

**ANNEXURE 8**

**Flood Assessment**

**prepared by**

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**PROPOSED MODIFICATION APPLICATION TO MP06-0228, SHOALHAVEN STARCHES EXPANSION PROJECT, MODIFICATION TO APPROVED PACKING PLANT, FLOOD IMPACT ASSESSMENT**

**JANUARY 2016**

<b>Project</b> Proposed Modification Application To MP06-0228, Shoalhaven Starches Expansion Project, Modification To Approved Packing Plant, Flood Impact Assessment		<b>Project Number</b> 114044	
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## EXECUTIVE SUMMARY

**Background:** Project Approval MP06\_0228 was granted by the Minister of Planning on 28<sup>th</sup> January 2009 for the Shoalhaven Starches Expansion Project. The Project sought to increase ethanol production in a staged manner from 126 to 300 million litres per year. The Project Approval also consolidated all previous approvals into one Project Approval. The 2009 Project Approval included the establishment of a new Packing Plant and container storage area on land on the northern side of Bolong Road.

Under this Modification Application it is proposed to:

- increase the floor area of the approved packing plant from 3050m<sup>2</sup> to 6200m<sup>2</sup> (excluding awnings);
- construct 5 storage silos adjacent to the packing plant;
- relocate the packing plant within the previously approved lots (Lot 16 DP 1121337 and Lot 2 DP 538289);
- import fill and regrade to construct a temporary and a permanent car park;
- import fill and regrade to construct a raised road from Bolong Road to the packing plant;
- import fill and regrade to create a pad for temporary storage of containers;
- assume containers will be stored on the site during a flood;
- import fill and regrade to construct an additional rail spur line adjacent to the packing plant to accommodate the increase in dry product transported from the site; and
- change the location and alignment of the pipe bridge across Bolong Road.

The site is currently an open field (Figure 1). This report provides an assessment of the impact that the proposed works (Figure 2) has on surrounding flood levels. The results are provided on Figure 3.

**Past Studies:** Several previous studies have been undertaken by WMAwater for Shoalhaven City Council and Shoalhaven Starches in regard to flooding. The key ones are listed below.

1. Lower Shoalhaven River Flood Study - for Shoalhaven City Council, April 1990 (Reference 1);
2. Shoalhaven River Flood Study - for Shoalhaven Starches, March 2013 (Reference 2);
3. Proposed Ethanol Production Upgrade Including Proposed Odour Reduction and Wastewater Treatment Measures for Existing and Proposed Shoalhaven Starches Operations - Bolong Road, Nowra. Hydraulic, Economic, Social and Environmental Impacts of Flooding - for Shoalhaven Starches, May 2008 (Reference 3).

**Scope of Work:** The scope of work was to use up to date hydraulic modelling from Reference 2 to assess the impacts of the proposed works on flooding. The NSW Office of Environment and Heritage provided a letter of 9<sup>th</sup> November 2015 (refer Appendix E) outlining the issues that should be investigated as part of this Modification Application.

**Assessment of Impacts of Proposed Development:** The proposed works will increase flood levels as shown on Figure 3. In summary the maximum increase in the 1% AEP flood level

outside the subject site is 0.05m and mainly affects buildings and land owned by Shoalhaven Starches. The only exception is at 21 Bolong Road and to Bolong Road itself.

**Climate Change:** Possible changes to design flood levels (sea level rise and rainfall intensity increase) have been evaluated in Reference 2. The results indicated that sea level rise would have negligible impact on flood levels at the site due to the considerable distance upstream from the Pacific Ocean. Any increase in design rainfall intensities will increase design flood levels. Reference 2 indicates that a 10%, 20% and 30% increase in design rainfalls will increase 1% AEP flood levels by approximately 0.1m, 0.2m and 0.3m respectively.

Council's flood certificates (Appendix D) indicates that the 2050 projected sea level rise estimate of 0.4m due to climate change will not increase the 1% AEP flood level at this site as it is too far upstream from the ocean.

