upstream of infiltration basins to levels equal to or better than groundwater concentrations prior to groundwater recharge and any storm discharge will have a neutral or beneficial impact on groundwater quality.	Please refer to section 2.2 of this report regarding 1 metre buffer to ground water. The amended report (April 2010) prepared by Dr Martens demonstrates that all stormwater will be treated upstream of infiltration basins to levels equal to or better than groundwater concentrations prior to groundwater recharge and any storm discharge will have a neutral or beneficial impact on groundwater quality..

Authority	Issue Raised	Issue Ref	Submission	Response
		13	Now supports the strategies within the 'report' including Annex D – Additional Water Assessment- Amended Water Cycle Management Strategy prepared by Martens Consulting Engineers (December 2009) to mitigate impacts on groundwater.	Noted
		14	Additional key strategies in the 'report' (including Annex "D") – include: • Adoption of best practice management practice solutions in-line with the principles of Water Sensitive Urban Design and Ecological Sustainable Development. • Works not to have adverse impacts on the local surface and groundwater quality. • Development is not to rely on the treatment capacity of the proposed infiltration basins. • Establishment of a network of groundwater monitoring bores. • Preparation of groundwater trigger values and contingency strategies. • Annual stormwater and groundwater monitoring reports.	DoP could consider including a reference to these strategies and requirements in the conditions of approval.
		15	Section 5.4.7 Basin Liners of Annex D recommends that there is no requirement to line basins given the elevation design of the basin inverts and the fact that adequate water treatment will occur in a distributed treatment system within the catchment prior to discharge to the infiltration basins.	Agreed.
		16	Under Section 6.4 Communications of Annex "D" NOW recommends that there is a requirement for technical assessment and reporting by a qualified consultant of the annual groundwater monitoring results to the approval authority. Further, the approval authority should take full responsibility in ensuring that groundwater monitoring is carried out according to the approval conditions. NOW should only be notified if negative results are indicated in the groundwater monitoring data and groundwater assessment. Any polluting activity impacting on the surface water or ground water system should be administered by an Environmental Protection Licence administered under	DoP could consider including requirements in the conditions of approval.

Authority	Issue Raised	Issue Ref	Submission	Response
			provisions of the Protection of the Environment Operations Act 1997.	
		17	NOW suggests that the project include a Groundwater Management Plan within the Community Lands Environmental Management Plan to raise community awareness by highlighting the proper use of fertilisers, promoting use of low phosphorous detergents for washing cars, driveways etc and advertising the potential impacts of domestic pets on the operation of the infiltration basin system.	DoP could consider including requirements in conditions of approval.
Department of Environment, Climate Change and Water (DECCW)	Zoning Provisions:	18	DECCW notes that the proposed conservation lands are still not zoned for conservation. As previously advised, DECCW's agreement on the use of the CLEMP was premised on the basis that the zoning would be altered to reflect the new land-uses. Despite the proponent acknowledging the need for the rezoning, the Submission Report states that this will be facilitated by Council at a later stage. We remain strongly of the view that the rezoning should be implemented at the approval stage.	As noted by DECCW this issue has previously been discussed. The proponent acknowledges DECCW's position on this matter and confirms that the rezoning is the responsibility of Port Stephens Council.
	Infrastructure Impacting on Conservation Lands	19	DECCW has raised concern about infrastructure being placed in conservation lands. In particular large stormwater basins, which had not been disclosed in many previous iterations of the proposal, will significantly impact on the functioning of wildlife corridors in the area. Placement of these structures in the Community Conservation Lands is inconsistent with the Master Plan approved by the Minister in 2006. As noted on page 12 of the EA, a key part of the Master Plan process was to establish the ecological footprint of the subdivision. Despite DECCW's previous comments it is evident that proposed sewer pump station P3, P5 and P6 as well as proposed constructed basins and stormwater infiltration measures are still proposed to be located within the Community Conservation Lands. DECCW notes that previously proposed detention basins have now been renamed "Existing Basins" (refer plan 15 of 22, Existing Basins 1, 4 and 5). The use of this term for these areas is questionable given that these 'existing basins' are located within Wet Heath, Swamp sclerophyll Forest and low lying portions	Refer to *section 2.4* which discusses facilities proposed in the conservation lands and details the impacts of the development on the functioning of the wildlife corridors. Use of the term existing basins was not intended to be deceptive, but to distinguish these areas from those that require excavation for the construction of basins. Reference to existing basins

Authority	Issue Raised	Issue Ref	Submission	Response
			of Apple Blackbutt Forest. The submission Report (Appendix J – Additional Ecological Information) notes the placement of these structures in conservation lands will require the removal of vegetation outside of the development area. Proposed Basin 6 will require the removal of 7,285m2 of vegetation within conservation lands in a key par of a habitat corridor. It is noted from the Martens (2009) Amended Water Cycle Management Strategy that where overland swales are to be constructed to reach a basin these shall be lined with aggregate to prevent bed revegetation. Construction of the overland swales will result in further clearing of 4,893m2 of vegetation within conservation lands. We further note from the Review of Water-related Elements of Preferred Project Report for Seaside Boulevard, Fern Bay – Draft' prepared by Cardno Lawson Treloar for the Department of Planning (dated 8 February 2010 that it appears that there is potential for the size of the infiltration basins to become larger due to the non conservative approach to the DRAINS modelling undertaken by Martens (2009). DECCW has mapped at a regional scale Key Habitats and Corridors in the area. The vegetation contained by the Community Conservation Lands forms what will be left of the Stockton Regional Fauna Corridor. The conservation lands will become the only retained vegetative link between the Worimi State Conservation Area and Worimi Regional Park (refer Attachment 2). Basins 1 and 6 will be constructed within vegetation considered vital to maintaining this link. A review of Figures 3 and 15 (Daly Smith) shows the impact of these basins on corridors. This is considered significant as the corridor is already being reduced from an average 900m in width down to approximately 150m in width. DECCW strongly opposes the placement of stormwater facilities / structures within lands that have been set aside for environmental conservation purposes. All infrastructure associated with the proposed development should be located	could have been substituted with reference to discharge to existing water bodies or receiving waters or natural depressions. Further modelling has been undertaken and is included in the amended report (April 2010) prepared by Dr Martens (*attached in Annex C*). This report recommends a minor increase to the size of basin 3 that can be accommodated within the development footprint. No changes are recommended to the remaining basins as a result of more conservative modelling undertaken in response to Department of Planning requirements. Land has yet to be set aside for environmental conservation purposes as this is proposed by DECCW to happen at the approval stage.

Authority	Issue Raised	Issue Ref	Submission	Response
			wholly within the development footprint as was envisaged in the Master Plan	
	Asset Protection Zones	20	DECCW acknowledges that the asset protection zones (APZ's) have now been placed entirely within the development area and outside of the community conservation lands. The draft statement of commitments (item 21 – bushfire management) states that the measures contained in the bushfire hazard assessment prepared by ERM, 2009 will be implemented. The Bushfire Hazard Assessment should therefore be updated to include the revised asset protection zones, particularly Figure 1.2 – Project Plan of this report. This report should also be updated to make reference to the restrictions to land use pursuant to Section 88B of the Conveyancing Act 1919 which are to be placed upon the lots affected by the revised APZ's.	An update of the Bush Fire Hazard Assessment is considered unnecessary at this time. The existing subdivision approval and the draft Statement of Commitments detail that a Bush Fire Management Plan will be prepared for each stage of development identifying APZ's. DoP could consider including requirements in the conditions of approval to implement APZ into Bush Fire Management Plans for each stage of development. A condition of approval relating to restrictions to land use pursuant to Section 88B of the Conveyancing Act 1919, which are to be placed upon the lots affected by the revised APZ's, could also be considered.
	Cut and Fill	21	Reference is made to plan 22 of 22 (prepared by Daly Smith Pty Ltd, dated 22/12/2009) provided in the Submission Report in accordance with DoP's request. This plan depicts cuts of up to 6m and fill of up to 4 m occurring within the community Conservation Lands. DECCW advises that all cut and fill should be contained within the development area due to the potential impacts upon retained vegetation, particularly Swamp Sclerophyll vegetation.	Plan 22 of 22 has been amended and cut and fill outside the development footprint has been largely restricted to those required for construction of water management infrastructure.

Authority	Issue Raised	Issue Ref	Submission	Response
	Responsibilities of the Community Association:	22	DECCW acknowledges that the community Title Scheme by-laws have now been amended to include reference to the Community lands Environmental Management plan (CLEMP). We are satisfied that the Community Association is now required to adhere to the environmental objectives of this document.	Noted
	Developer Access Rights	23	As previously advised, By-Law 12.1 refers to the access rights of the Original Proprietor (nominated in By-law 36 Definition and Interpretation as Winton (No 20) Pty Ltd) over Community Property whilst carrying out development on land adjacent to the Community Parcel. These access rights include unrestricted access over Community property which, by definition, includes the Community Conservation Lands. Despite the proponent's response to this issue, DECCW remains of the opinion that allowing the Original Proprietor to carry out activities within the Community Conservation Lands should be avoided. DECCW therefore requests that appropriate action be taken to exclude the rights provided to the Original Proprietor by By-law 12 from the community Conservation Lands. DECCW notes that despite s.54(5) of the Community Land Management Act referred to by the proponent in its response, s54.6 provides that a by-law can be amended or revoked by obtaining the written consent of each person entitled by the by –law to use the restricted property. This consent should therefore be obtained.	Developer access rights are considered essential for the development of the proposed subdivision. Access rights do not, as stated by the DECCW, allow the original proprietor to carry out activities within the Community Conservation Lands as they do not permit any physical works, including vegetation clearing, which would require their own consent. Therefore the removal of this clause is considered unnecessary and unduly restrictive to the development of the proposed subdivision.
	Aboriginal Cultural Heritage	24	DECCW acknowledges the additional information provided regarding ACH assessment undertaken and recommends that the Statement of Commitments contained in the EA, the recommendations of the Aboriginal Heritage Assessment and the amendments contained in the Preferred Project Report are reflected in any Conditions of Approval for the proposal.	DoP could consider including appropriate conditions of approval

Annex B

Amended Subdivision Plans

GN

Sheet List Table	
Sheet Number	Sheet Title
0	SHEET LIST
1	SITE & STAGING PLAN
2	STAGE 4 - 6 DETAIL PLAN
3	STAGE 7 DETAIL PLAN
4	STAGES 8 & 9 DETAIL PLAN
5	STAGES 10 - 12 DETAIL SHEET
6	STAGES 13 & 14 DETAIL PLAN
7	STAGES 15 & 16 DETAIL PLAN
8	STAGE 17 DETAIL PLAN
9	STAGE 18 & 19 DETAIL PLAN
10	STAGE 20 DETAIL PLAN
11	INDICATIVE SEWER LAYOUT
12	INDICATIVE WATERMAIN LAYOUT
13	LAND TENURE PLAN
14	SUBJECT & ADJOINING TITLE DETAILS
15	CONCEPT SITE DRAINAGE PLAN - PROPOSED SWALES AND BASINS
16	FLOOD PRONE & LOW LYING AREAS
17	TYPICAL DRAINAGE TREATMENTS DETAIL1
18	TYPICAL DRAINAGE TREATMENTS DETAIL 2
19	FOOTPATH & CYCLEWAY
20	TYPICAL ROAD DETAIL
21	AERIAL VIEW
22	BULK EARTHWORKS (CUT-FILL) PLAN

A2

SCALE 1: 1000
REVISION DATE ----
PLOT DATE 25/03/2010
DRAWN/CHKD BY GJS / AED
DA NUMBER
CC NUMBER

DRAWING TITLE SHEET LIST
DEVELOPMENT PROJECT PLAN A
FERN BAY SEASIDE VILLAGE
NELSON BAY ROAD, FERN BAY

CLIENT ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying
OFFICES AT:
PORT STEPHENS ☑ DRAWING ISSUED FROM: 6/10 YACAABA STREET, NELSON BAY Ph (02) 49813444 Email: bay@dmssurvey.com.au
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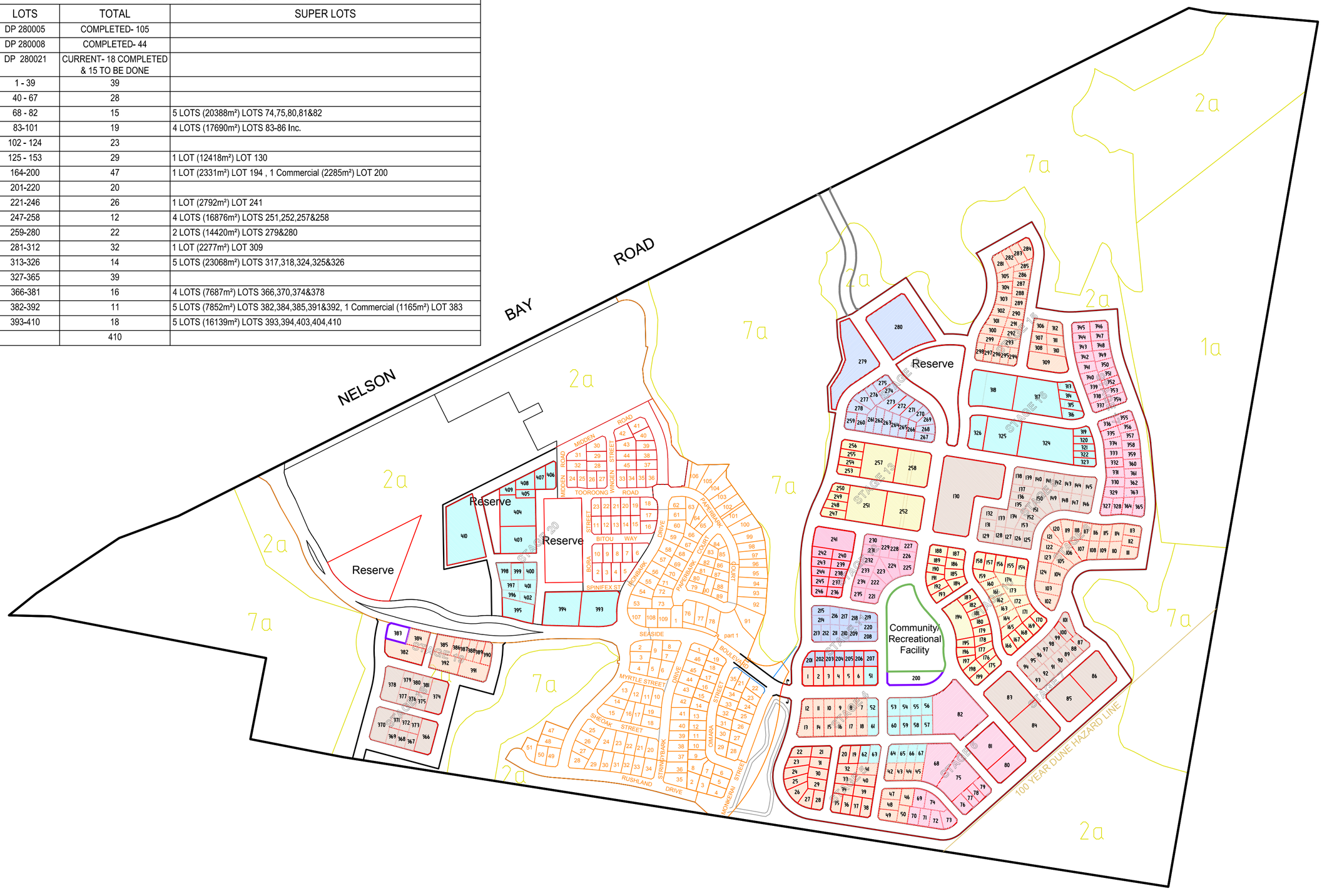
0 OF 22

STAGING & LOT TABLE			
STAGE	LOTS	TOTAL	SUPER LOTS
1	DP 280005	COMPLETED- 105	
2	DP 280008	COMPLETED- 44	
3	DP 280021	CURRENT- 18 COMPLETED & 15 TO BE DONE	
4	1 - 39	39	
5	40 - 67	28	
6	68 - 82	15	5 LOTS (20388m²) LOTS 74,75,80,81&82
7	83-101	19	4 LOTS (17690m²) LOTS 83-86 Inc.
8	102 - 124	23	
9	125 - 153	29	1 LOT (12418m²) LOT 130
10	164-200	47	1 LOT (2331m²) LOT 194 , 1 Commercial (2285m²) LOT 200
11	201-220	20	
12	221-246	26	1 LOT (2792m²) LOT 241
13	247-258	12	4 LOTS (16876m²) LOTS 251,252,257&258
14	259-280	22	2 LOTS (14420m²) LOTS 279&280
15	281-312	32	1 LOT (2277m²) LOT 309
16	313-326	14	5 LOTS (23068m²) LOTS 317,318,324,325&326
17	327-365	39	
18	366-381	16	4 LOTS (7687m²) LOTS 366,370,374&378
19	382-392	11	5 LOTS (7852m²) LOTS 382,384,385,391&392, 1 Commercial (1165m²) LOT 383
20	393-410	18	5 LOTS (16139m²) LOTS 393,394,403,404,410
TOTAL		410	



A2

SCALE 1: 5000	DATUM AHD	DRAWING TITLE	SITE & STAGING PLAN REV-A
REVISION DATE 1/3/2010	CONTOURS X m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ---
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

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1 715 m² | 2 647 m² | 3 647 m² | 4 647 m² | 5 647 m² | 6 647 m² | 7 904 m²

COMMERCIAL
200
2285 m²

198 615 m² | 199 610 m² | 175 616 m² | 94 652 m² | 91 594 m² | 92 594 m² | 93 652 m²

23.5 WIDE

18 725 m² | 17 692 m² | 16 688 m² | 15 684 m² | 14 680 m² | 13 676 m² | 12 664 m²
19 932 m² | 20 700 m² | 21 700 m² | 22 700 m² | 23 700 m² | 24 700 m² | 25 692 m²

11 738 m² | 10 659 m² | 9 655 m² | 8 670 m²
26 779 m² | 27 700 m² | 28 700 m² | 29 700 m²
82
7040 m²

ROAD 17.5 WIDE

83
4729 m²

ROAD 20 WIDE

84
4729 m²

ROAD 15 WIDE

81
3975 m²

80
2357 m²

ROAD 17.5 WIDE

ROAD 20 WIDE

39 728 m² | 38 767 m²
40 739 m² | 48 713 m²
41 800 m² | 47 713 m²
42 753 m² | 46 700 m²
43 804 m² | 44 677 m² | 45 712 m²

ROAD 15 WIDE

37 634 m² | 36 610 m² | 35 612 m² | 34 641 m²
49 710 m² | 58 798 m²
50 705 m² | 57 787 m²
51 705 m² | 56 788 m²
52 650 m² | 53 630 m² | 54 630 m² | 55 665 m²

33 615 m² | 32 570 m² | 31 571 m² | 30 572 m²
59 592 m² | 60 550 m² | 61 552 m² | 62 560 m²
74
3515 m²
75
3503 m²

ROAD 17.5 WIDE

79 513 m²
78 520 m²
77 520 m²
76 768 m²

ROAD 20 WIDE

64 691 m² | 63 768 m² | 73 749 m² | 72 924 m²
65 670 m²
66 696 m² | 67 648 m² | 68 648 m² | 69 648 m² | 70 704 m² | 71 731 m²

ROAD 20 WIDE

100 YEAR DUNE HAZARD LINE

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE	STAGE 4 - 6 DETAIL PLAN REV-A
REVISION DATE ----	CONTOURS X m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

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ROAD

611 m²

193
629 m²

183
557 m²

182
557 m²

181
557 m²

180
557 m²

179
561 m²

178
545 m²

177
600 m²

176
577 m²

175
616 m²

194
2331 m²

195
546 m²

196
548 m²

197
558 m²

198
615 m²

199
610 m²

23.8 WIDE

17.5 WIDE

Community/
Recreational
Facility

COMMERCIAL

200
2285 m²

161
551 m²

162
536 m²

163
602 m²

164
674 m²

165
757 m²

166
616 m²

173
752 m²

172
629 m²

171
720 m²

170
507 m²

169
556 m²

168
589 m²

167
564 m²

ROAD 17.5 WIDE

103
984 m²

102
872 m²

101
639 m²

100
575 m²

99
530 m²

98
508 m²

97
503 m²

96
503 m²

95
503 m²

94
652 m²

93
652 m²

92
594 m²

91
594 m²

90
594 m²

89
530 m²

88
536 m²

87
553 m²

ROAD 17.5 WIDE

86
4222 m²

85
4010 m²

83
4729 m²

84
4729 m²

ROAD 20 WIDE

ROAD 15 WIDE

ROAD 17.5 WIDE

ROAD 20 WIDE

3.5 WIDE

11
738 m²

10
659 m²

9
655 m²

8
670 m²

26
779 m²

27
700 m²

28
700 m²

29
700 m²

82
7040 m²

81
3975 m²

80
2357 m²

33
615 m²

32
570 m²

31
571 m²

30
572 m²

74
3515 m²

59
12 m²

60
550 m²

61
552 m²

62
560 m²

100 YEAR DUNE HAZARD LINE

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE	STAGE 7 DETAIL PLAN REV-A
REVISION DATE -----	CONTOURS X m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

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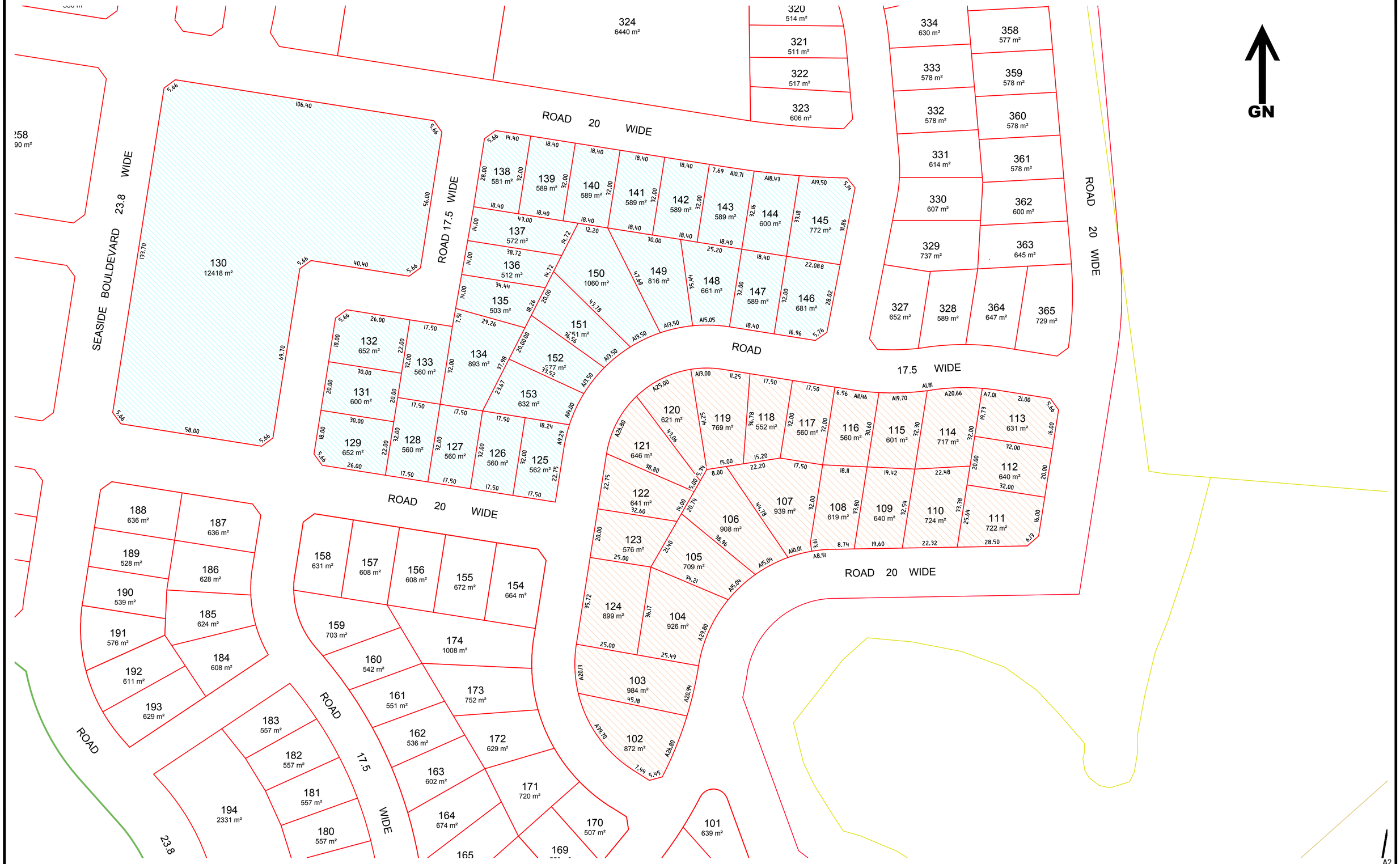

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE STAGES 8 & 9 DETAIL PLAN REV-A
REVISION DATE -----	CONTOURS X m	DEVELOPMENT PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED	
DA NUMBER	CC NUMBER	CLIENT ASPEN GROUP LIMITED

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ROAD 20 WIDE

ROAD 17.5 WIDE

SEASID

247 720 m²

252 4438 m²

241 2792 m²

242 719 m²

243 622 m²

244 569 m²

245 570 m²

246 520 m²

240 627 m²

239 545 m²

238 508 m²

237 508 m²

236 503 m²

230 600 m²

231 589 m²

232 570 m²

233 570 m²

234 582 m²

235 613 m²

229 636 m²

228 636 m²

227 600 m²

226 589 m²

225 717 m²

224 882 m²

223 864 m²

222 738 m²

221 661 m²

215 574 m²

214 569 m²

216 558 m²

217 581 m²

218 580 m²

219 574 m²

220 597 m²

213 514 m²

212 534 m²

211 522 m²

210 502 m²

209 500 m²

208 589 m²

201 518 m²

202 522 m²

203 522 m²

204 522 m²

205 522 m²

206 522 m²

207 726 m²

1 715 m²

2 647 m²

3 647 m²

4 647 m²

5 647 m²

6 647 m²

7 904 m²

Community/ Recreational Facility

COMMERCIAL 200 2285 m²

23.8 WIDE

23.5 WIDE

188 636 m²

189 528 m²

190 530 m²

191 576 m²

192 611 m²

193 629 m²

187 636 m²

186 628 m²

185 624 m²

184 608 m²

183 557 m²

182 557 m²

181 557 m²

180 557 m²

179 561 m²

178 545 m²

177 600 m²

176 577 m²

175 616 m²

194 2331 m²

195 546 m²

196 548 m²

197 558 m²

198 615 m²

199 610 m²

132 652 m²

133 560 m²

134 893 m²

151 651 m²

152 577 m²

153 632 m²

131 600 m²

129 652 m²

128 560 m²

127 560 m²

126 560 m²

125 562 m²

158 631 m²

157 608 m²

156 608 m²

155 672 m²

154 664 m²

159 703 m²

174 1008 m²

160 542 m²

161 551 m²

173 752 m²

162 536 m²

172 629 m²

163 602 m²

171 720 m²

164 674 m²

165 757 m²

170 507 m²

169 556 m²

168 589 m²

167 564 m²

166 616 m²

120 621 m²

119 769 m²

118 552 m²

121 646 m²

122 641 m²

123 576 m²

106 908 m²

105 709 m²

124 899 m²

104 926 m²

103 984 m²

102 872 m²

101 639 m²

100 575 m²

99 530 m²

98 508 m²

97 503 m²

96 503 m²

95 503 m²

94 652 m²

88 536 m²

89 530 m²

90 594 m²

91 594 m²

92 594 m²

93 652 m²

SCALE 1: 1000	DATUM AHD	DRAWING TITLE	DETAIL SHEET STAGES 10 - 12 REV-A
REVISION DATE -----	CONTOURS X m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying
OFFICES AT:
PORT STEPHENS ☐
CENTRAL COAST & HUNTER ☐
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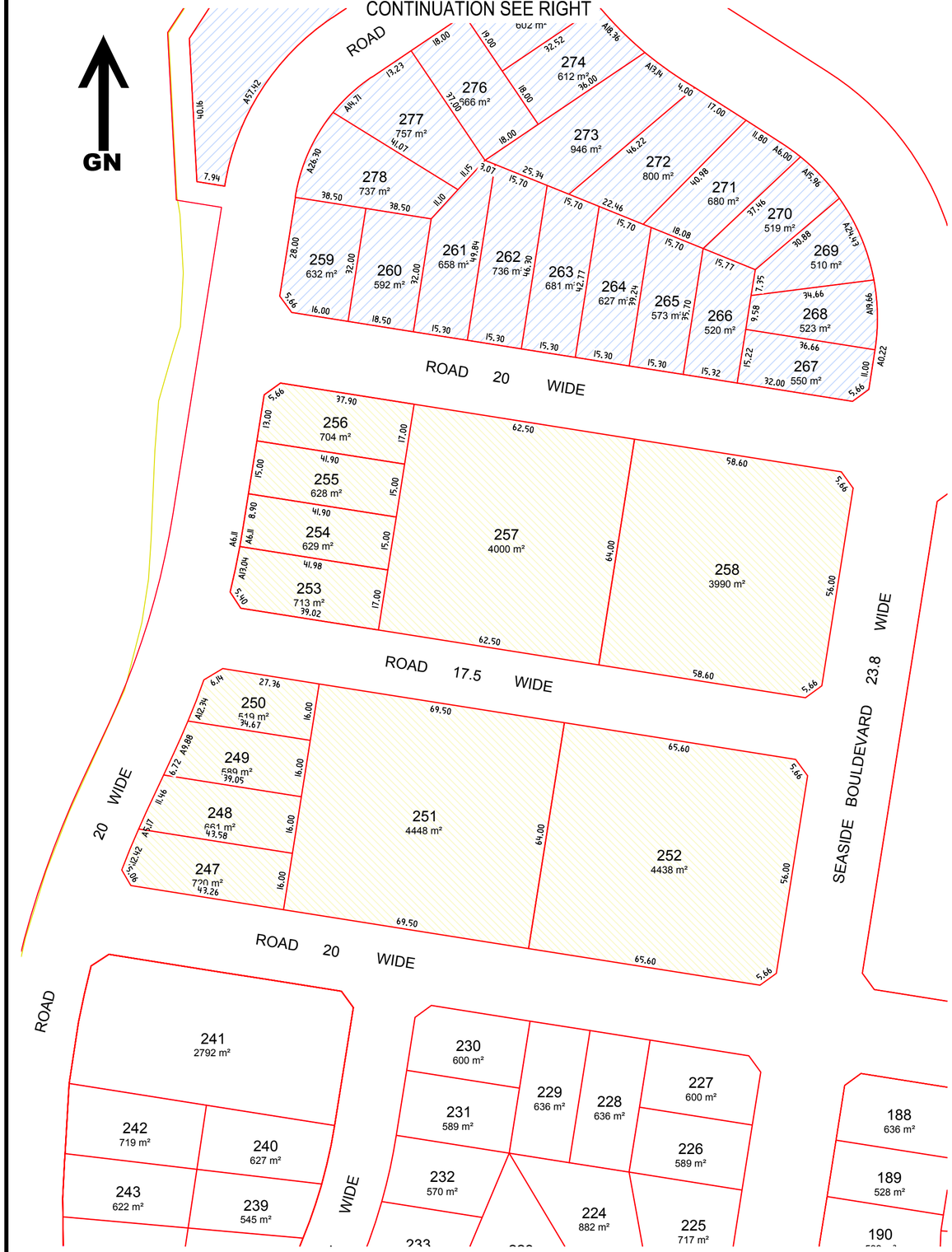

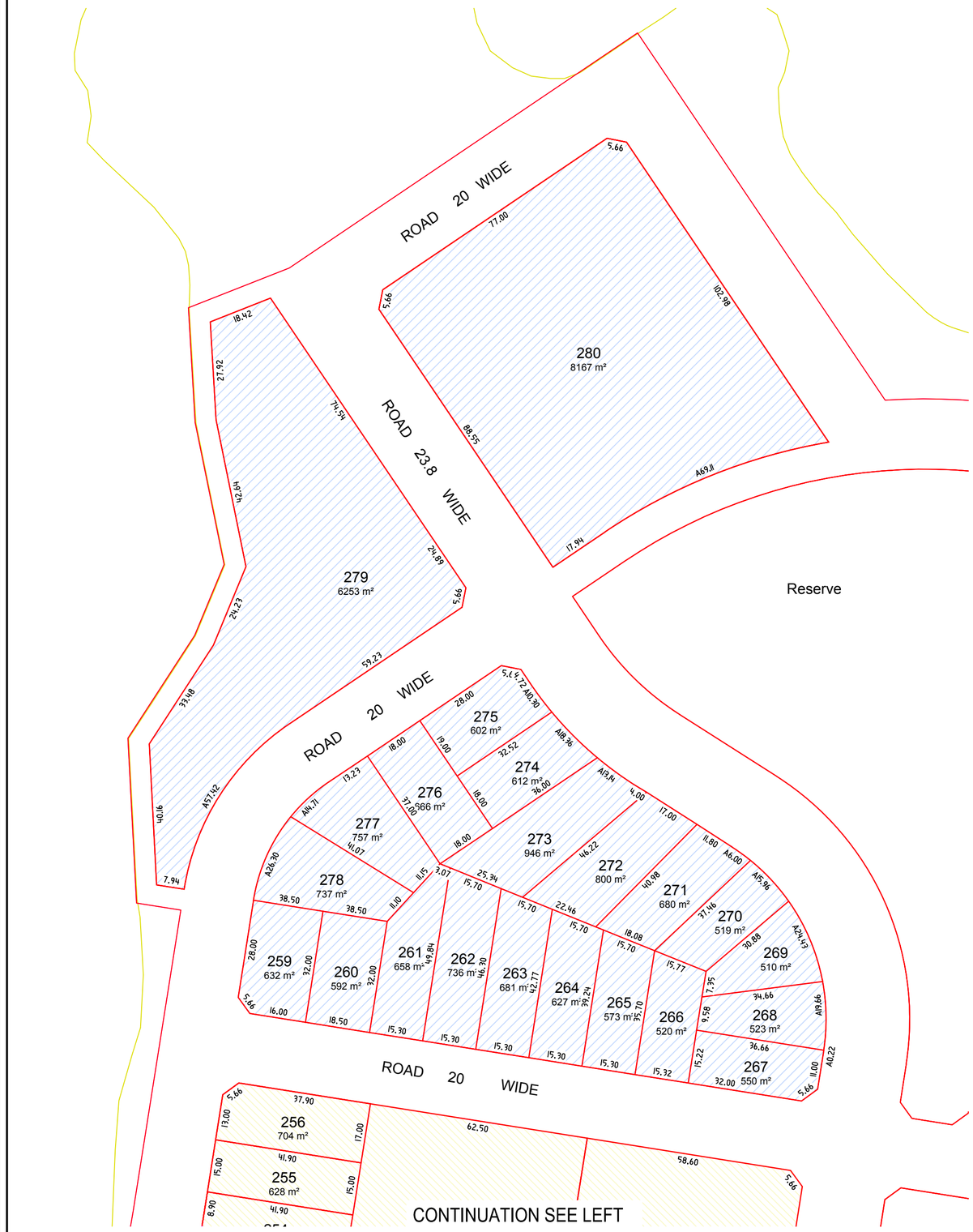

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE STAGES 13 & 14 DETAIL PLAN REV-A
REVISION DATE -----	CONTOURS X m	DEVELOPMENT PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED	
DA NUMBER	CC NUMBER	CLIENT ASPEN GROUP LIMITED

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GN

ROAD 20 WIDE

281 741 m²
282 613 m²
283 646 m²
284 737 m²
285 501 m²
286 500 m²
287 508 m²
288 510 m²
289 508 m²
290 565 m²
291 572 m²
292 594 m²
293 629 m²
294 502 m²
295 510 m²
296 510 m²
297 510 m²
298 503 m²
299 672 m²
300 674 m²
301 634 m²
302 650 m²
303 654 m²
304 557 m²
305 654 m²
306 624 m²
307 562 m²
308 542 m²
309 2277 m²
310 562 m²
311 631 m²
312 674 m²
313 504 m²
314 560 m²
315 634 m²
316 680 m²
317 5384 m²
318 5339 m²

ROAD 20 WIDE

345 619 m²
344 566 m²
343 631 m²
342 628 m²
341 643 m²
34 656

ROAD 17.5 WIDE

CONTINUATION SEE RIGHT

CONTINUATION SEE LEFT

ROAD 20 WIDE

319 504 m²
320 514 m²
321 511 m²
322 517 m²
323 606 m²
324 6440 m²
325 4096 m²
326 1809 m²

ROAD 20 WIDE

345 619 m²
346 619 m²
344 566 m²
347 556 m²
343 631 m²
348 574 m²
342 628 m²
349 601 m
341 643 m²
340 656 m²
339 593 m²
338 593 m²
337 601 m²

ROAD 17.5 WIDE

ROAD 20 WIDE

138 581 m²
139 589 m²
140 589 m²
141 589 m²
142 589 m²
143 589 m²
144 600 m²
145 772 m²
137 572 m²

ROAD 17.5 WIDE

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE STAGES 15 & 16 DETAIL PLAN REV-A
REVISION DATE ----	CONTOURS X m	DEVELOPMENT PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED	
DA NUMBER	CC NUMBER	CLIENT ASPEN GROUP LIMITED

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Design Management Surveying
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GN

ROAD 20 WIDE

ROAD 17.5 WIDE

288 510 m²
289 508 m²
290 565 m²
306 624 m²
307 562 m²
308 542 m²
309 2277 m²
310 562 m²
311 631 m²
312 674 m²
313 504 m²
314 560 m²
315 634 m²
316 680 m²
317 5384 m²
319 504 m²
320 514 m²
321 511 m²
322 517 m²
323 606 m²
324 6440 m²
340 656 m²
341 643 m²
342 628 m²
343 631 m²
344 566 m²
345 619 m²
346 619 m²
347 556 m²
348 574 m²
349 601 m²
350 608 m²
351 545 m²
352 545 m²
353 545 m²
354 602 m²
337 601 m²
338 593 m²
339 593 m²
141 589 m²
142 589 m²
143 589 m²
144 600 m²
145 772 m²
146 681 m²
147 589 m²
148 661 m²
149 816 m²
120 621 m²
121 646 m²
122 641 m²
119 769 m²
118 552 m²
117 560 m²
116 560 m²
115 601 m²
114 717 m²
113 631 m²
112 640 m²
111 722 m²
106 908 m²
107 939 m²
108 619 m²
109 640 m²
110 724 m²
355 619 m²
336 619 m²
356 558 m²
335 611 m²
357 532 m²
334 630 m²
358 577 m²
333 578 m²
359 578 m²
332 578 m²
360 578 m²
331 614 m²
361 578 m²
330 607 m²
362 600 m²
329 737 m²
363 645 m²
327 652 m²
328 589 m²
364 647 m²
365 729 m²

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE	STAGE 17 DETAIL PLAN REV-A
REVISION DATE ----	CONTOURS X m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying
OFFICES AT:
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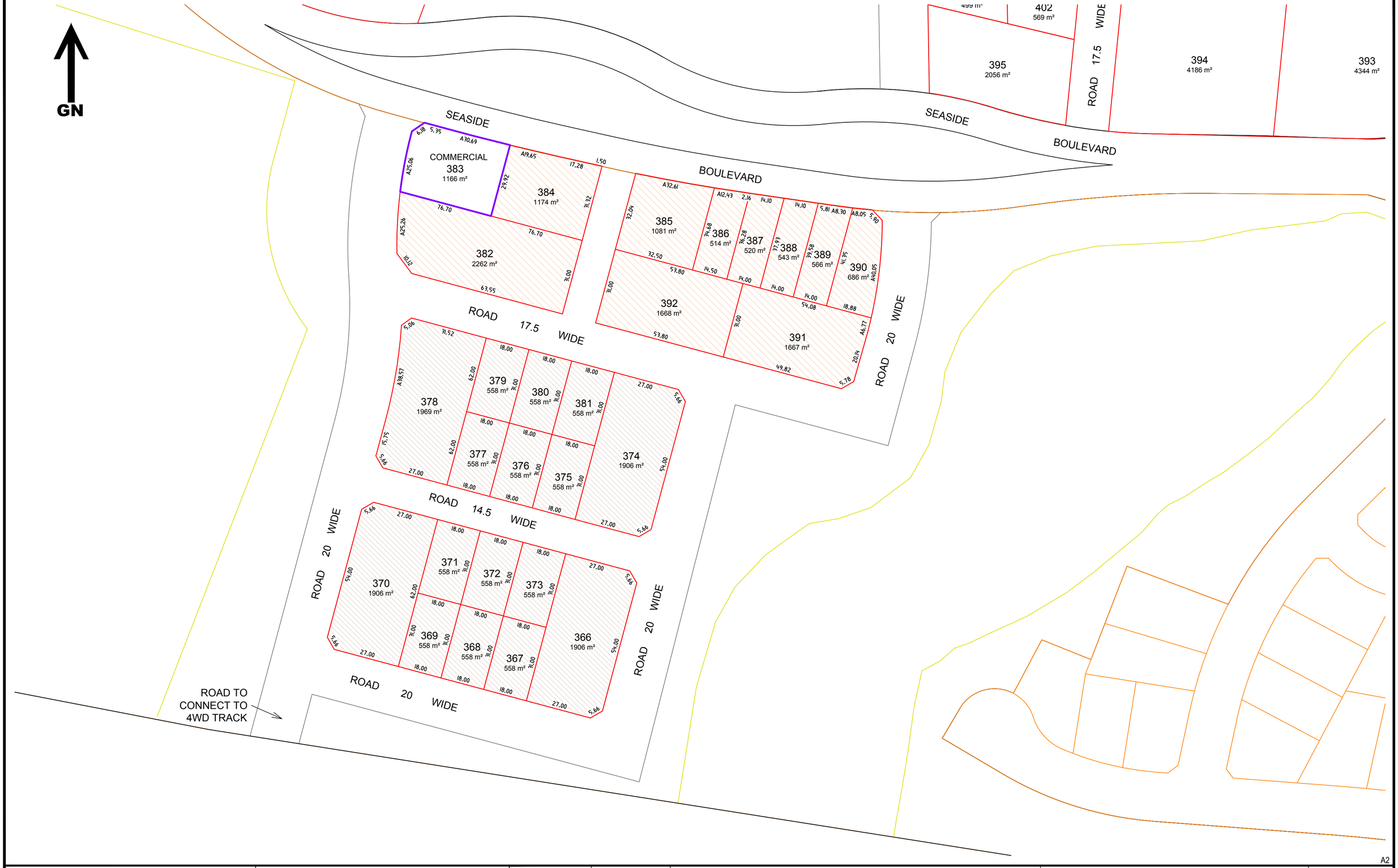

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE	STAGE 18 & 19 DETAIL PLAN
REVISION DATE ----	CONTOURS X m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

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GN

ROAD 20 WIDE

Reserve

410
6979 m²

ROAD 16 WIDE

409
573 m²

408
900 m²

407
782 m²

406
903 m²

405
552 m²

404
3612 m²

403
3300 m²

ROAD 17.5 WIDE

CULTURAL HERITAGE RESERVE

Reserve

398
743 m²

399
746 m²

400
748 m²

397
598 m²

401
750 m²

396
499 m²

402
569 m²

395
2056 m²

ROAD 17.5 WIDE

394
4186 m²

393
4344 m²

Reserve

SEASIDE BOULEVARD

COMMERCIAL
383
1166 m²

384
1174 m²

385

SEASIDE BOULEVARD

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE STAGE 20 DETAIL PLAN
REVISION DATE ----	CONTOURS X m	DEVELOPMENT PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED	
DA NUMBER	CC NUMBER	CLIENT ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying

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LEGEND

- ~ CATCHMENT 1
- ~ CATCHMENT 2
- ~ CATCHMENT 3
- ~ CATCHMENT 4
- ~ CATCHMENT 5
- ~ CATCHMENT 6
- ~ CATCHMENT 7
- ~ EASEMENT FOR SEWAGE PUMPING STATION
- (P) ~ PROPOSED PUMP STATION (WITH NUMBER)
- (E) ~ EXISTING PUMP STATION (WITH NUMBER)

NOTE:
- E1 & E2 ARE EXISTING PUMP STATIONS

- P3 - P7 ARE PROPOSED PUMP STATIONS

- P3 ,P4 & P7 PROPOSED PUMP STATIONS TO BE LOCATED IN EXISTING CLEARED AREA

- P5 & P6 PROPOSED PUMP STATIONS TO MINIMISE VEGETATION REMOVAL

GN

NELSON BAY ROAD

Reserve

Reserve

100 YEAR DUNE HAZARD LINE

A2

SCALE 1: 4000	DATUM	DRAWING TITLE INDICATIVE SEWER LAYOUT REV-A
REVISION DATE ----		DEVELOPMENT PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED	
DA NUMBER	CC NUMBER	CLIENT ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying

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LEGEND

~ EXISTING 100mm WATERMAIN
~ EXISTING 200mm WATERMAIN
~ EXISTING 250mm WATERMAIN
~ EXISTING 300mm WATERMAIN
~ PROPOSED 100mm WATERMAIN
~ PROPOSED 150mm WATERMAIN
~ PROPOSED 200mm WATERMAIN

GN

NELSON BAY ROAD

Reserve
Reserve
Reserve
Reserve
Community/ Recreational Facility
100 YEAR DUNE HAZARD LINE

A2

SCALE 1: 4000	DATUM AHD	DRAWING TITLE	INDICATIVE WATERMAIN LAYOUT REV-A
REVISION DATE -----	CONTOURS X m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying
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RESERVE TABLE

Shading	Area/Section	Ownership	Maintenance Responsibility	Exist/Prop
	Existing Roads	Port Stephens Council	Port Stephens Council	E
	Proposed Roads	Port Stephens Council	Port Stephens Council	P
	Completed Development			E
	R1	Community Association	Community Association (DP270466)	E
	R2	Precinct Associaton	Precinct Association	P
	R3	Community/Precinct Ass	Community /Precinct Association	P
	R4 & R5	Community/Precinct Ass	Community/Precinct Association	P
	Detention Basins	Community/Precinct Ass	Port Stephens Council	E
	Conveyance Swales (see note)	Community/Precinct Ass	Port Stephens Council	P
	Detention basins	Aspen Land	Port Stephens Council	E
	Precinct Property	Precinct DP 280005 Property	Precinct DP 280005 Association	E
	Precinct Property	Precinct DP 280008 Property	Precinct DP 280008 Association	E

Note: Conveyance swales are 2 metres wide, with associated batters as required
(drawn not to scale for clarity)

RESERVE TABLE

No.	TITLE	AREA	COMMENTS
R1	CABBAGE TREE PARK	1.302 Ha	ACTIVE RECREATION
R2	UNNAMED	2500 m^2	-
R3	UNNAMED	1.0 Ha	CULTURAL HERITAGE RESERVE
R4	BANKSIA PARK	1.38 Ha	PROPOSED RECREATIONAL FACILITY/COMMUNITY CENTRE
R5	CORYMBIA PARK	1.09 Ha	-

A2

SCALE 1: 5000		DRAWING TITLE	LAND TENURE PLAN REV-A
REVISION DATE -----		DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying

OFFICES AT:
PORT STEPHENS
CENTRAL COAST & HUNTER

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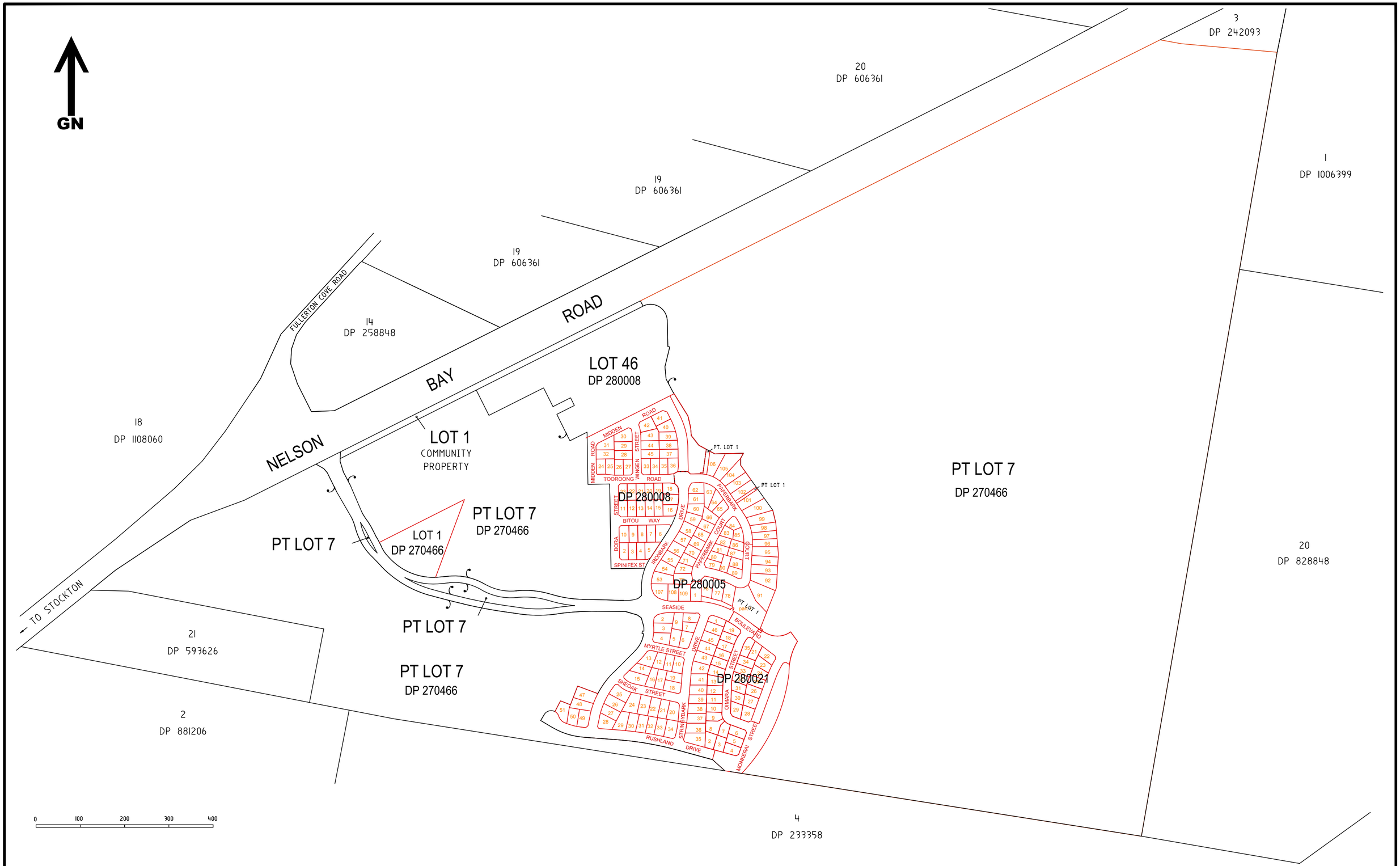

A2

SCALE 1: 5000	DATUM AHD	DRAWING TITLE	SUBJECT & ADJOINING TITLE DETAILS
REVISION DATE ----	CONTOURS X m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying
OFFICES AT:
PORT STEPHENS ☐ 6/10 YACAABA STREET, NELSON BAY Ph (02) 49813444 Email: bay@dmssurvey.com.au
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DRAWING ISSUED FROM:

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GN

EXISTING BASIN 4
IWL = RL 1.35
BWL = RL 1.80
TWL = RL 1.81

SWALE 770m2
BATTERS 2050m2

EXISTING BASIN 5
IWL = RL 2.5
BWL = RL 2.70
TWL = RL 2.76

SWALE 440m2
BATTERS 1280m2

STA 0+00.00
DESIGN SPEED = 100 km/h

Reserve

PROPOSED BASIN 2
IWL = RL 1.35
BWL = RL 2.00
TWL = RL 2.08

EXISTING BASIN 1
IWL = RL 1.35
BWL = RL 1.80
TWL = RL 1.80

SWALE 273m2
BATTERS 80m2

Community/
Recreational
Facility

PROPOSED BASIN 3
IWL = RL 2.30
BWL = RL 2.5
TWL = RL 3.24

PROPOSED BASIN 6
IWL = RL 2.50
BWL = RL 2.50
TWL = RL 3.24
BASIN AREA 4500m2
BATTER AREA 2785m2

A2

SCALE	1: 3000
DATUM	AHD
REVISION DATE	-----
CONTOURS	2 m
PLOT DATE	25/03/2010
DRAWN/CHKD BY	GJS / AED
DA NUMBER	
CC NUMBER	

DRAWING TITLE
CONCEPT SITE DRAINAGE PLAN-PROPOSED SWALES AND BASINS REV-A

DEVELOPMENT
CIVIL DESIGN PLANS A
FERN BAY SEASIDE VILLAGE
NELSON BAY ROAD, FERN BAY

CLIENT
ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying

OFFICES AT:
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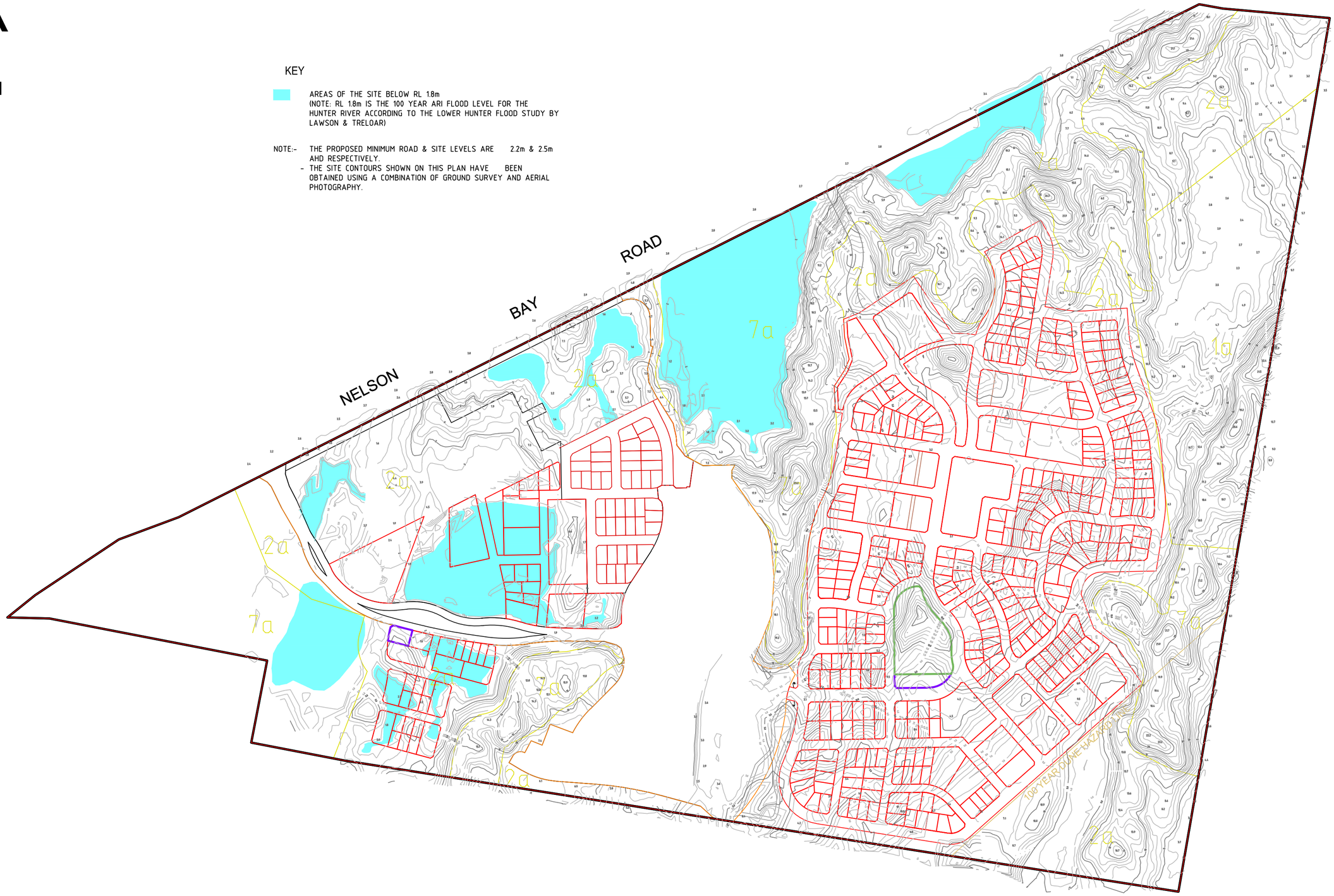
GN

KEY

AREAS OF THE SITE BELOW RL 1.8m
(NOTE: RL 1.8m IS THE 100 YEAR ARI FLOOD LEVEL FOR THE HUNTER RIVER ACCORDING TO THE LOWER HUNTER FLOOD STUDY BY LAWSON & TRELOAR)

NOTE:- THE PROPOSED MINIMUM ROAD & SITE LEVELS ARE 2.2m & 2.5m AHD RESPECTIVELY.
- THE SITE CONTOURS SHOWN ON THIS PLAN HAVE BEEN OBTAINED USING A COMBINATION OF GROUND SURVEY AND AERIAL PHOTOGRAPHY.



A2

SCALE	1: 5000
DATUM	AHD
REVISION DATE	-----
CONTOURS	X m
PLOT DATE	25/03/2010
DRAWN/CHKD BY	GJS / AED
DA NUMBER	
CC NUMBER	

DRAWING TITLE: FLOOD PRONE & LOW LYING AREAS REV-A

DEVELOPMENT: PROJECT PLAN A
FERN BAY SEASIDE VILLAGE
NELSON BAY ROAD, FERN BAY

CLIENT: ASPEN GROUP LIMITED

DALY . SMITH Pty Ltd
Design Management Surveying

OFFICES AT:
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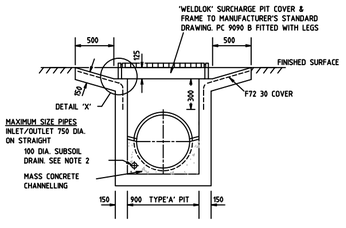
GN

SURCHARGE PIT - RM11(TYPE A)



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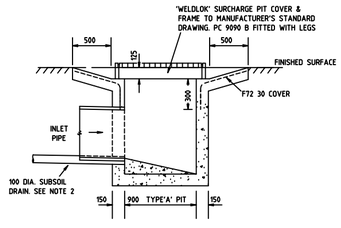

SECTION B-B
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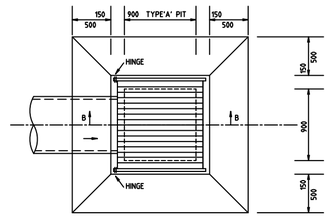
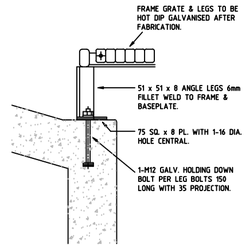


PLAN
NOT TO SCALE



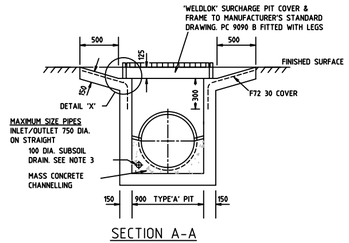
DETAIL 'X'
NOT TO SCALE

NOT TO SCALE
DENOTED P

NOTES

1. COMPRESSIVE STRENGTH OF CONCRETE Fc AT 28 DAYS TO BE 20 MPa.
2. 100 DIA. SUBSOIL DRAINAGE 3000 LONG WRAPPED IN FABRIC COSK TO BE PROVIDED IN PIPE TRENCHES ADJACENT TO INLET PIPES.
3. PROVIDE CLIMB IRONS TO R.M.3 WHERE PIT IS DEEPER THAN 1200.

SURFACE INLET PIT - RM11(TYPE A)



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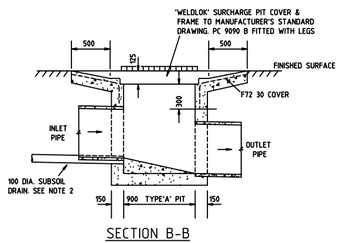

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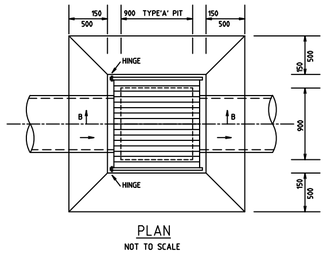

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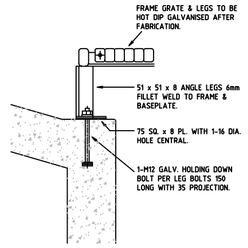


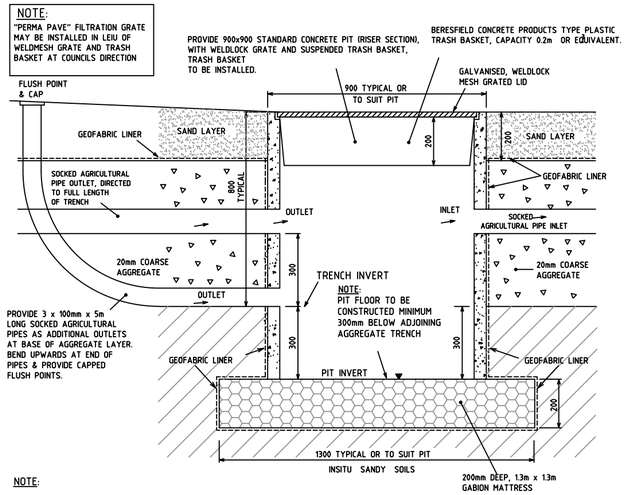
DETAIL 'X'
NOT TO SCALE

NOT TO SCALE
DENOTED I

NOTES

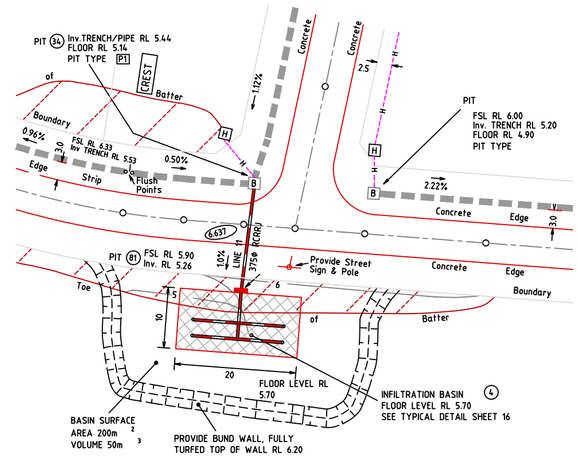
1. COMPRESSIVE STRENGTH OF CONCRETE Fc AT 28 DAYS TO BE 20 MPa.
2. TOP OF BENCHING TO BE 1/2 OF OUTLET PIPE DIAMETER.
3. 100 DIA. SUBSOIL DRAINAGE 3000 LONG WRAPPED IN FABRIC COSK TO BE PROVIDED IN PIPE TRENCHES ADJACENT TO INLET PIPES.
4. PROVIDE CLIMB IRONS TO R.M.3 WHERE PIT IS DEEPER THAN 1200.

NOTE:
"PERMA PAVE" FILTRATION GRATE MAY BE INSTALLED IN LEU OF WELDMESH GRATE AND TRASH BASKET AT COUNCILS DIRECTION



NOTE:
NOMINAL PIT SIZE 900x900x800 DEEP UNLESS OTHERWISE INDICATED.
PIT TYPE P1 SIZE 1100x1100x800 DEEP (CAPACITY 1.0m³)
PIT TYPE P2 SIZE 1600x1600x800 DEEP (CAPACITY 2.0m³)

BIO RETENTION SURFACE INLET PIT
NOT TO SCALE



TYPICAL INFILTRATION BASIN
NOT TO SCALE

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE	TYPICAL DRAINAGE TREATMENTS DETAIL1
REVISION DATE -----	CONTOURS X m	DEVELOPMENT	PROJECT PLAN FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

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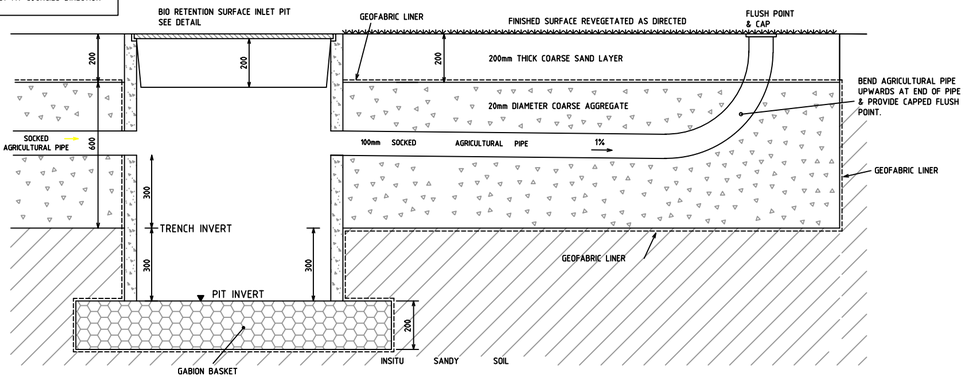
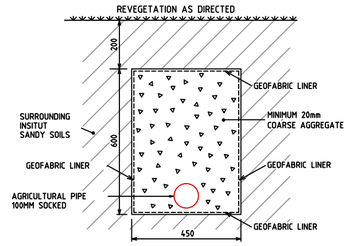
GN

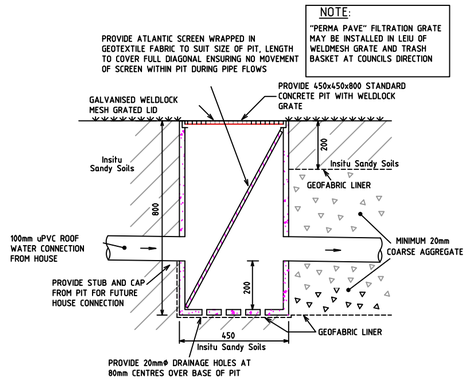
NOTE:
"PERMA PAVE" FILTRATION GRATE MAY BE INSTALLED IN LEIU OF WELDMESH GRATE AND TRASH BASKET AT COUNCILS DIRECTION



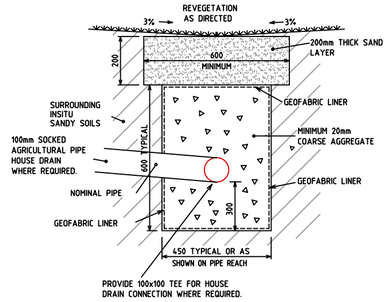


BIO RETENTION TRENCH
HOUSE DRAINS DETAIL
NOT TO SCALE

NOTE:
"PERMA PAVE" FILTRATION GRATE MAY BE INSTALLED IN LEIU OF WELDMESH GRATE AND TRASH BASKET AT COUNCILS DIRECTION

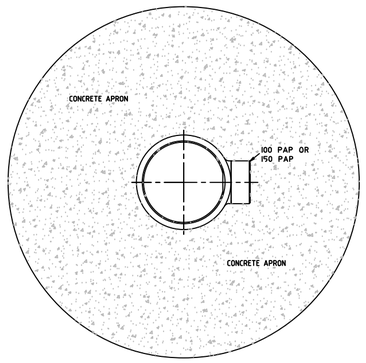


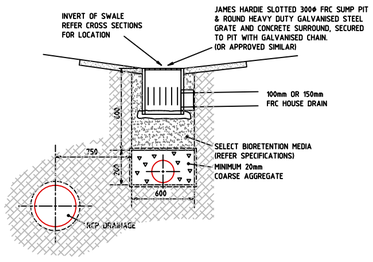
HOUSE DRAINAGE PIT DETAIL
NOT TO SCALE



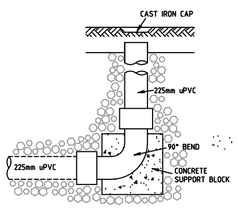
BIO RETENTION SWALE AND TRENCH
NOT TO SCALE

NOTES:
1. PITS CONSTRUCTED IN CRESTS TO BE USED FOR FLUSHING 100mm SOCKED AGRICULTURAL PIPE, 100mm AGRICULTURAL PIPE TO BE CLEARLY ACCESSIBLE.
2. OUTLET OF BIO RETENTION SURFACE PITS TO BE ABLE TO TAKE 100mm SOCKED AGRICULTURAL PIPE OUTLET OR 375mm RCRRJ CONCRETE PIPE.
3. DRAINAGE INSTALLATION AS DIRECTED AND SPECIFICATION TO BE WITH 'STORMWATER MANAGEMENT AT THE PROPOSED STOCKTON BEACH DEVELOPMENT STAGE 2' BY URBAN WATER CYCLE SOLUTIONS, JANUARY, 2005.