## 1. INTRODUCTION

### 1.1. Background

Project Approval MP06\_0228 was granted by the Minister of Planning on 28<sup>th</sup> January 2009 for the Shoalhaven Starches Expansion Project. The Project sought to increase ethanol production in a staged manner from 126 to 300 million litres per year. The proposed works included:

- Provision of an additional product dryer;
- Additional equipment and storage vessels;
- Upgrades to the Stillage Recovery Plant;
- Establishment of a new packing plant, container loading area and rail spur line on the northern side of Bolong Road.

The Project Approval also consolidated all previous approvals into one Project Approval. Under this Modification Application it is proposed to:

- increase the floor area of the packing plant from 3050m<sup>2</sup> to 6200m<sup>2</sup> (excluding awnings);
- construct 5 storage silos adjacent to the packing plant;
- relocate the packing plant within the previously approved lots (Lot 16 DP 1121337 and Lot 2 DP 538289);
- import fill and regrade to construct a temporary and a permanent car park;
- import fill and regrade to construct a raised road from Bolong Road to the packing plant;
- import fill and regrade to create a pad for temporary storage of containers;
- assume containers will be stored on the site during a flood;
- import fill and regrade to construct an additional rail spur line adjacent to the packing plant to accommodate the increase in dry product transported from the site; and
- change the location and alignment of the pipe bridge across Bolong Road.

The proposed site is vacant open space with ground levels varying from less than 2 m AHD in the eastern corner adjacent to Bolong Road to over 5 m AHD in the north western corner near Railway Street. (refer Image 1).

The NSW Office of Environment and Heritage provided a letter of 9<sup>th</sup> November 2015 (refer Appendix E) outlining the issues that should be investigated as part of this Modification Application.



Image 1 - Proposed Development Site (NearMap 2015)

WMAwater Pty Ltd (formerly Webb McKeown & Associates) was commissioned by Shoalhaven Starches to provide a flood impact assessment of the proposed works.

A glossary of flood related terms is provided in Appendix A.

## 1.2. Scope of Work

The flood assessment undertaken included the following:

- assessment of existing flood conditions at the site;
- assessment of hydraulic impact (increase in 1% AEP flood level) of the proposed works. This was considered in comparison to "existing 2015" floodplain conditions. Due to the minimal impacts it was not considered of benefit to provide a cumulative impact assessment of works by Shoalhaven Starches and others on the northern floodplain since 1990;

- assessment of increases in depth of above building floor inundation of the proposed works.

### **1.3. Study Area**

The proposed development site is located within the Shoalhaven River catchment (Figure 1) which is part of the Shoalhaven City Local Government Area.

Shoalhaven Starches is located on the northern bank of the Shoalhaven River approximately 1.5 kilometres downstream of Nowra Bridge. The plant has been on this site since approximately 1970 and has expanded considerably since that time.

There is a well documented history of flooding on the Shoalhaven River since European settlement commenced around 1800. Most notable are the floods of 1860 and 1870 which devastated the then urban and commercial centre at Terara on the southern bank causing most of the population to move Nowra. Since that time Terara has declined to a small village.

Since the 1970's major flooding has occurred in 1974, 1975 and 1978 with smaller events in 1976 and 1988.

### **1.4. History of Floodplain Modelling**

The Lower Shoalhaven River Flood Study (Reference 1) was commissioned by the NSW Government Public Works and determined design flood levels along the river and adjoining floodplain. From approximately the year 2000 to 2010 the hydraulic computer model, termed the CELLS model, established in that study was used by WMAwater, on behalf of Shoalhaven Starches, to evaluate the potential increases in flood level due to further works on the northern floodplain, including expansion of the plant itself and construction of the storage ponds.

In 2013 Shoalhaven Starches commissioned WMAwater to update the Shoalhaven River Flood Study to current best practice (Reference 2).

#### **1.4.1. Brief description of Flood Modelling Undertaken in Reference 1**

Flood modelling typically involves the setting up and calibration of two computer models. A hydrologic model that converts the rainfall to runoff and a hydraulic model that includes inflow from the hydrologic model, as well as ocean boundaries, which determines peak flood levels and velocities based on hydraulic formulae. Both models are calibrated to historical data, including historical flood levels and river flow gaugings, to ensure that they can replicate the historical events and are then used to determine design flood events. These are events that have a known probability of occurrence, such as the 1% Annual Exceedance Probability (AEP) event.

The CELLS model of the Shoalhaven River represented the channel and floodplain as a series

of interconnected cells, termed either river or floodplain cells. The river cells were connected by cross sections and the floodplain cells connected by weirs. Approximately 100 cells were used in the Shoalhaven River model with some cells over 4km<sup>2</sup> in area. The CELLS model is termed a one dimensional (1D) branched model in that it cannot account for flow in other than the one direction but has “branches” which allow flow to extend across the floodplain. The model used both field survey for weirs as well as bathymetric survey for the river cross sections at approximately 1 to 2 kilometre spacing.

The CELLS model is an unsteady flow model in that it modelled the full flood event (rising and falling water levels) and not just the peak and included ocean tidal hydrographs at both entrances, namely the Shoalhaven Heads and Crookhaven River, and some six flow hydrographs from the WBNM hydrologic model.

### **1.4.2. Advancements in Flood Modelling since 1990**

Since 1990 there have been significant advancements in the field of hydraulic modelling, though in hydrologic modelling there has been significantly less advancements and the WBNM model used in Reference 1 is still used today.

The main advancements in hydraulic modelling are through the use of more complex computer software that allows the river and floodplain to be discretised into a grid. This is typically 15m by 15m on large rivers and up to 2m by 2m on small urban catchments. These models are termed 2 Dimensional (2D) in that they determine the flow direction between grid cells producing vector velocities. These models are thus able to more accurately define the topography and in turn can more accurately represent the hydraulic effects of even a small development on a large floodplain. With the CELLS model this was only possible using a conservative approach due to the large spacing between cross sections and weirs.

### **1.4.3. Availability of More Detailed Survey**

2D hydraulic models also require much more detailed survey data than the CELLS model and this has only become possible with the advent of what is known as Airborne Laser Scanning survey or ALS or Light Detecting and Ranging or LIDAR. ALS uses laser technology that is emitted from a plane to define the ground levels (height in mAHD) and co-ordinates of points on the ground or on buildings. ALS cannot penetrate deep water in the Shoalhaven River and a detailed bathymetric survey of the river is therefore also required.

Ortho-rectified digital aerial photography is also required in combination with ALS to ensure that buildings and other features on the floodplain are accurately accounted for. ALS has been introduced since approximately the year 2000 over NSW and there is now coverage of the majority of the urban areas and coastal rural areas in NSW.

#### 1.4.4. Summary

2D hydraulic models in conjunction with ALS, digital aerial photography and a detailed bathymetric survey provide the most accurate and up to date approach for determining flood levels that is currently available. This also allows an accurate representation of the effects of development on the floodplain that is far superior to that available with the CELLS model, by adjusting the characteristics of the grid cells. Thus for a new building several grid cells can be blocked out so no flow can occur across it.

#### 1.5. Previous Reports

The key past reports undertaken for Shoalhaven Starches by WMAwater relevant to this project are:

1. Shoalhaven River Flood Study, March 2013 (Reference 2);
2. Proposed Ethanol Production Upgrade Including Proposed Odour Reduction and Wastewater Treatment Measures for Existing and Proposed Shoalhaven Starches Operations - Bolong Road, Nowra. Hydraulic, Economic, Social and Environmental Impacts of Flooding, May 2008 (Reference 3).