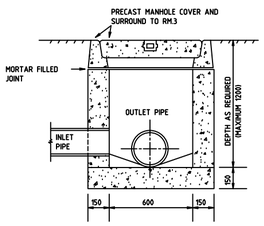




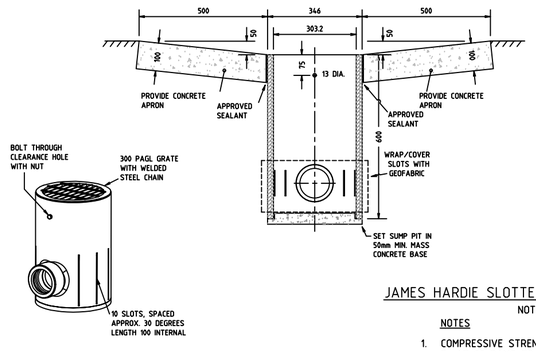
TYPICAL ARRANGEMENT
300mm FRC SUMP PIT BIORETENTION SWALE
AND STORMWATER DRAINAGE LINE
NOT TO SCALE

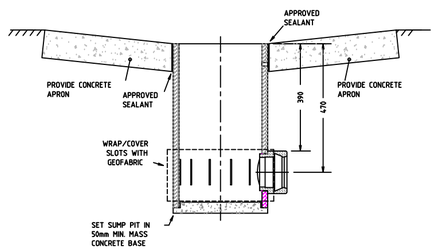


TYPICAL SLOTTED PIPE
& FLUSHING POINT
N.T.S.



JUNCTION PIT RM8
NOT TO SCALE





JAMES HARDIE SLOTTED FRC SUMP PIT
NOT TO SCALE

NOTES
1. COMPRESSIVE STRENGTH OF CONCRETE Fc AT 28 DAYS TO BE 20 MPa.

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE TYPICAL DRAINAGE TREATMENTS DETAIL 2
REVISION DATE -----	CONTOURS X m	DEVELOPMENT PROJECT PLAN FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED	
DA NUMBER	CC NUMBER	CLIENT ASPEN GROUP LIMITED

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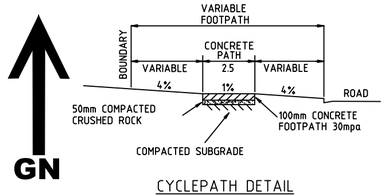


GN

CYCLEPATH DETAIL

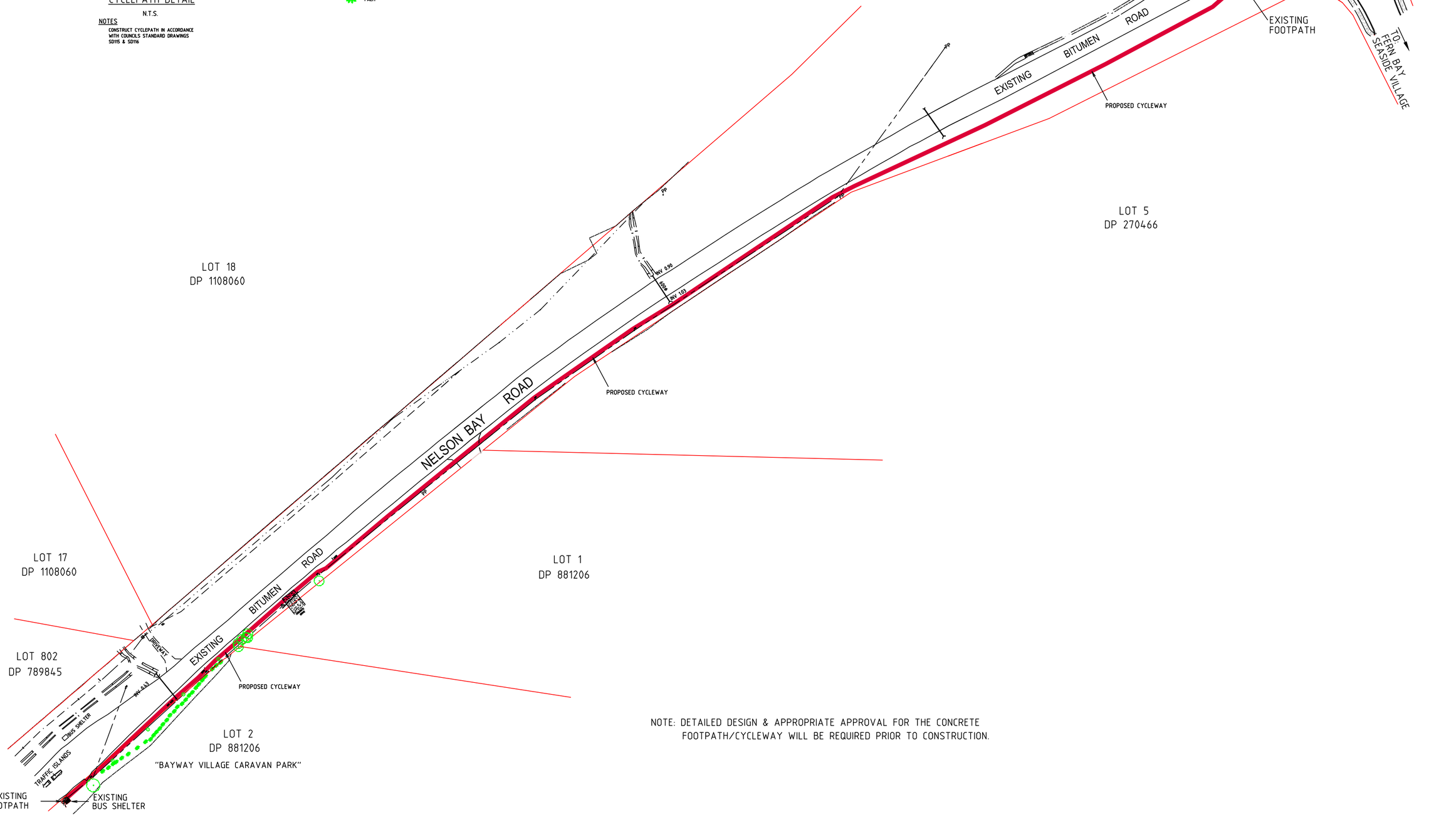
N.T.S.

NOTES

CONSTRUCT CYCLEPATH IN ACCORDANCE WITH COUNCILS STANDARD DRAWINGS SD115 & SD116

LEGEND

	HYDRANT	SRM	SEWER RISING MAIN
	HYDRANT CAP	W	WATER PIPE
	STOP VALVE	G	GAS PIPE
PP	POWER POLE	T	TELSTRA CABLE
LP	LIGHT POLE	O	OPTIC FIBRE
EB	EDGE BITUMEN		OVERHEAD POWER LINE
NIP	NORFOLK ISLAND PINE	U	UNDERGROUND POWER CABLE
KIP	KERB INLET PIT		
	SHRUB		
	PALM		



NOTE: DETAILED DESIGN & APPROPRIATE APPROVAL FOR THE CONCRETE FOOTPATH/CYCLEWAY WILL BE REQUIRED PRIOR TO CONSTRUCTION.

A2

SCALE 1: 1500	DATUM AHD	DRAWING TITLE	FOOTPATH & CYCLEWAY
REVISION DATE -----	CONTOURS X m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED		
DA NUMBER	CC NUMBER	CLIENT	ASPEN GROUP LIMITED

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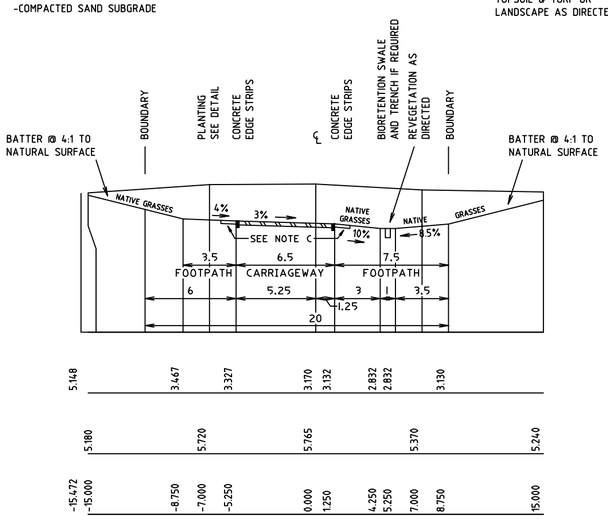
SUBGRADE NOTES

- REFER TO GEOTECHNICAL REPORT FOR PAVEMENT DETAILS AND GEOTECHNICAL ADVICE.
- SUBGRADE TO BE OF CLEAN SAND TO DEPTH OF 500mm. WHERE EXISTING MATERIAL IS CONSIDERED UNSUITABLE, REFER TO SUBGRADE PREPARATION ADVICE IN GEOTECHNICAL REPORT.
- IF WET CLAY MATERIAL IS ENCOUNTERED IN SUBGRADE THEN SUBGRADE SUITABILITY IS TO BE ASSESSED BY CONSULTANT GEOTECHNICAL ENGINEERS.
- IN AREAS OF GRADE OF GREATER THAN 10%, CONSULTANT GEOTECHNICAL ENGINEER IS TO ASSESS SUITABILITY OF MATERIAL AND VERIFY SUBBASE THICKNESS.

PAVEMENT DETAILS

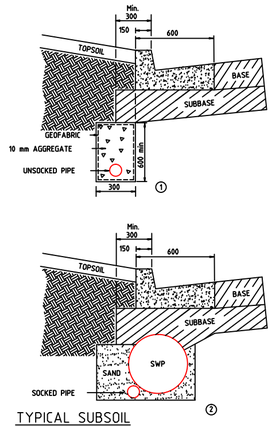
ROAD No.1
-PRIME 7mm COAT & 25mm AC RESIDENTIAL MIX
-100mm COMPACTED BASECOURSE
-200mm COMPACTED SUBBASE
-COMPACTED SAND SUBGRADE

NOTE C
PROVIDE 1.0m WIDE 100mm THICK CRUSHER DUST LAYER, AT 60mm BELOW FSL, COVER WITH TOPSOIL & TURF OR LANDSCAPE AS DIRECTED



Chainage 87.290
Datum -4.000

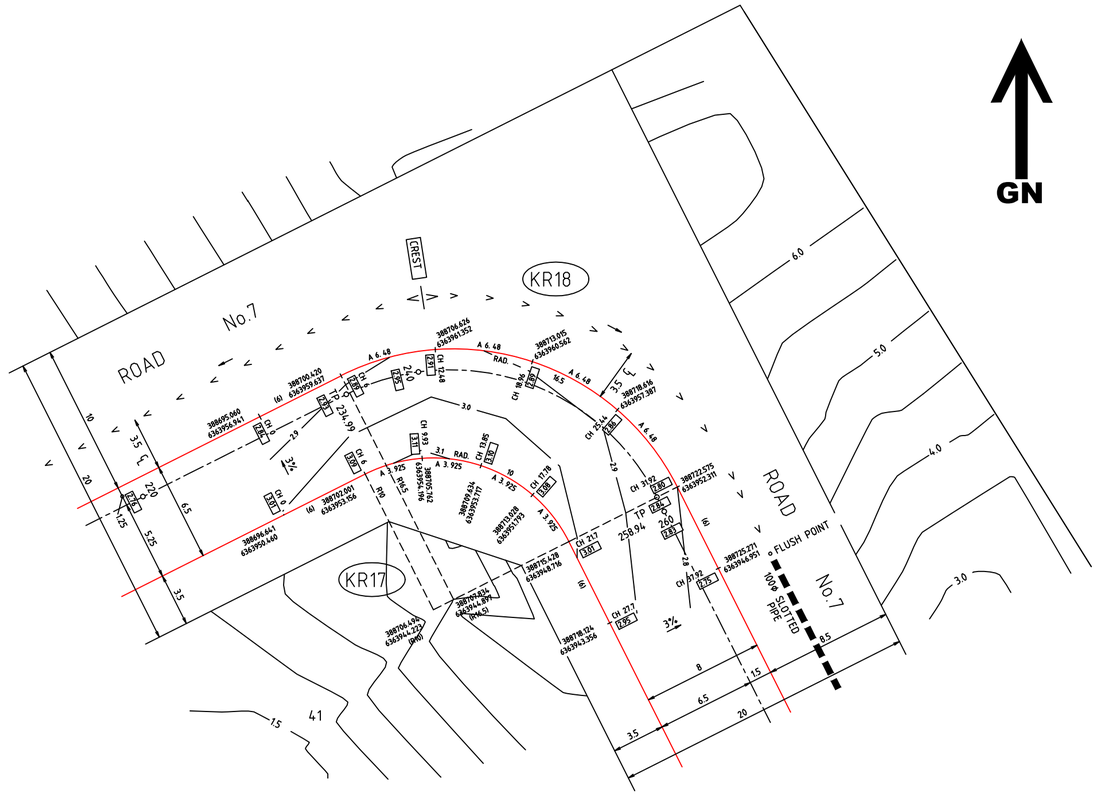
TYPICAL CROSS SECTION - SINGLE CARRIAGEWAY



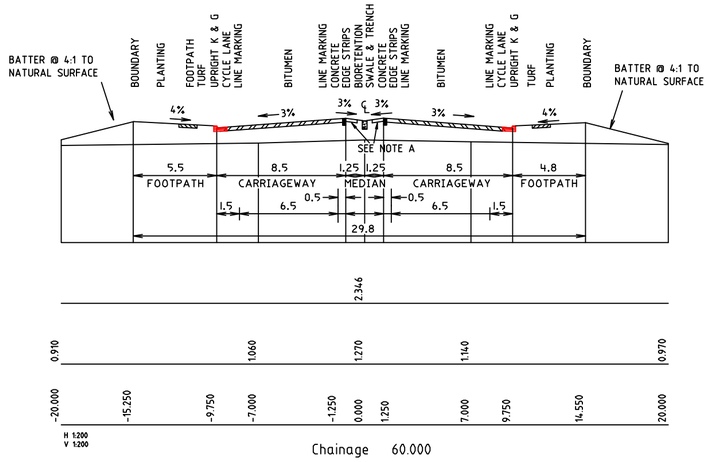
TYPICAL SUBSOIL DRAINAGE DETAIL

NOTE: -GEOFABRIC IN ALL SUBSOIL DRAINS TO BE PLACED ON TOP AND BOTH SIDES AS DETAILED.

-SUBSOIL DRAINS TO BE CONSTRUCTED IN ACCORDANCE WITH PORT STEPHENS COUNCIL'S STANDARD DRAWING D4, SEE PORT STEPHENS COUNCIL'S SUBDIVISION CODE - PART 2.

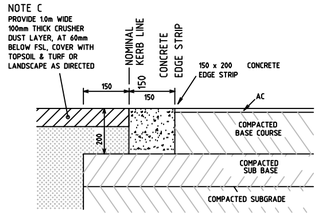


TYPICAL INTERSECTION DETAIL
SCALE 1:200

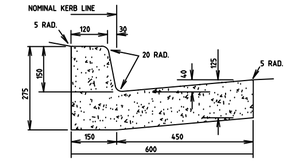


Chainage 60.000
Datum -5.000

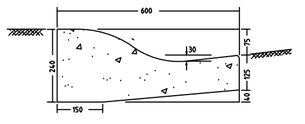
TYPICAL CROSS SECTION - DUAL CARRIAGEWAY



TYPICAL CONCRETE EDGE STRIP DETAIL
N.T.S.



TYPICAL150mm KERB & GUTTER
N.T.S.



TYPICAL ROLL KERB & GUTTER
N.T.S.

A2

SCALE 1: 1000	DATUM AHD	DRAWING TITLE TYPICAL ROAD DETAIL
REVISION DATE -----	CONTOURS X m	DEVELOPMENT PROJECT PLAN FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY
PLOT DATE 25/03/2010	DRAWN/CHKD BY GJS / AED	
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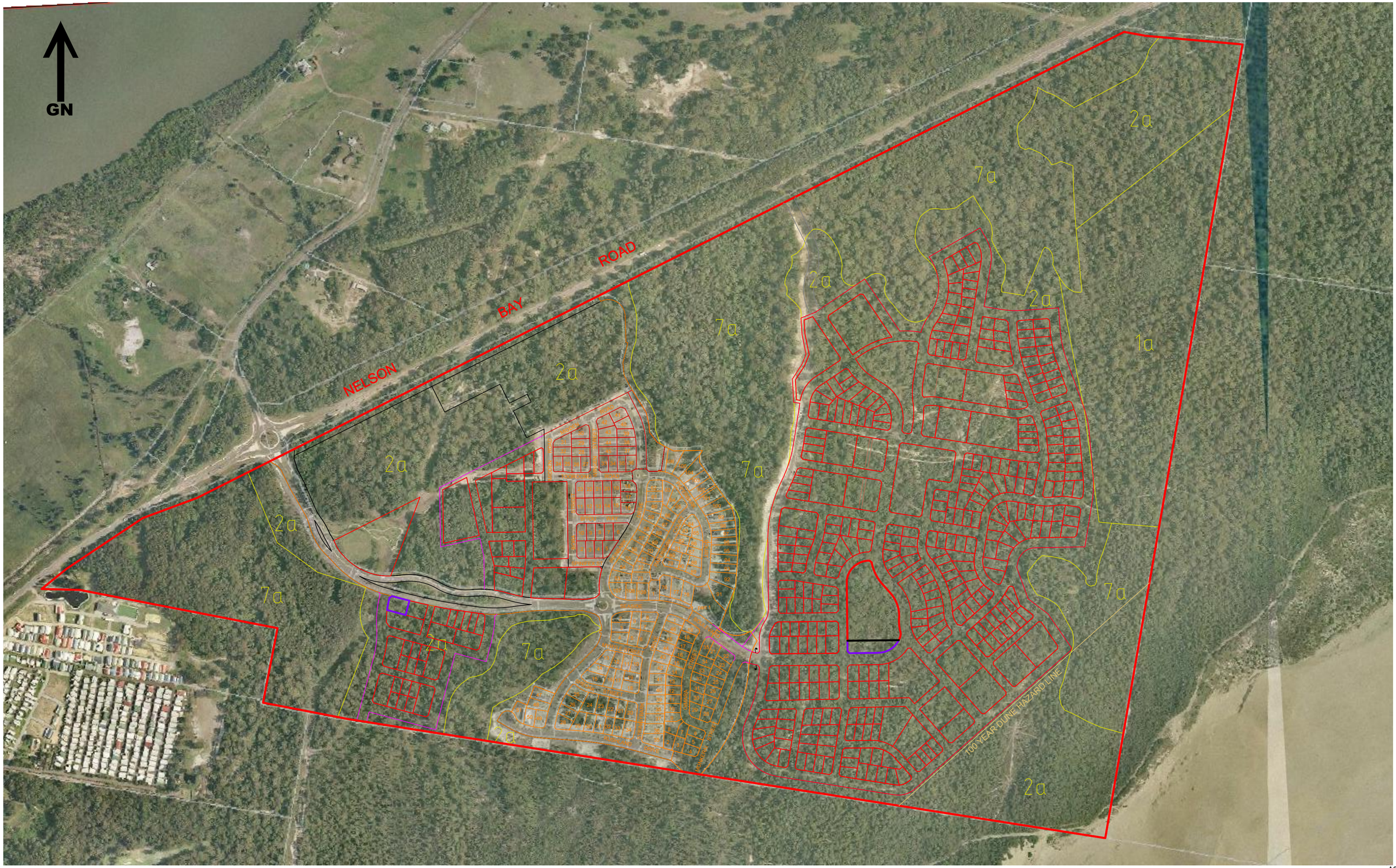

A2

SCALE	1: 5000
DATUM	AHD
REVISION DATE	-----
CONTOURS	X m
PLOT DATE	25/03/2010
DRAWN/CHKD BY	GJS / AED
DA NUMBER	
CC NUMBER	
DRAWING TITLE	AERIAL VIEW REV-A
DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY ----
CLIENT	ASPEN GROUP LIMITED