##### 1.5.1. Shoalhaven River Flood Study, March 2013 (Reference 2)

The main purpose of this report was to create a best practice hydraulic model (termed TUFLOW) that would supersede the CELLS model prepared as part of the Lower Shoalhaven River Flood Study (Reference 1) in 1990. The approach adopted in the study is summarised as follows:

- collect and digitally map available flood height data;
- as no major floods have occurred since publication of the Lower Shoalhaven River Flood Study (Reference 1) in 1990 and the WBNM hydrologic model used in that study is still valid today, the same historical and design inflow hydrographs for the Shoalhaven River upstream of Nowra Bridge have been adopted in this study. Thus no recalibration of the 1990 WBNM hydrologic model was undertaken. Some minor changes to the inflow hydrographs downstream of Nowra Bridge were undertaken to ensure more accurate representation in the hydraulic model;
- survey data was collated from a bathymetric survey of the Shoalhaven River and an ALS survey of the entire floodplain;
- a 2 Dimensional hydraulic computer model termed TUFLOW was established based on the survey data. Modifications were made to the topography to reflect changes to levees and increased development on the floodplain since 1974;
- historical and design ocean tidal hydrographs were obtained from Reference 1;
- the TUFLOW model was calibrated to match the historical flood level data for the 1974, 1975, 1978 and 1988 floods;
- design inflows were included in the TUFLOW model and peak flood depths, velocities and contours obtained for the 10%, 5%, 2%, 1%, 0.5%, 0.2% AEP events and an Extreme event;

- sensitivity analysis into the possible impacts of both a possible climate change sea level rise and rainfall increase were undertaken for the 1% AEP event. The effect of a changed entrance condition, whether open or closed, at Shoalhaven Heads was also undertaken.

In summary the TUFLOW hydraulic model established in this reference provides a best practice tool that can be used to determine the hydraulic effects (increase in flood level, change in velocity of flow) of development within the Shoalhaven Starches plant.

### **1.5.2. Proposed Ethanol Production Upgrade Including Proposed Odour Reduction and Wastewater Treatment Measures for Existing and Proposed Shoalhaven Starches Operations - Bolong Road, Nowra. Hydraulic, Economic, Social and Environmental Impacts of Flooding, May 2008 (Reference 3)**

Shoalhaven Starches proposed to undertake the following works (termed ethanol plant upgrade and odour reduction works in this report) on the floodplain in 2008:

- to construct additional plant facilities within the existing complex south of Bolong Road and including to the west of Abernethy's Drain,
- to establish a new packing plant and container loading area, including new railway spur line on vacant land north of Bolong Road and west of Abernethy's Drain (Creek),
- adaption of the approved Pond No. 7 as a wastewater treatment pond, (these proposed works do not increase the flood affectation above what was considered in previous reports as part of the approval for Pond No. 7)

This report detailed the likely hydraulic, economic, social and environmental impacts of flooding as a result of the proposed works. The hydraulic assessment was undertaken using the CELLS model established for the Lower Shoalhaven River Flood Study (Reference 1) in 1990.

It also assessed possible mitigation measures to address the hydraulic impacts. In summary it stated: *Shoalhaven Starches cannot directly negate the hydraulic impacts of the works it has constructed or proposes to construct. For example it is not possible to construct a wet weather storage or wastewater treatment pond of the required dimensions with no increases in flood level or construct plant or associated works which does not in some way obstruct a flow path (e.g. railway spur line, container storage).*

*In order to compensate for the adverse impacts of the existing and proposed works, a range of management measures have been considered which will at least partially offset the potential increases in damages caused by the cumulative impacts of the existing and proposed works on the northern floodplain since 1990.*

## 2. APPROACH

### 2.1. Background

Each development on the floodplain has the potential to cause an impact upon flood levels. The potential impacts of works within the floodplain on hydraulic characteristics are twofold - firstly a loss of temporary floodplain storage volume and secondly a loss of flow area. It is the loss of flow area which produces the greatest impact, as the area of floodplain storage lost due to all works since 1990, represents approximately less than 1% of the total available floodplain storage area for the northern floodplain (say 3000+ hectares).