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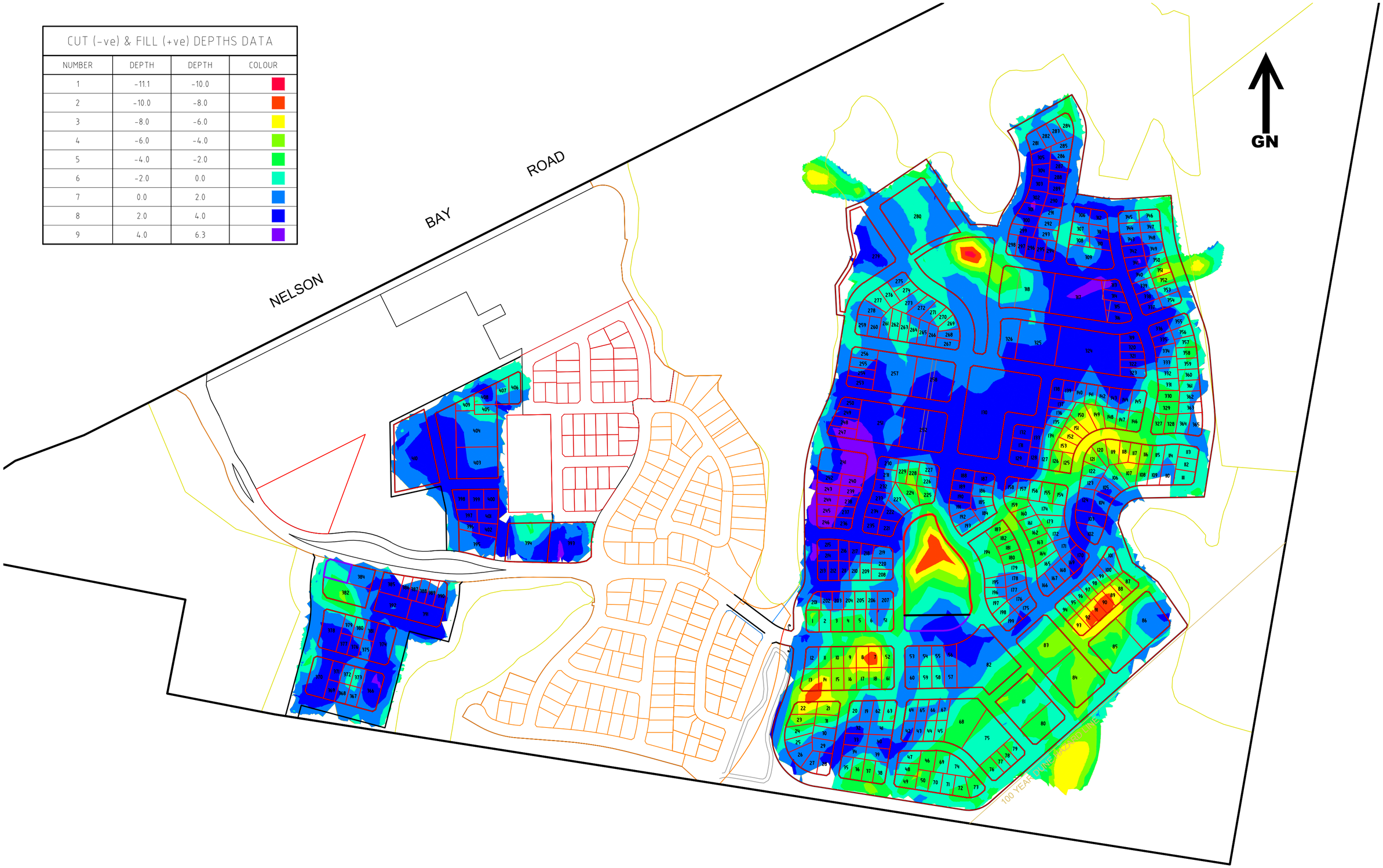
CUT (-ve) & FILL (+ve) DEPTHS DATA			
NUMBER	DEPTH	DEPTH	COLOUR
1	-11.1	-10.0	
2	-10.0	-8.0	
3	-8.0	-6.0	
4	-6.0	-4.0	
5	-4.0	-2.0	
6	-2.0	0.0	
7	0.0	2.0	
8	2.0	4.0	
9	4.0	6.3	



A2

SCALE 1: 4000	DATUM AHD	DRAWING TITLE	BULK EARTHWORKS (CUT-FILL) PLAN REV-A
REVISION DATE ----	DEPTH CONTOURS 2 m	DEVELOPMENT	PROJECT PLAN A FERN BAY SEASIDE VILLAGE NELSON BAY ROAD, FERN BAY
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Annex C

Supplementary Water Cycle Management Information, Fern Bay Seaside Village, NSW

Aspen Group

Supplementary Water Cycle Management Information, Fern Bay Seaside Village, NSW

martens consulting engineers

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT

P0902479JR02V01
April 2010

Limitations Statement

The sole purpose of this report and the associated services performed by Martens & Associates Pty Ltd is to prepare supplementary water cycle management information in accordance with the scope of services set out in the contract / quotation between Martens & Associates Pty Ltd and Aspen Group (hereafter known as the Client). That scope of works and services were defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

Martens & Associates Pty Ltd derived the data in this report primarily from a number of sources which may include for example site inspections, correspondence regarding the proposal, examination of records in the public domain, interviews with individuals with information about the site or the project, and field explorations conducted on the dates indicated. The passage of time, manifestation of latent conditions or impacts of future events may require further examination / exploration of the site and subsequent data analyses, together with a re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, Martens & Associates Pty Ltd may have relied upon and presumed accurate certain information (or absence thereof) relative to the site. Except as otherwise stated in the report, Martens & Associates Pty Ltd has not attempted to verify the accuracy of completeness of any such information (including for example survey data supplied by others).

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This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between Martens & Associates Pty Ltd and the Client. Martens & Associates Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

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			Document Location					
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1	Final	06.04.10	1P	1H	1P			

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All enquiries regarding this project are to be directed to the Project Manager.

Contents

1 Introduction and Overview

1.1 Background

The report provides supplementary information to support an amended water cycle management strategy for the Fern Bay seaside Village development (the 'development'), located some 8 km north of Newcastle. The development is currently undergoing assessment by the NSW Department of Planning (DoP) under Part 3A of the Environment Planning and Assessment Act 1979.

The amended water cycle management strategy documented in Martens & Associates Pty Ltd report number P0902479JR01V02 updated the original concept water cycle management strategy and sought to address numerous matters raised by the relevant stakeholders and DoP's review consultant. This report specifically responds to supplementary matters raised by NSW Department of Planing (DoP) in their letter dated 15th February, 2010.

1.2 Scope

This report provides supplementary information on the following key areas:

1. Stormwater quality management
2. Groundwater conditions
3. Stormwater drainage
4. Flood risk management

2 Stormwater Quality Management

2.1 Issues Raised

The following issues were raised by DoP in relation stormwater quality (MUSIC modelling):

1. Model Files
   MUSIC model files were requested for review and inspection of assumptions made with respect to bioretention systems.

   Action
   Files are provided as a part of this report for review.

2. Catchment Areas
   Catchment areas draining to infiltration basins were to be increased to include non-urban areas which contribute flows directly to infiltration basins.

   Action
   Updated MUSIC modelling is provided which includes these additional contributing areas and associated contributing flows.

3. Total Nitrogen Objectives Compliance
   MUSIC modelling should meet the stated water quality objectives for Total Nitrogen.

   Action
   Updated MUSIC modelling is provided which demonstrates compliance with objectives for Total Nitrogen.

2.2 Supplementary MUSIC Modelling

2.2.1 Adopted Performance Objectives

Water quality objectives for the sites stormwater management system as documented in the amended water cycle management strategy are reiterated below:

1. Objective 1: Pollutant Retention Targets
   To comply with the pollutant retention criteria specified by Port Stephens Council as documented in Table 1.

Table 1: Stormwater pollutant retention performance objectives for new urban developments (PSC, 2003).

Pollutant	Retention Criteria[1]
Coarse sediment	80% of average annual load for particles ≤ 0.5 mm
Fine particles	50% of average annual load for particles ≤ 0.1 mm
Total Phosphorus	45% of average annual pollutant load
Total Nitrogen	45% of average annual pollutant load
Litter / gross pollutants	70% of average annual litter load ≥ 5 mm
Hydrocarbons	90% of average annual pollutant load

1. For all flows up to and including 25% of the 1 in 1 year ARI peak flow for the development site.

2. Objective 2: Protection of the Groundwater System
   To ensure that the average concentration of pollutants (notably nutrients) in site stormwater discharges should not be greater than the existing average concentration of these pollutants in local groundwater thus ensuring that no adverse impacts on local surface and groundwater quality.

3. Objective 3: Non-reliance On End-of-Line Treatment Measures
   To ensure that all water quality treatment occurs upstream of proposed stormwater infiltration basins / areas which ensures that these areas are treated as 'receiving waters'.

2.2.2 Modelling Overview

All MUSIC model catchment areas were reviewed and updated to ensure that local drainage to infiltration basins were included in the amended model. Table 2 and Table 3 and provide amended MUSIC model sub-catchment land-use summaries for both existing and developed (untreated and treated) conditions.

MUSIC modelling layouts for existing and developed (with and without treatment) conditions are provided in Attachment A.

Table 2: Summary of MUSIC model catchments for existing conditions.

Catchment	Land-Use Category	MUSIC Node	Area (ha)	Pervious (%)	Impervious (%)
1 – Existing	Forest	Forest	10.18	100.0	0.0
2 – Existing	Forest	Forest	12.53	100.0	0.0
3 – Existing	Forest	Forest	21.14	100.0	0.0
4 – Existing	Forest	Forest	41.62	100.0	0.0
5 – Existing	Forest	Forest	34.42	100.0	0.0
6 – Existing	Forest	Forest	20.17	100.0	0.0

Table 3: Summary of MUSIC model catchments for developed conditions.

Catchment	Land-Use Category	MUSIC Node	Area (ha)	Pervious (%)	Impervious (%)
1 – Urban	Urban – Residential	Urban	3.763	71.3	28.7
1 – Roads	Urban – Roads	Urban	0.531	0.0	100.0
1 – Forest	Forest	Forest	5.886	100.0	0.0
2 – Urban	Urban – Residential	Urban	8.235	70.9	29.1
2 – Roads	Urban – Roads	Urban	1.027	0.0	100.0
2 – Forest	Forest	Forest	3.268	100.0	0.0
3 – Urban	Urban – Residential	Urban	17.079	63.5	36.5
3 – Roads	Urban – Roads	Urban	1.828	0.0	100.0
3 – Forest	Forest	Forest	2.233	100.0	0.0
4 – Urban	Urban – Residential	Urban	24.936	70	30
4 – Roads	Urban – Roads	Urban	1.630	0.0	100.0
4 – Forest	Forest	Forest	15.054	100.0	0.0
5 – Urban	Urban – Residential	Urban	15.411	71.4	28.6
5 – Roads	Urban – Roads	Urban	1.257	0.0	100.0
5 – Forest	Forest	Forest	17.752	100.0	0.0
6 – Urban	Urban – Residential	Urban	11.406	66.7	33.3
6 – Roads	Urban – Roads	Urban	1.123	0.0	100.0
6 – Forest	Forest	Forest	7.641	100.0	0.0

2.2.3 Music Model Results – Pollutant Loads

Modelling results for mean annual pollutant loads under each modelling scenario are provided in Table 4 which demonstrates that sediment, nutrient and litter reduction targets will be met. MUSIC is not capable of simulating hydrocarbon removal effectiveness. However, with the proposed stormwater treatment train, including bioretention swales and gross pollutant traps, together with low expected hydrocarbon production rates within the residential urban catchments, that reduction targets will be met.

Table 4: Average annual pollutant loads for existing and developed (untreated and treated) conditions.

Water Quality Parameter	Existing conditions (kg/year)	Post Development Untreated (kg/year)	Post Development Treated (kg/year)	Load Reduction (%)
TSS	21000	7800	8370	99.2
TP	14.5	139	8.88	93.7
TN	203	1270	147	88.4
Gross Pollutants	0	13700	0	100.0

2.2.4 *MUSIC Model Results – Discharge to Infiltration Basins*

Modelling results for mean daily pollutant concentrations discharging to each of the proposed site basins are provided in Table 5. These demonstrate that at each basin site, stormwater will be treated to a level such that it is equal to or better than existing mean groundwater conditions.

Table 5: Average daily pollutant concentrations for existing and developed (untreated and treated) conditions.

Basin ID	Water Quality Parameter	Mean Groundwater Conditions (mg/L)	Modelled Post Development Untreated (mg/L)	Modelled Post Development Treated (mg/L)
1	TSS	na	109.88	51.38
	TP	0.140	0.17	0.04
	TN	2.800	1.62	0.60
2	TSS	na	123.09	41.16
	TP	0.140	0.21	0.05
	TN	2.800	1.94	0.80
3	TSS	na	136.97	28.24
	TP	0.140	0.26	0.06
	TN	2.800	2.34	1.05
4	TSS	na	123.44	39.65
	TP	0.140	0.22	0.05
	TN	2.800	1.99	0.87
5	TSS	na	107.19	49.56
	TP	0.140	0.18	0.04
	TN	2.800	1.72	0.67
6	TSS	na	137.47	46.39
	TP	0.140	0.26	0.04
	TN	2.800	2.35	0.71

2.3 Summary

The following summary comments are provided:

1. The supplementary MUSIC modelling demonstrates that each of the stormwater quality performance objectives for the site are met.

2. The development will not have a net detrimental impact on receiving waters and does not rely on any treatment capacity of the proposed infiltration basins.

3 Groundwater Conditions

3.1 Issues Raised

The following issues were raised by DoP in relation groundwater:

1. Recharge Under Developed Conditions
   Concern was raised by Council and DoP's consultant (Cardno Lawson Treloar) that recharge rates adopted for the groundwater modelling may be under representative of those that may occur in the developed case. Amended groundwater modelling was requested to adopt recharge rates (for the developed conditions) that are benchmarked using information from the MUSIC model.

   Action
   Prepare MODFLOW model runs based on recharge rates (for the developed conditions) which are benchmarked using information from the MUSIC model. This will provide a sensitivity analysis of the data provided in the original amended water cycle management strategy report.

2. Infiltration Basin Buffers to Groundwater
   Clarification is requested in regard to the buffers between groundwater and infiltration basins. Where a 1 m buffer is not provided, justification is requested that there will not be any detrimental impacts on groundwater conditions.

   Action
   Review buffers at each infiltration basin for steady state and transient model runs. Review these buffers within the context of water quality being discharged to the infiltration basins.

3.2 Supplementary MODFLOW Modelling

3.2.1 Model Development Approach

The following scenarios were modelled as part of the amended water cycle management strategy:

Model 1 (M1): Existing Conditions (steady state)
Using past and the current site geotechnical data, a single layered steady state model was developed. The primary purpose of the model was to enable calibration of the various MODFLOW boundary

conditions in order that more detailed transient modelling could be undertaken.

Model 2 (M2): Existing Conditions (transient)
Using model M1 as the calibrated basis for transient modelling, model M2 was developed to determine existing time varying (ie. transient) aquifer behaviour. The transient simulation period was taken on the basis of historical rainfall data being 1950 – 2009 (60 years).

Model 3 (M3): Developed Conditions (steady state)
Model 3 was developed to examine the impact of the proposed development on steady state groundwater conditions. In particular, model M3 reduced recharge rates within the urban footprint and locally increased recharge rates (on the basis of bulk water balances) at each of the site sub-catchment discharge locations.

Model 4 (M4): Developed Conditions (transient)
Model 4 was developed to examine the impact of the proposed development on transient groundwater conditions with calibration being essentially similar to model M3. Simulation period was taken on the basis of historical rainfall data being 1950 – 2009 (60 years).

Model 5 (M5): Developed Conditions + Sea Level Rise (steady state)
Model M5 was identical to model M3 except that sea level boundary conditions at the Hunter River and the Pacific Ocean were increased to 1 mAHD to simulate potential sea level rise in the coming 100 years.

Model 6 (M6): Developed Conditions + Sea Level Rise (transient)
Model M6 was identical to model M5 except that transient conditions were modelled in order that basin invert levels under sea level rise conditions could be investigated. Simulation period was taken on the basis of historical rainfall data being 1950 – 2009 (60 years).

3.2.2 Groundwater Recharge under Developed Conditions

In developed condition models prepared for the amended water cycle management strategy, the approach taken for estimating recharge was as follows:

1. Over impervious areas, recharge was reduced to zero.

2. 50 % of water from impervious areas was allowed to recharge through the site swale system which is consistent with the expected behaviour of the swales and the sandy nature of local soils.

3. 50 % of water from impervious areas was taken to proportionally increase recharge at each of the site basins (eg. a 130 mm increase in catchment runoff depth for a catchment area of 5 ha directed to a basin with an area of 1 ha, resulted in an increased recharge at the basin of 650 mm).

As an alternative to the above approach, MUSIC discharge volumes were used to provide estimates of recharge increases at each basin site in model run M7 described as follows:

Model 7 (M7): Developed Conditions (steady state)
Model 7 was developed to examine the impact of the proposed development on steady state groundwater conditions. The model was constructed on a similar basis to model M3 construction. However, recharge at each basin site was increased by urban runoff inflow rates as estimated by MUSIC modelling (Table 6). Model M7 was used as the basis of a sensitivity analysis for previous recharge assumptions.

Table 6: Basin inflow rates and recharge rates based on MUSIC modelling.

Basin No.	Previously Adopted Recharge (mm/yr)	Inflow Rate Based on MUSIC Modeling (ML/year)	Modified Recharge Based on MUSIC Modeling (mm/yr)
1	436	18.1	887
2	439	12.9	608
3	2147	13.7	2015
4	441	62.3	851
5	438	57.1	1929
6	1120	26.3	3868

3.2.3 Modelling Results

Results of the modelling are provided in Figure 1 which shows drawdown plots (ie. difference between developed and existing conditions) under each recharge assumption. Figure 1a is the same as Figure 15 provided in the amended water cycle management strategy. Figure 1b shows drawdown (ie. difference between model M7 and M1) using the MUSIC model basin inflow volume estimates as benchmarks for groundwater recharge.

Comments are as follows:

1. Recharge rates at infiltration basins benchmarked against MUSIC model estimates are generally higher at basins than previously estimated in the amended water cycle management strategy.

2. Previous results indicated that water tables may fluctuate locally by say ± 2 cm in response to the urban footprint and increased recharge at the basins.

3. Using the MUSIC model to benchmark basin infiltration rates, results indicate that water tables may be raised in the order of 2-10 cm within the site and in the order of 2-4 cm at the site boundary in response to the urban footprint and increased recharge at the basins. We consider that this would be a 'worst case' estimate.

4. Modelling indicates that the site groundwater conditions are not particularly sensitive to recharge at the basins and that the level changes predicted by model M7 (being < 10 cm) are within the level of modelling accuracy and do not warrant further adjustment to the infiltration basin design levels previously nominated in the amended water cycle management strategy (which already conservatively accounts for sea level rise).

3.3 Basin Buffer Heights to Groundwater

Buffer heights between site storm water basin design invert levels (existing or proposed) and groundwater levels derived from various modeled developed conditions are outlined in Table 7.

Table 7: Summary of storm water basin buffer heights to modelled groundwater levels.

Basin No.	Basin Invert Level (mAHD)	Steady-state Groundwater Level (mAHD) / Buffer Height (m)	Steady-state Groundwater Level (mAHD) with 1 m Sea Level Rise / Buffer Height (m)	Maximum Transient Groundwater Level (mAHD) with 1 m Sea Level Rise / Buffer Height (m)
1	1.35	1.55 / -0.20	1.82 / -0.47	1.83 / -0.48
2	1.35	1.50 / -0.15	1.81 / -0.46	1.87 / -0.52
3	2.30	1.68 / 0.62	2.22 / 0.08	2.53 / -0.23
4	1.35	1.18 / 0.17	1.78 / -0.43	1.81 / -0.46
5	2.50	1.71 / 0.79	2.15 / 0.35	2.43 / 0.07
6	2.50	1.60 / 0.90	2.22 / 0.28	2.58 / -0.08

Comments are as follows:

1. Under existing steady state (ie. average) conditions, buffers in the order of 0.17 to 0.90 m are maintained at basins 3-6. No buffers are provided at basins 1 and 2 where groundwater is already exposed

at the surface.

2. With 1 m sea level rise and for steady state conditions, the above buffers are further reduced to < 0.35 m at basins 3, 5 and 6. No buffers are available at basins 1, 2 and 4.

3. Under peak transient conditions with 1 m sea level rise, only basin 5 retains a minor buffer to groundwater.

On the basis of the above, it is clear that a 1 m buffer to groundwater is presently not available at the basin sites. Where buffers presently exist, these will be either diminished or removed under a 1 m seal level rise condition. However, we do not see this as a limitation to the development. Inflows to each of the basin sites will be fully treated by the internal bioretention swale system and GPTs prior to discharge at the basin sites. Basin inflow nutrient concentrations will be considerably lower than existing groundwater conditions as demonstrated in Table 5.

3.4 Summary

The following summary comments are provided:

1. A sensitivity analysis has been completed on the assumed developed condition groundwater recharge rates. Using MUSIC model estimates for basin inflow to benchmark recharge rates, predicted groundwater level changes are < 10 cm within the site and < 4 cm at the site boundary. These changes are within the expected level of modelling accuracy.

   Results do not warrant further adjustment to the infiltration basin design levels previously nominated in the amended water cycle management strategy (which already conservatively accounts for sea level rise. Supplementary groundwater modelling (model M7) indicates that the site groundwater conditions are not particularly sensitive to recharge at the basins.

2. A 1 m buffer to groundwater is presently not available at the basin sites. Where buffers presently exist, these will be either diminished or removed under a 1 m seal level rise condition. However, we do not see this as a limitation to the development. Inflows to each of the basin sites will be fully treated by the internal bioretention swale system and GPTs prior to discharge at the basin sites. Basin inflow nutrient concentrations will be considerably lower than existing groundwater conditions as demonstrated in Table 5.

4 Stormwater Drainage

4.1 Issues Raised

The following issues were raised by DoP in relation stormwater quality (MUSIC modelling):

1. Drainage System Design
   Clarify whether any traditional stormwater pits and pipes will be provided in the proposed drainage system.

   Action
   There will be a need for some traditional stormwater pipes and culverts where swales pass under roads. These have been broadly identified on the attached concept site drainage plan (shown as solid lines). No further action required.

2. Swale Network
   Clarify if the correct description for the site drainage system is a network of bioretention swales which have both a bioretention and flood conveyance component.

   Action
   Generally the site drainage system consists of a network of bioretention drainage swales with some interconnected pipes to enable flows to pass under roads. Three standard swales sizes are proposed which have been sized and located in order that they can safely accommodate the 1 in 100 year ARI flow event. Location of each swale type has been identified on the attached concept site drainage plan. No further action required.

3. Treatment Train Schematic
   Provide a treatment train schematic for each infiltration basin.

   Action
   Treatment train schematics are provided in Figure 2 as appended to this document. No further action required.

4. Altered Lot Sizes
   Provide clarification whether that the Martens report considers the amended lot size arrangements presented in the Daly Smith plans.

   Action
   As a part of preparing this response document, we have contacted Daly Smith surveyors and obtained the most recent site

development layout. Some very minor difference in layout were noted. Our modelling has been reviewed and amended as required with a summary of results provided in this report.

5. Modelling Sensitivity Analysis
   A DRAINS modelling sensitivity analysis has been requested with a changed soil type, AMC-3 and a lowered storage depression assumption (10 mm). Clarify whether this sensitivity analysis warrants a change in the proposed stormwater drainage scheme design.

   Action
   Undertake the sensitivity analysis as a part of the supplementary modelling provided in this report.

6. Basin Recovery Rate
   Clarify the likely recovery rate of basin water levels following a 100 year ARI storm event. If basin recovery times are more than a few days, then a sensitivity analysis of the 'embedded storm approach' should be undertaken.

   Action
   Undertake the recovery analysis as a part of the supplementary modelling provided in this report.

4.2 Supplementary DRAINS Modelling

4.2.1 Modelling Overview

A sensitivity analysis was undertaken to determine basin peak water levels and recovery rates under a range of scenarios including a changed soil type, antecedent moisture conditions (AMC) and depression storage assumptions. Modelling scenarios are described in Table 8 noting that Scenario 1 was that used in the amended water cycle management strategy.

Table 8: Parameters used in each scenario modelling

Parameters	Scenario 1	Scenario 2	Scenario 3
Soil Type	1	1	2
Antecedent Moisture Condition (AMC)	1	3	3
Depression Storage (mm)	20	10	10

In relation to the above simulation scenario parameters, we note the following:

1. Soil Type 1 represents sands and gravels (as occur at the site) with high infiltration potential and low runoff potential. Soil Type 2 represents soils with moderate infiltration rates.

2. AMC condition 1 represents dry soils which are likely to occur at the site at most times, with soils 'drying out' very rapidly after a rainfall event (within hours) due to the high sand content. AMC 3 represents wet soils. These are very unlikely to occur at the site, particularly given the site is elevated above maximum groundwater levels.

3. Depression storage was reduced from 20 mm taken in the original modelling to 10 mm in the two sensitivity analysis model runs (2 and 3).

4. For each scenario, the 1 % AEP storm event was simulated through a range of durations ranging from 5 minutes to 72 hours. In total, 21 storms were simulated for each DRAINS modelling scenario.

5. For all model runs, rainfall intensity was increased by 20 % to account for the possible impacts of climate change. All model runs also included a basin bottom water level (BWL) as set by the MODFLOW predicted groundwater level with 1 m sea level rise.

4.2.2 DRAINS Model Results

Peak Water Levels

Results of the peak water level analysis are provided in Figure 3 through to Figure 8 and summarised in Table 9.

Table 9: Summary of peak basin water levels for each DRAINS modelling scenario.

Basin ID	DRAINS Model Scenario 1		DRAINS Model Scenario 2		DRAINS Model Scenario 3	
	Peak Water Level (mAHD)	Critical Duration (hr)	Peak Water Level (mAHD)	Critical Duration (hr)	Peak Water Level1 (mAHD)	Critical Duration (hr)
1	1.80	NA	1.82	1.0	1.83	2.0
2	2.05	1.0	2.27	1.5	2.36	2.0
3	3.19	3.0	3.54	2.0	3.87	3.0
4	1.81	1.5	1.89	1.5	1.93	1.5
5	2.76	1.0 & 1.5	2.97	1.5	3.06	1.5
6	3.12	3.0	3.34	1.5	3.37	4.8

Comments are as follows:

1. Scenarios 2 and 3 increased peak basin water levels at each basin site.

2. It is our view that using Soil Type 2 is unrealistic given that the sites soils are characterised as highly friable and permeable dune sands. This is consistent with Soil Type 1.

3. Whilst we maintain that in terms of antecedent moisture conditions, soils will be generally dry due to the inherently high permeability of dune sands, we accept that use of this condition delivers an additional level of design security.

4. Decreasing the depression storage to 10 mm as requested delivers an additional level of design security.

5. On the basis of the above, Scenario 2 is recommended for site drainage design purposes in that it caters realistically for site soils, but also offers additional design security by relying on lower depression storage and significantly higher antecedent soil moisture conditions than are likely to occur on the site.

Basin Recovery Times

Results of the basin recovery time analysis are also provided in Figure 3 through to Figure 8 and summarised in Table 10.

Table 10: Summary of longest recovery times of each scenario modelling

Basin ID	DRAINS Model Scenario 1		DRAINS Model Scenario 2		DRAINS Model Scenario 3	
	Maximum Recovery Time (hrs)	Critical Duration (hr)	Maximum Recovery Time (hrs)	Critical Duration (hr)	Maximum Recovery Time (hrs)	Critical Duration (hr)
1	0.0	NA	0.4	1	0.7	2
2	0.6	2	2.4	12	2.4	12
3	5.4	24	3.2	24	9.2	24
4	0.2	1	1.1	3	1.5	4.5
5	0.8	3	2.0	3	4.1	12
6	5.2	24	6.0	24	9.4	24

Comments are as follows:

1. Maximum recovery times for all DRAINS modelling scenarios are < 12 hours. In the case of scenarios 1 and 2 (adopted for design), recovery is ≤ 6 hours.

2. On the basis of these results, a sensitivity analysis of the 'embedded storm approach' is not required.

4.3 Drainage Scheme Design Amendments

On the basis of the supplementary modelling and drainage basin sensitivity analysis, basin design specifications have been slightly modified as summarised in Table 11. We note that drainage Basin 3 will need to be increased slightly in area in order that level changes can be minimised.

The attached concept site drainage plan shows the amended Basin 3 area, together with preliminary swale inverts at various locations within the development site. We note that these levels are very similar to those previously issued, although there have been some minor adjustments in the sub-catchments to Basins 3 and 6 to accommodate the slightly higher modelled top water levels (TWL).

Further we note that the existing constructed drainage system to the west of Basin 3 (Stage 3b) will not be compromised by the minor increase in Basin 3 TWL. We understand that the proposed 4WD access road through to National Parks and Wildlife Lands along the southern portion of Basin 3 maintains a minimum elevation of 3.6 mAHD. This design level will still be adequate to ensure that the road is trafficable during the 1 in 100 year basin level with the impacts of climate change included.

Table 11: Design basin water levels and inverts.

Basin ID	Base Area (m^2)	IWL	BWL	TWL
1	27880	1.35	1.80	1.82 (+0.02m)
2	10970	1.35	2.00	2.27 (+0.22m)
3	8100 (+1100 m^2)	2.30	2.50	3.54 (+0.21m)
4	52870	1.35	1.80	1.89 (+0.08m)
5	15050	2.50	2.70	2.97 (+0.21m)
6	4500	2.50	2.50	3.34 (+0.22m)

IWL = Design basin invert level or existing mean ponded water level.
BWL = Assumed level at high groundwater condition with 1 m sea level rise.
TWL = Peak water level during 1% AEP critical storm event under Scenario 2 modelling.

4.4 Summary

The following summary comments are provided:

1. Generally the site drainage system consists of a network of bioretention drainage swales with some interconnected pipes to enable flows to pass under roads. Three standard swales sizes are proposed which have been sized and located in order that they can safely accommodate the 1 in 100 year ARI flow event. Location of each swale type has been identified on the attached concept site drainage plan.

2. A sensitivity analysis has been conducted for the DRAINS modelling undertaken at the site. Scenario 2 has been adopted for design purposes.

3. As a result of the sensitivity analysis, some minor modifications to basin top water level (TWL) and site swale invert levels are proposed. The area of Basin 3 will also require a minor increase to minimise any potential water level variations. There is sufficient space available within the development site to accommodate the amended Basin 3 layout.

4. No level changes to the proposed 4WD access track (minimum track level of 3.6 mAHD proposed) through to National Parks and Wildlife lands along the southern portion of Basin 3 are required as a result of the drainage sensitivity analysis.

5 Flood Risk Management

5.1 Issues Raised

The following issues were raised by DoP in relation flood risk management:

1. Most Recent Flood Levels
   The site flood assessment should be re-evaluated on the basis of newer information available including updated flooding reports prepared by Newcastle City Council (DHI, 2008 and DMT WBM 2009 and 2009a). Prepare an emergency management plan in light of information relating to the probable maximum flood (PMF) level.

   Action
   Undertake a review of the most recent flood reports available for the area and provide a description of expected flood conditions at the site / development. Prepare an emergency management plan in light of information relating to the PMF level.

2. Flood Mapping
   Areas of inundation from the 1% AEP event under a 0.9 m sea level rise and a catchment rainfall intensity increase of 20 % and the PMF.

   Action
   Prepare the necessary flood maps together with a flood hazard assessment. Document minimum habitable floor levels and advise on emergency response approaches to be adopted.

3. Internal Drainage System
   Clarify how the proposed drainage system will manage local overland flooding and confirm whether the drainage system within the development meets the conveyance requirements for the 100 year ARI event.

   Action
   This matter has been dealt with under Section 4.1. No further action is required.

5.2 Relevant Documentation

The following flood studies were used to assist with the preparation of this report:

1. BMT WBM (July 2009) *Newcastle Flood Planning Stage 1: Concept Planning, Final*

2. BMT WBM (July 2009) *Newcastle Flood Planning Stage 1: Concept Planning – Compendium and Figures, Final*

3. DHI (September 2008) *Upgrading of Lower Hunter Flood Model at Hexham, Final Report Phase 4*

5.3 Flood Behaviour

5.3.1 Flooding Types

Flooding at Fullerton Cover can occur as a consequence of one or more of the following flood types:

1. Flash Flooding – as a result of intense rainfall with the local catchments.

2. River Flooding – as a result of backwater inundation from the adjacent Hunter River

3. Sea Level Flooding – As a result of high ocean tides, storm surge etc (eg. King tides + sea level rise).

For the purposes of this study, only types 2 and 3 are considered relevant in terms of flood risk management / planning.

5.3.2 Flood Levels

River flood levels for the site are taken from the DHI (July 2008) flood study. Nearest reported observation to the site is Fullerton Cover. Levels for the 100 year event with 0.85 m sea level rise and a 20 % increase in catchment runoff / rainfall intensity, and the PMF are provided in Table 12.

Table 12: Flood levels at Fullerton Cove based on 0.85 m sea level rise and 20 % rainfall intensity increase (DHI, 2008)

1 in 100 year ARI (mAHD)	PMF (mAHD)
2.14	4.45

Further to the above, BMT WBM (2009) have adopted a 1 in 100 year ARI sea level flood with 0.9 m sea level rise at 2.3 mAHD. This event is higher than the 1 in 100 year river flood event and is adopted for design purposes (ie. adopted as the design 1 in 100 year event).

5.3.3 Flood Classification

The site is classified as flood fringe for both the river and sea level flooding under both the 1 % AEP and PMF events.

5.3.4 Flood Extents

Flood extents for the design 1 in 100 year ARI and the PMF events are plotted in the plans provided as part of Attachment A. The following observations are made:

1. Residential areas are not affected by the design 1 in 100 year ARI event including the effects of 0.9 m sea level rise and a 20 % increase in rainfall intensity.

2. On the basis of current site levels, numerous lots would be affected by the PMF, depending on final site levels.

5.3.5 Flood Behaviour

There is limited information available in relation to the behaviour of flood in the local area / at the development site. The following comments are provided:

1. During the design 1 in 100 year ARI event, site flooding occurs through backup of water via the sites internal drainage system. Nelson Bay Road is not overtopped.

2. Site flooding would be gradual as waters backup through the drainage system. Near zero flow velocity would be expected on the site, with design 1 in 100 year ARI event being represented on the site as 'pools' of water.

3. The behaviour of the 1 in 100 year ARI event sea level flood event is expected to be similar to that for 1 in 100 year ARI river flood event.

4. In the PMF event, flowing flood waters would pass over Nelson Bay Road and enter the site. However, it is worth noting that a range of sand dune features will be retained between the development site and Nelson Bay Road. These will provide a significant barrier to the passage of flood waters onto the site.

   On this basis, it is expected that the PMF event will behave in a similar fashion to the 1 in 100 year ARI event, with minimal fast flowing water during the flood event. Localised higher velocities would be expected between dune systems as waters rise or fall.

5.3.6 *Flood Warning Times*

The Hunter River has a catchment area of some 22,000 km^2, with many separate sub-catchments including the Williams River, Paterson River, Wollombi Brook and the Goulburn River.

Being at the very downstream end of the river system, the site is afforded significant warning time for any floods moving down the catchment. We would expect warning times of > 6 hours based on the Bureau of Meteorology's flood forecasting capabilities.

5.3.7 *Flood Hazard Classification*

A preliminary hydraulic hazard assessment is provided in Attachment A for the design 1 in 100 year ARI event. Hydraulic hazard is generally low in accordance with the NSW Floodplain Development Manual (2005, see Figure 8) due to very low (near zero) expected flood velocities. High hazard areas typically conform with deeper flood waters.

Using the hydraulic behaviour thresholds for Newcastle LGA as documented in BMT WMA (2009), classifications for flood liable land would be generally as follows:

Table 13: Hydraulic behaviour thresholds for flood affected areas in accordance with Newcastle LGA.

Event	Hazard	Comment
Design 1 in 100 year ARI	Generally H2	Hydraulically suitable for parked or moving heavy vehicles only, and for wading by able-bodied adults
PMF	Generally H3	Hydraulically suitable for light construction (eg. timber frame and brick veneer), but not for vehicles or for wading.

5.4 Flood Risk Management Measures

5.4.1 *Overview*

The NSW Floodplain Development Manual (2005) seeks to manage the following key flood risk elements:

1. Risks to life for the full range of floods up to the PMF.

2. Risk to property up to the relevant flood planning level (1% AEP + 0.5 m).

3. Risks to personal and societal wellbeing, including economic, social and environmental values.

5.4.2 Flood Planning Level (FPL)

The flood planning level (FPL) to be used for setting finished floor levels is taken as 2.8 mAHD. This is 1 in 100 year ARI sea level flooding level with 0.9 m sea level rise + 0.5 m freeboard. This level is 0.16 m higher than a FPL based on river flooding only.

5.4.3 Access

We make the following comments / recommendations in relation to site access:

1. Levels on Nelson Bay Road adjacent to the site vary between approximately 2.4 and 2.8 mAHD. On this basis, Nelson Bay Road is not likely to be inundated by the design 1 in 100 year ARI river flood or sea level flood event.

2. Existing site internal roads are at levels > 2.4 mAHD. On this basis, existing internal roads are not likely to be inundated by the 1 % AEP river flood or sea level flooding event.

3. We recommend that all new internal roads be constructed at a level of 2.6 mAHD or higher, which is 300 mm higher than the 1 % AEP sea level flooding level.

4. During a PMF event, site access to Nelson Bay Road will be prevented. Flood modelling undertaken to date does not provide information for what period of time access is likely to be unavailable during a PMF event. However, on the basis of historical flood data available near the site, access may be prevented in the order of 12-24 hours.

5.4.4 Drainage System Performance

The following comments are provided in relation to the sites internal drainage system:

1. Preliminary swale inverts (see Attachment A) are above the design 1 in 100 year ARI flood level of 2.3 m AHD and it is not expected that flooding will impact on the operation of the internal drainage system.

2. Basins 3, 5 and 6 maintain design BWL's which are set above the design 1 in 100 year ARI flood level of 2.3 m AHD. Flooding will not affect the performance of these basins should a 1 in 100 year ARI flood coincide with a local 100 year rainfall event (which is unlikely).

3. Basins 1, 2 and 4 maintain BWL's which are set slightly below the design 1 in 100 year ARI flood level of 2.3 m AHD. Specific

comments for each basin are provided below:

a. Basin 1 – This basin does not show any significant change in water level in response to site inflows (+ 2 cm). Temporary elevation of the basin BWL to 2.3 mAHD during a 1 in 100 year ARI flood event would not affect the basin's performance or impact on local drainage to the basin.

b. Basin 2 – This basin does shows a 27cm water level response to site inflows. Temporary elevation of the basin BWL to 2.3 mAHD during a 1 in 100 year ARI flood event would bring the design TWL to 2.57 mAHD. This would not affect the performance of the basin, but would locally submerge the nearest bioretention swale for approximately 10-20 m. This is not considered significant.

c. Basin 4 - This basin does not show any significant change in water level in response to site inflows (+ 9 cm). Temporary elevation of the basin BWL to 2.3 mAHD during a 1 in 100 year ARI flood event would not affect the basin's performance or impact on local drainage to the basin.

5.4.5 Specific Risk Management Measures

We recommend the following specific flood risk management measures:

1. Floor Levels
   All finished floor levels should be a minimum of 2.8 mAHD.

2. Evacuation
   Evacuation during a during a 1 in 100 year ARI flood event is not necessary. Evacuation for other less frequent events up to and including the PMF will may only be required from a small number of dwellings located in the western portion of the site.

3. Final Landform Levels
   We recommend that where possible, final earthworks levels should be set such that the risk of PMF incursion into the development site is minimised or removed.

4. Flood Evacuation Plan (FEP)
   As part of emergency risk management, a Flood Evacuation Plan (FEP) should be developed for the site to guide the management of a flood induced evacuation. This plan should be made available to all existing and new residents.

The main objectives of a Flood Evacuation Plan should be to:

a) Protect residences from the potential dangers arising from flooding.

b) Ensure a planned and co-ordinated approach is taken to evacuation.

c) Identify evacuation routes and evacuation centre locations.

d) Link flood warning, response, evacuation and recovery processes.

5. Flood Proofing
Flood proofing provides a combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages. We recommend that all buildings / structures which are likely to be affected by the design 1 in 100 year ARI flood event be constructed using flood proofing methods.

6. Temporary Flood Recovery Centre (FRC)
We recommended that there should be a temporary flood recovery centre established within the site (which could be located at or near the current site office for example) and ensure the following:

a) Location of the FRC shall be documented in the FEP.

b) An undercover area of sufficient space to accommodate evacuated people until such time as all evacuated persons may be accounted for. This may include the use of tents for emergency cover.

c) In the event of the closure of Seaside Boulevard, there is sufficient space to temporarily accommodate affected persons who are unable to access their place of residence.

d) Provide equipment to ensure that sufficient resources are available to minimise the disturbance arising from the evacuation.

7. Flood Awareness and Readiness
Having a high level of flood awareness and readiness means less damage and disruption and less chance of injury during and after a flood event. Flood awareness is increased by providing warning signs explaining the potential implications and dangers of a flood situation.

A flood awareness program for the development involves informing residents about flooding, including how it affects the site, where the floodwaters flow through the site, what to do before, during and after a flood event at the site, and where to get further information. We recommend that the flood awareness program be incorporated as part of the FEP and include the following:

a) *Flood Warning Signs*
The location and scope of such signs shall be initially determined at the development of the FEP.

b) *Flood information flyers / information sheets*
Flood information flyers should be produced and distributed to the community on an annual basis and to any new residents as part of the FEP. This shall include relevant information for site flood conditions including:

- Any updates to the FEP
- Description of flood warning signs
- At what stage the area might be inundated
- Identification of meeting places
- Evacuation routes that would apply to them
- Identification of area(s) for evacuation

c) *Community Involvement*
The community as a whole should be involved in the formulation and implementation of the FEP and preparation of flood information flyers. The FEP and flood information flyers should be updated on a 5 yearly basis under the direction of the community association.

All amendments should be exhibited for a period of 3 months and public comment should be sought and taken into account before it is finalised and adopted. At the completion of a revised FEP and new flood information flyers, these shall be distributed to the community.

6 References

Martens & Associates (December 2009) *Amended Stormwater Management Strategy, Fern Bay Seaside Village, NSW* (report reference P0902479JR01V02)

BMT WBM (July 2009), *Newcastle Flood Planning Stage 1: Concept Planning, Final*

BMT WBM (July 2009) *Newcastle Flood Planning Stage 1: Concept Planning – Compendium and Figures, Final*

Cardno Lawson Treloar (2009), Fern Bay Seaside Village Environmental Assessment, Water Resources and Coastal Management Review.

DHI (2009), *Upgrading of Lower Hunter Flood Model at Hexham, Final Report Phase 4*

NSW Government Department of Infrastructure, Planning and Natural Resources (2005), *Floodplain Development Manual: the management of flood liable land*

Port Stephens Council (PSC, 2003) *Urban Stormwater and Rural Water Quality Management Plan*

7 Attachment A – Plans

KEY:

- TYPE 1 GRASS SWALE (FLOW <0.2m3/s) (APPROXIMATE LOCATION ONLY)
- TYPE 2 GRASS SWALE (FLOW 0.2-0.8m3/s) (APPROXIMATE LOCATION ONLY)
- TYPE 3 GRASS SWALE (FLOW >0.8m3/s) (APPROXIMATE LOCATION ONLY)
- PIPE SECTION
- PROPOSED ON-SITE STORMWATER DETENTION (OSD)
- DESIGN LEVELS
- GRASS SWALE (STAGE 3B)
- PIPE (STAGE 3B)
- EXISTING LEVEL (STAGE 3B)

CONVEYANCE SWALE
WITH REVEGETATED BATTER

EXISTING BASIN 4
IWL = RL 1.35
BWL = RL 1.80
TWL = RL 1.89

EXISTING BASIN 5
IWL = RL 2.50
BWL = RL 2.70
TWL = RL 2.97

CONVEYANCE SWALE
WITH REVEGETATED BATTER

PROPOSED BASIN 2
IWL = RL 1.35
BWL = RL 2.00
TWL = RL 2.27

EXISTING BASIN 1
IWL = RL 1.35
BWL = RL 1.80
TWL = RL 1.82

PROPOSED BASIN 3
IWL = RL 2.30
BWL = RL 2.50
TWL = RL 3.54

PROPOSED BASIN 6
IWL = RL 2.50
BWL = RL 2.50
TWL = RL 3.34

PAGE BAR SCALE
0 60 120 180 240 300
UNITS - METRES
SCALE - 1:3000 @ A1 1:6000 @ A3

NOTE:
IWL = DESIGN BASIN INVERT LEVEL OR EXISTING MEAN PONDED WATER LEVEL
BWL = ASSUMED LEVEL AT HIGH GROUNDWATER CONDITION WITH 1M SEALEVEL RISE
TWL = PEAK WATER LEVEL DURING CRITICAL STORM EVENT ABOVE GROUND WATER LEVEL BASED ON SCENARIO 2 MODELLING - SOIL TYPE=1M, AMC=3, DEPRESSION STORAGE=10mm
(ALSO WITH 1M SEA LEVEL RISE AND CLIMATE CHANGE EFFECT (20% RAINFALL INTENSITY INCREASE)

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CLIENT/ PROJECT
ASPEN GROUP
FERN BAY SEASIDE VILLAGE

TITLE
CONCEPT SITE DRAINAGE PLAN - PROPOSED SWALES AND BASINS

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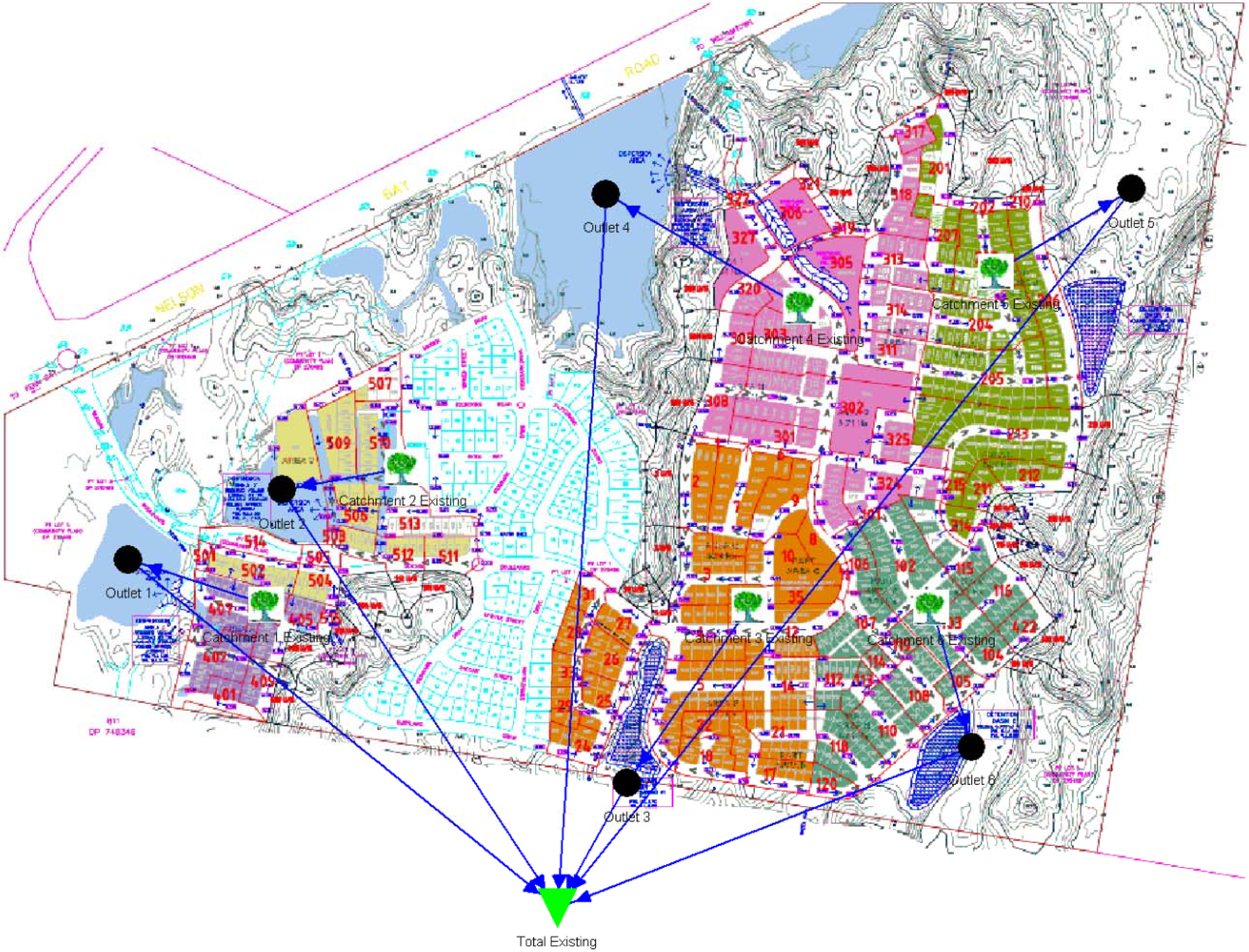
All measurements in mm unless otherwise specified.

PROJECT MANAGER: DMM

DRAWING NUMBER: P0902479JD01_V5

DESIGNED: SL	DATUM: mAHD	SHEET 1 OF 4 SHEETS
DRAWN: SL	HORIZONTAL RATIO: 1:3000 @ A1 1:6000 @ A3	
REVIEWED: DMM	VERTICAL RATIO: 1:3000@ A1 1:6000 @ A3	PAPER SIZE: A1 / A3

REV.	DESCRIPTION	DATE	ISSUED
5	ATTACHMENT A	24.12.2009	SL



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TITLE
MUSIC MODEL SCHEMATIC - EXISTING CONDITIONS

PROJECT MANAGER: DMM

DRAWING NUMBER: P0902479JD01_V5

DESIGNED:	SL
DRAWN:	SL
REVIEWED:	DMM
DATUM:	mAHD
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VERTICAL RATIO:	NA
SHEET	2 OF 4 SHEETS
PAPER SIZE:	A1 / A3

REV.	DESCRIPTION	DATE	ISSUED
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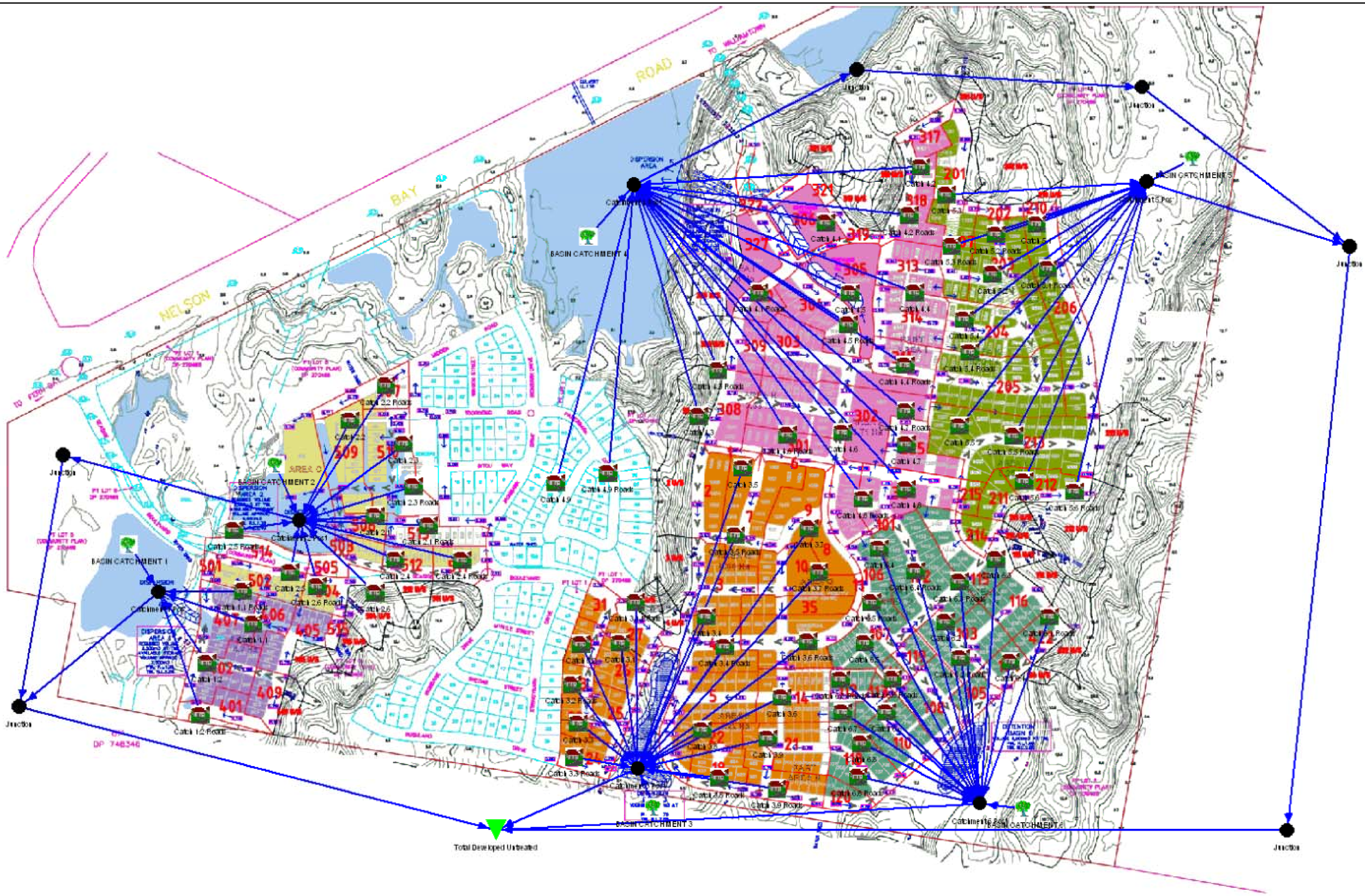

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All measurements in mm unless otherwise specified.

TITLE
MUSIC MODEL SCHEMATIC - PROPOSED CONDITIONS NO TREATMENT

PROJECT MANAGER: DMM
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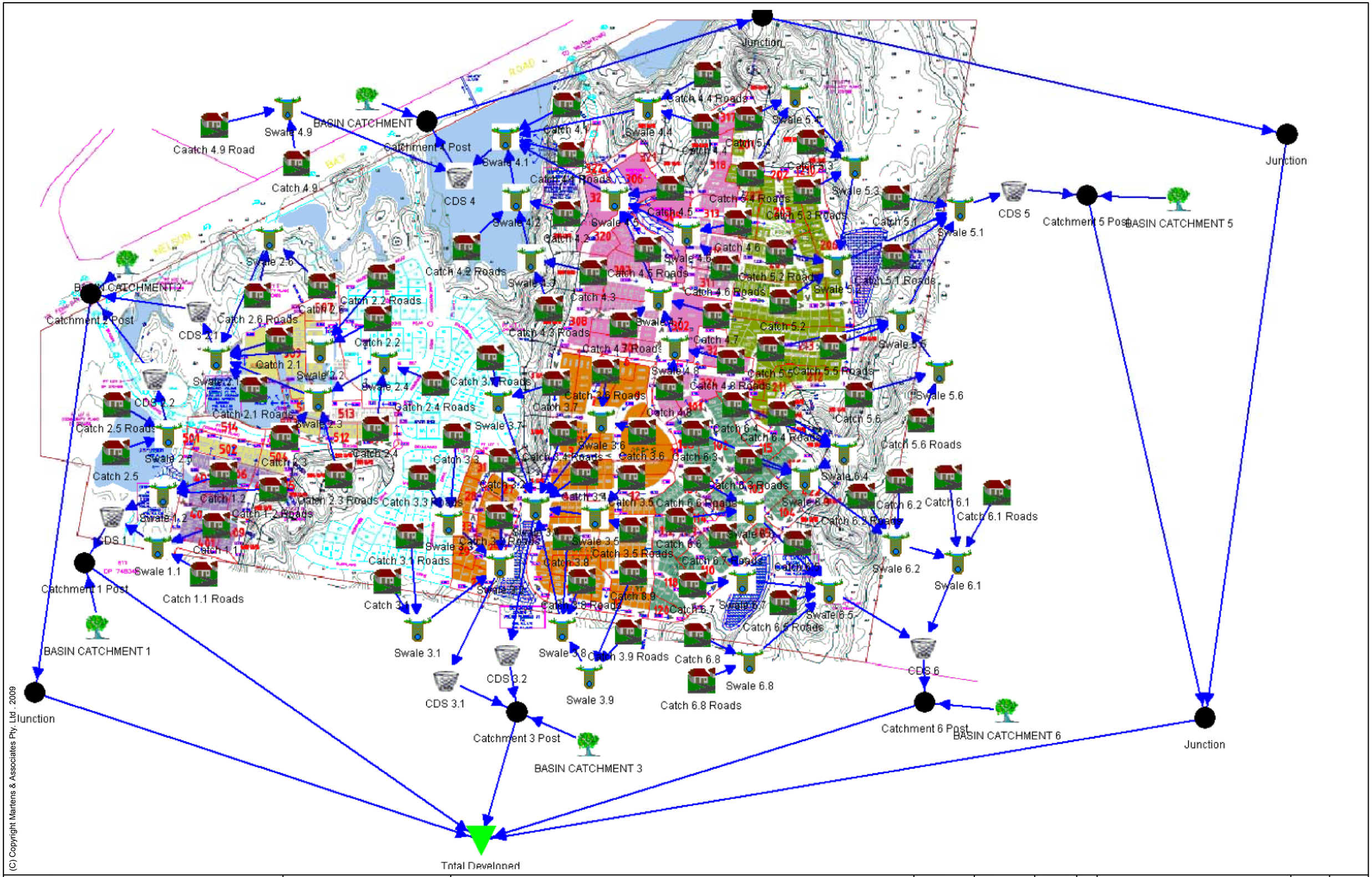
5	ATTACHMENT A	23.03.2010	SL



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All measurements in mm unless otherwise specified.

TITLE
MUSIC MODEL SCHEMATIC - PROPOSED CONDITIONS WITH TREATMENT

PROJECT MANAGER: DMM

DRAWING NUMBER: P0902479JD01_V5

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REVIEWED:	VERTICAL RATIO:	PAPER SIZE:
DMM	NA	A1 / A3

REV.	DESCRIPTION	DATE	ISSUED
1	ATTACHMENT A	23.03.2010	SL

1% SEA LEVEL FLOOD (2.3 MAHD)

PMF (4.54 MAHD)

N
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0 100 200 300 400 500

UNITS - METRES

Martens & Associates Pty Ltd ABN 85 070 240 890		Environment | Water | Wastewater | Geotechnical | Civil | Management	
Drawn:	FC	FLOOD EXTENTS	Drawing No.: P0902479 JD07V01_S1
Approved:	DMM		
Date:	30.03.2010		
Scale @A3:	1:10000	6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au	Job No.: P0902179JD07V01

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	FLOOD WATER DEPTH (M)	
	FROM	TO
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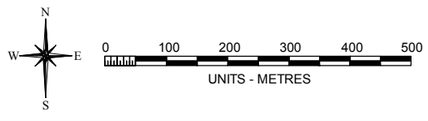
	1.0	2.0



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Approved:	DMM		
Date:	30.03.2010		
Scale @A3:	1:10000	6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au	Job No.: P0902179JD07V01

	HYDRAULIC HAZARD LEVEL
	LOW
	HIGH

N
W E
S

0 100 200 300 400 500
UNITS - METRES

Martens & Associates Pty Ltd ABN 85 070 240 890		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	FC	**PRELIMINARY HYDRAULIC HAZARD BASED ON 1% SEA LEVEL FLOOD EVENT + 0.9M SEA LEVEL RISE**	Drawing No.: **P0902479 JD07V01_S3**
Approved:	DMM		
Date:	30.03.2010		
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8 Attachment B – Figures

(b) Drawdown between existing (model M1) and developed (model M3) conditions using basin recharge assumptions as per amended water cycle management strategy.

(c) Drawdown between existing (model M1) and developed (model M7) conditions using basin recharge benchmarked using MUSIC modelling inflow volume estimates.

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Martens & Associates Pty Ltd ABN 85 070 240 890		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	DMM	**DRAWDOWN PLOTS BETWEEN DEVELOPED EXISTING CONDITIONS**	Drawing No: **FIGURE 1**
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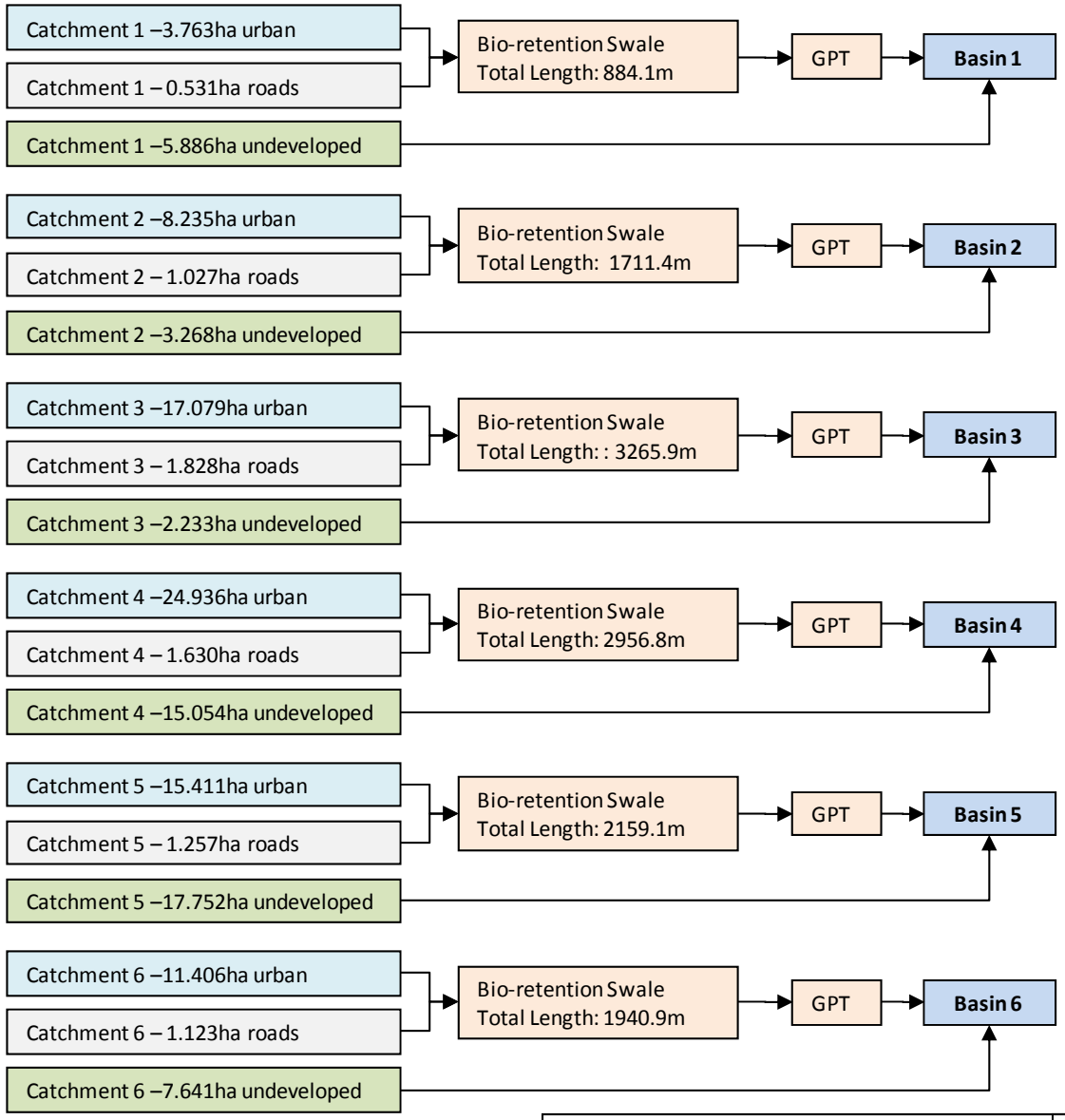

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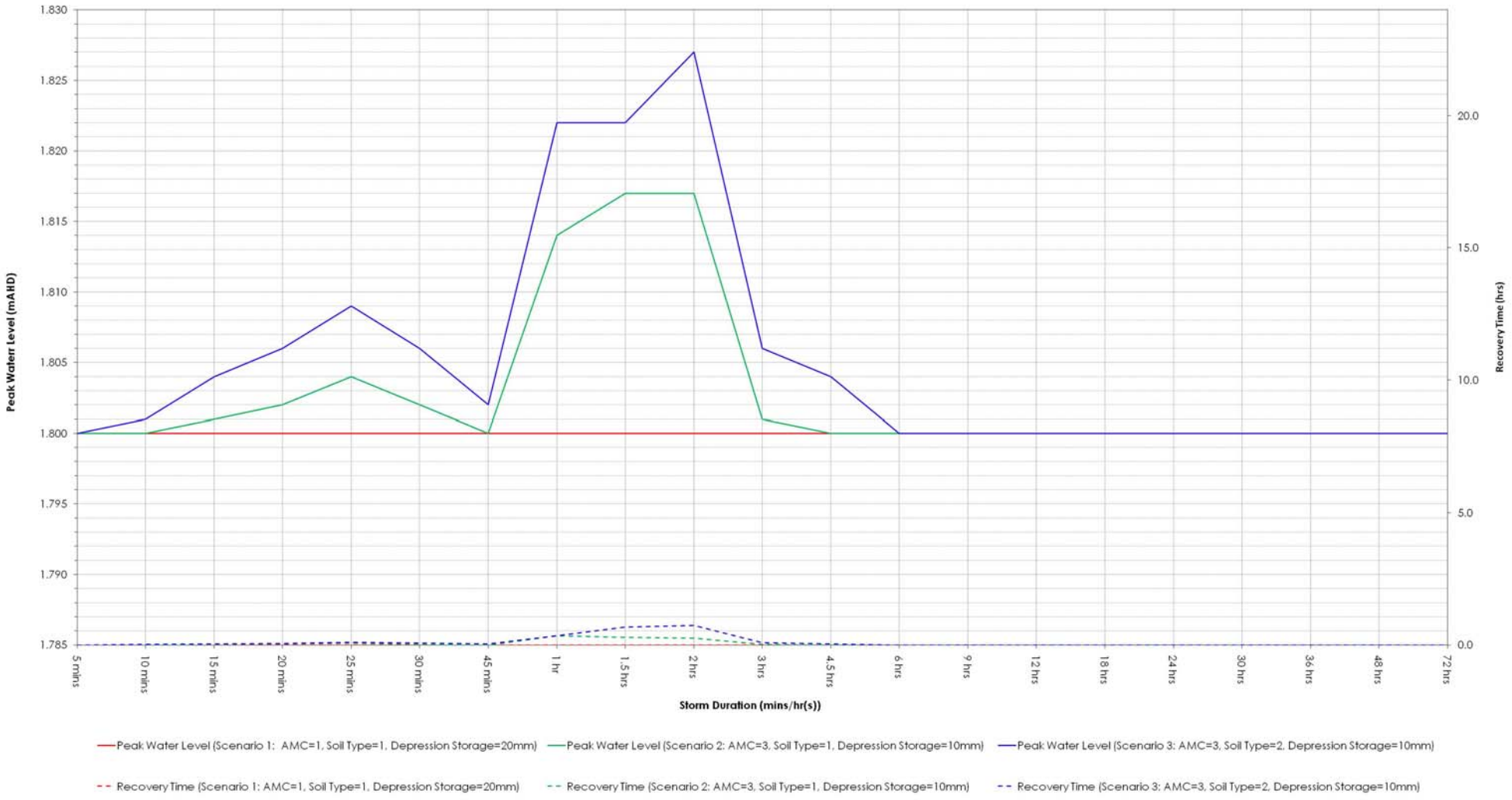

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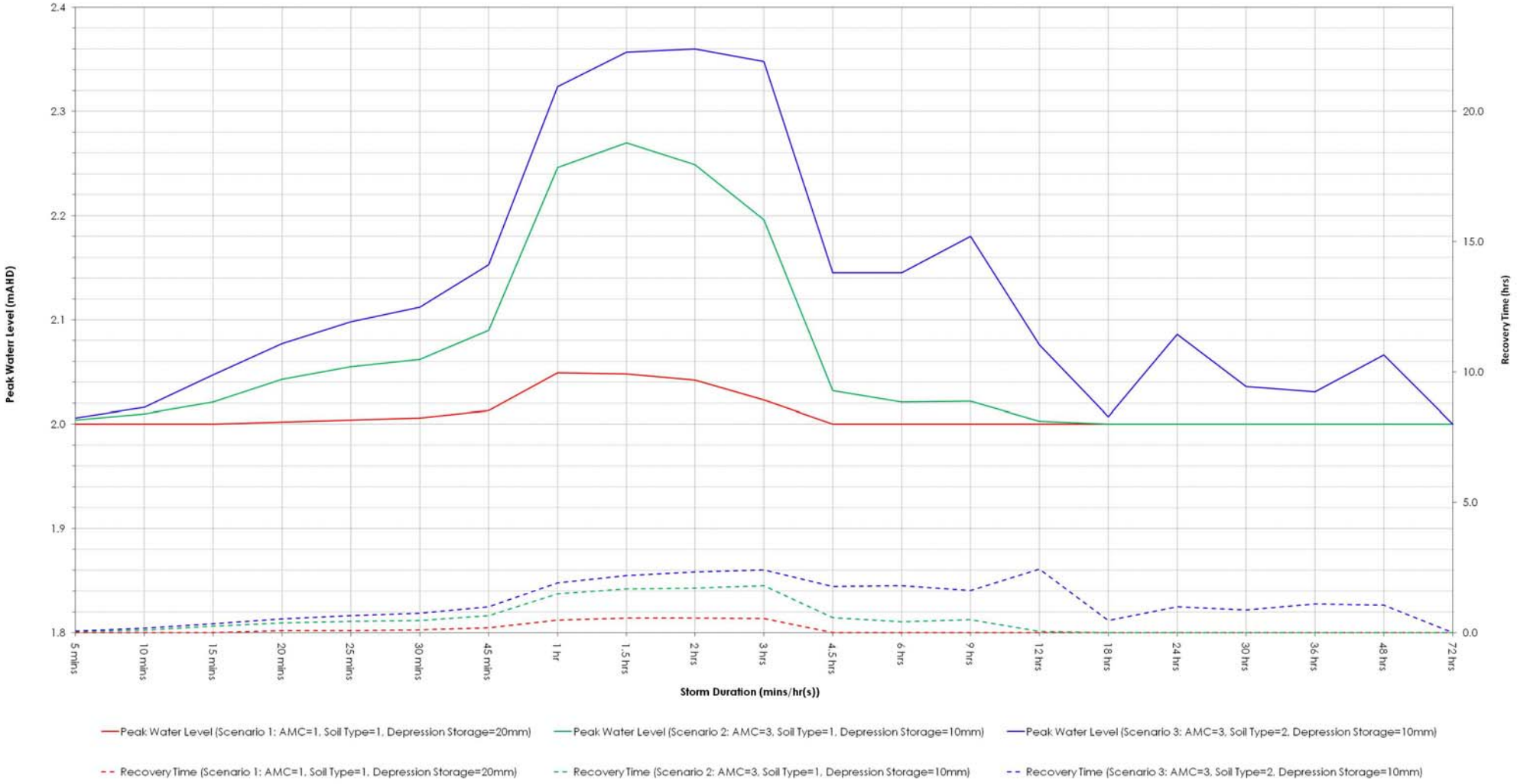

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Approved:	DMM		
Date:	22.03.10		
Scale:	na		Job No: P0902479

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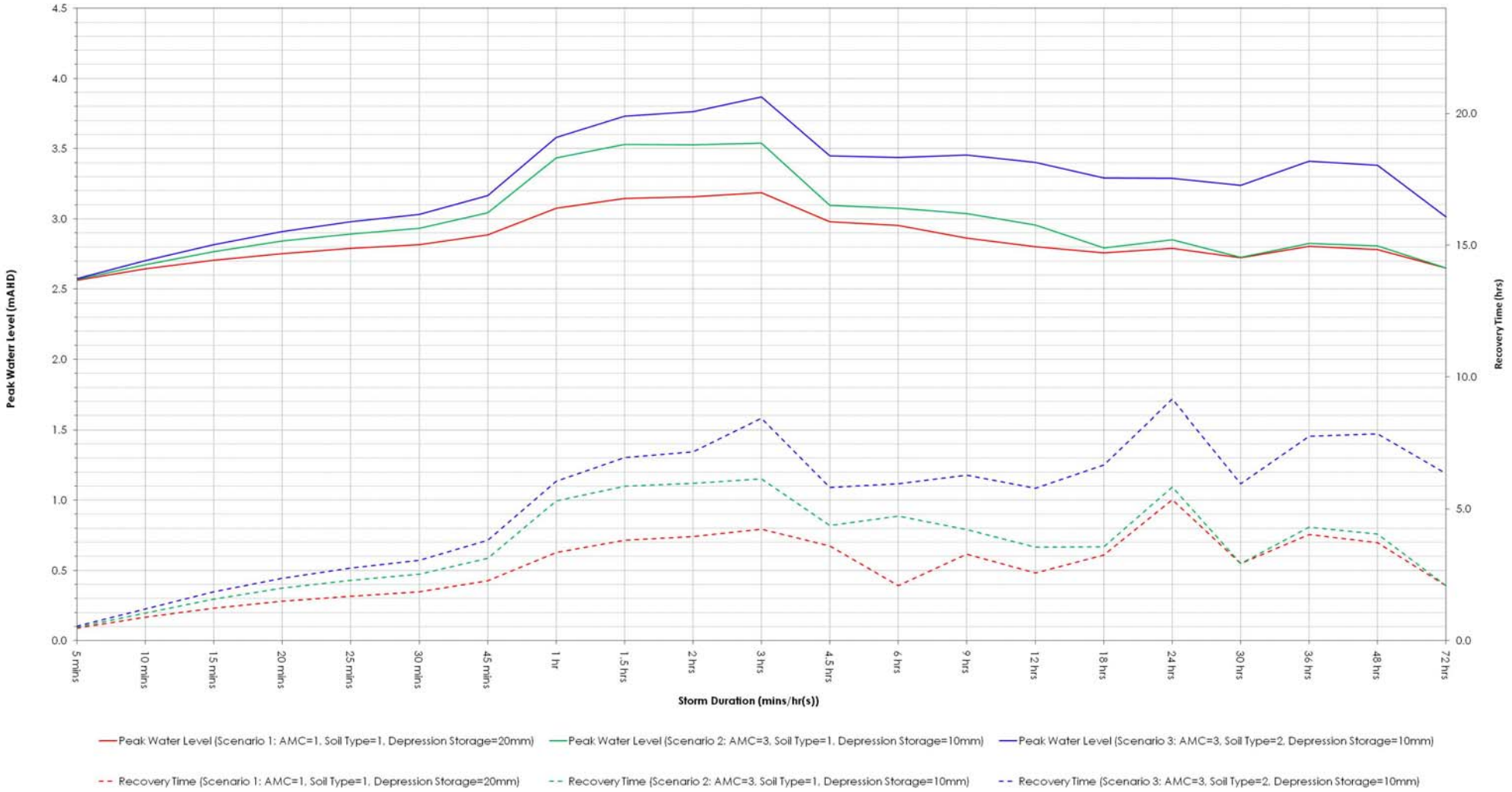

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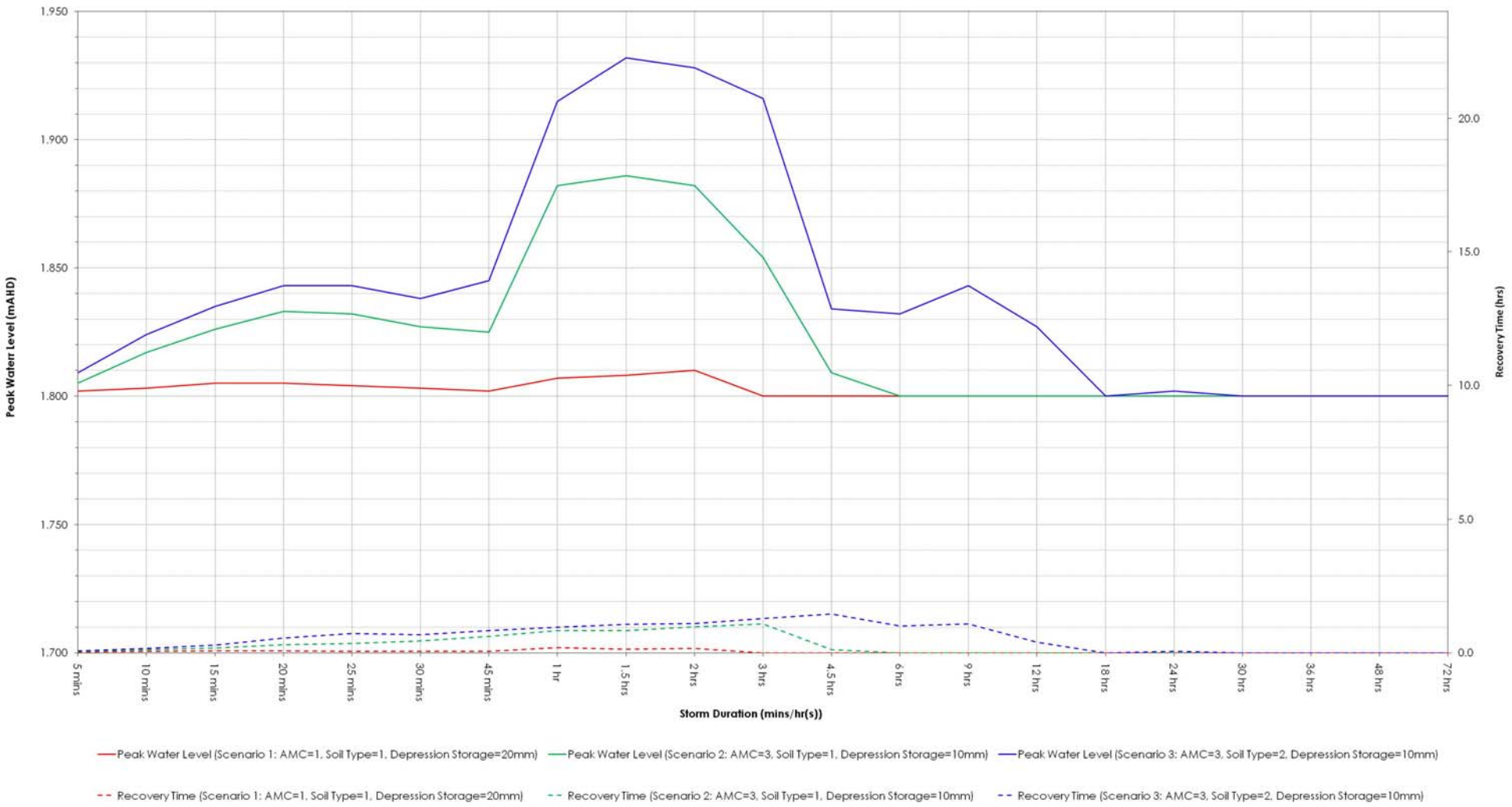

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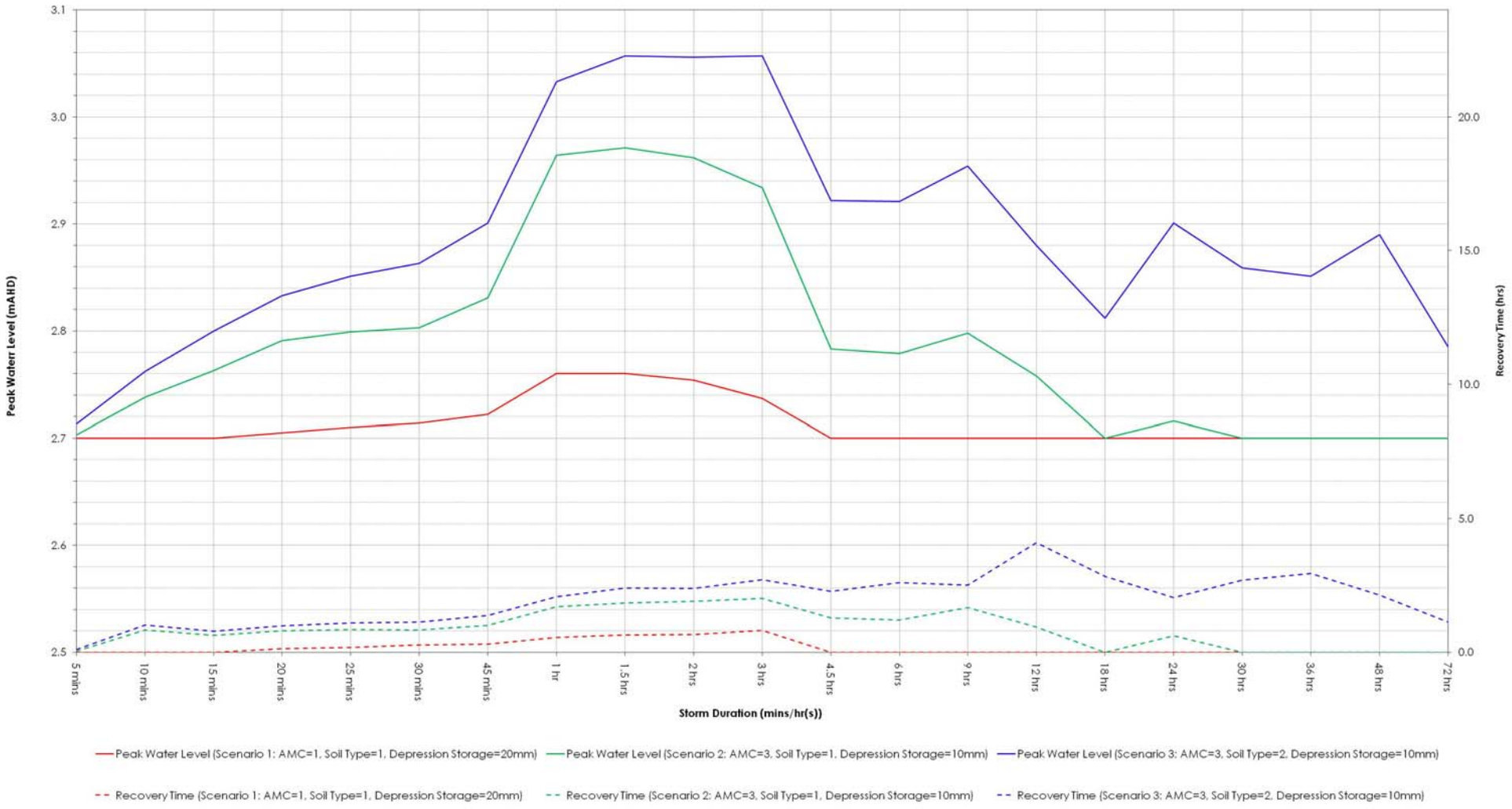

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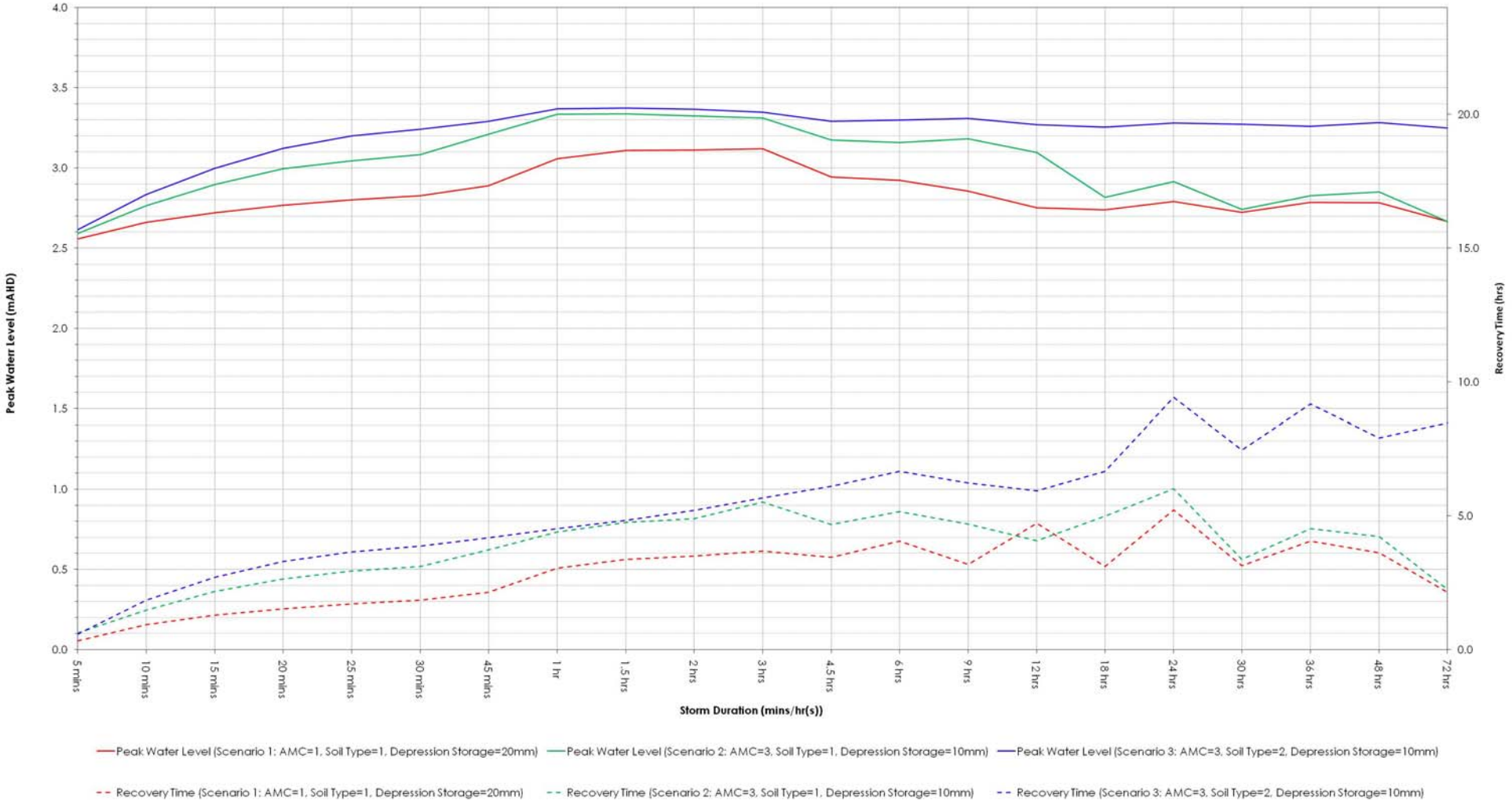

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Approved:	DMM		
Date:	22.03.10		
Scale:	na		Job No: P0902479

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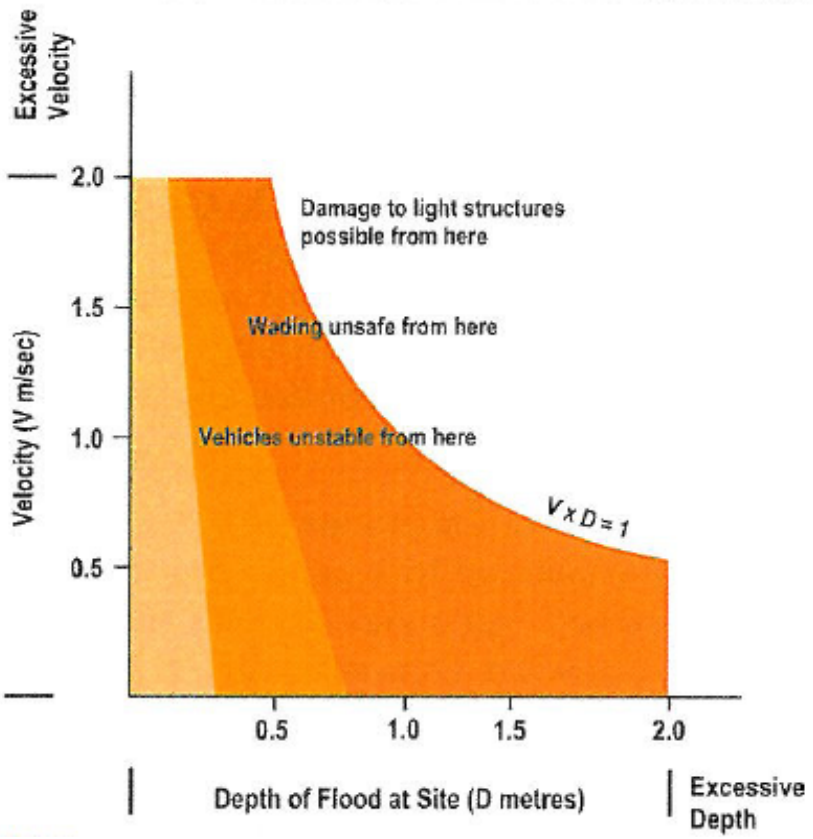

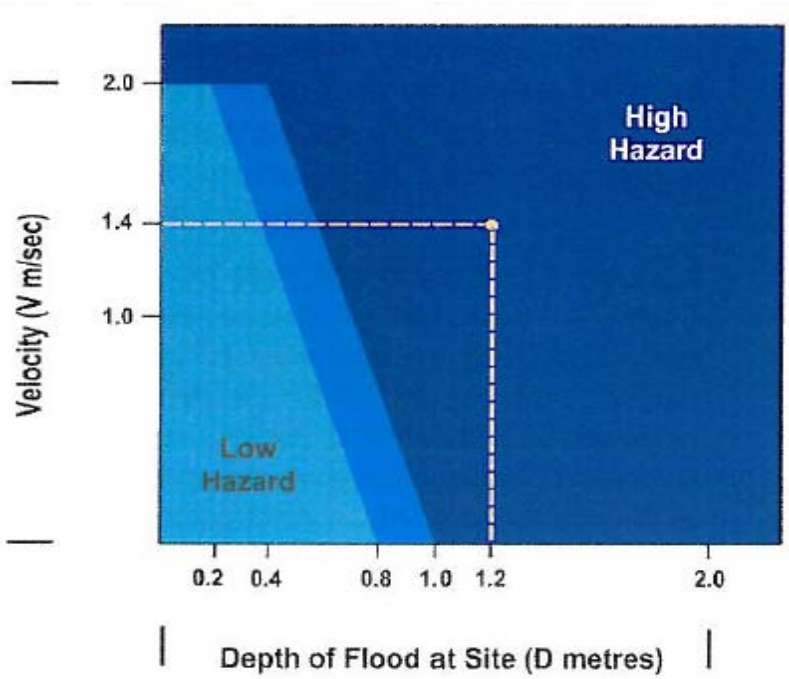

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Drawn:	FC	**PRELIMINARY HYDRAULIC HAZARD CLASSIFICATION**	Drawing No: **FIGURE 9**
Approved:	DMM		
Date:	31.03.10		
Scale:	na		Job No: P0902479

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