Whilst the individual impacts (construction of a road) may be small the cumulative increases from several developments may be significant. Therefore, the proposed works in 2008 needed to be assessed in the context of total cumulative impacts of all development within the immediate area. It is not possible to itemise all of the developments on the floodplain and their effects since white settlement. For the purposes of reporting the nominal starting date for the assessment of cumulative effects is 1990. This date was agreed previously (refer October 2000 report - Appendix C) and approximately corresponds to the floodplain development status at the time when the current design flood level information was established (1990 Lower Shoalhaven River Flood Study - Reference 1).

For the above reasons the impacts assessed in the May 2008 Proposed Ethanol Production Upgrade Report (Reference 3) represented the cumulative increases for all development by Shoalhaven Starches and others (Dairy Farmers pond) since 1990 and not just the incremental effects of the proposed ethanol upgrade and odour reduction works in 2008.

The impacts can be subdivided into hydraulic (changes in flood level, flow and velocity), social, economic and environmental.

An assessment of such impacts is required in order to advise the proponent of the possible damages to the existing and proposed structures making up the plant, and also to advise Council of the likelihood of any increase in risk to other occupiers or users of the floodplain. It should be noted that the three main floodplain users (Shoalhaven Starches, Dairy Farmers and the Paper Mill (both now owned by the Manildra group of companies)) work in conjunction or co-operation with each other. Each have swapped or sold land on the adjoining floodplain in recent times to suit their commercial needs.

Shoalhaven Starches and the Paper Mill “share” the railway line which passes through all three properties. Shoalhaven Starches also supplied product to the Paper Mill in the past. These two plants are located on the banks of the river in order to distance themselves from the urban environment and to be close to an unlimited supply of water. They also require a large amount of “flat” land for their operation with good road and rail access. Shoalhaven Starches makes excellent use of the floodplain by irrigating and farming the land using recycled water from the plant (initially stored in the seven effluent ponds).

## 2.2. Approach Adopted in this Study

### 2.2.1. May 2008 Proposed Ethanol Production Upgrade Report

The May 2008 Proposed Ethanol Production Upgrade Report (Reference 3) undertook a detailed hydraulic analysis using the CELLS model of all the works proposed as part of this program. The works on the subject site, which would impact on flooding, as part of this included:

- rail spur line;
- packing shed (3050m<sup>2</sup>);
- container storage area;
- road access and parking.

### 2.2.2. 2016 Modification Application

Under this Modification Application it is proposed to undertake the following works, which would impact on flooding, (refer Figure 2 and plans provided in Appendix B):

- increase the floor area of the packing plant from 3050m<sup>2</sup> to 6200m<sup>2</sup> (excluding awnings);
- construct 5 storage silos adjacent to the packing plant;
- relocate the packing plant within the previously approved lots (Lot 16 DP 1121337 and Lot 2 DP 538289);
- import fill and regrade to construct a temporary and a permanent car park;
- import fill and regrade to construct a raised road from Bolong Road to the packing plant;
- import fill and regrade to create a pad for temporary storage of containers;
- assume containers will be stored on the site during a flood;
- import fill and regrade to construct an additional rail spur line adjacent to the packing plant to accommodate the increase in dry product transported from the site; and
- change the location and alignment of the pipe bridge across Bolong Road.

Approximately 34,000 m<sup>3</sup> of fill will be imported with the finished ground level at the container store at 4 m AHD. Details of the proposed fill levels are provided in Appendix B. The existing 5% AEP flood level at the site is at approximately 4.7 m AHD (Appendix D).

### 2.2.3. Assessment of Impact of Proposed Works on Flooding

The loss of hydraulic conveyance depends on the extent of the restriction to a flowpath caused by the works. Prior to construction of the Shoalhaven Starches plant at Bomaderry there would have been significant flow through the site during a flood, as there is across any river bank. However, since approximately 1960 the ongoing construction of the plant has effectively blocked the flow path through the site. This issue has been investigated in our October 2000 report titled "*Further Development within the Manildra starches Plant off Bolong Road, Bomaderry - Hydraulic Assessment*". The conclusions from that report are provided in Appendix C. In

summary an agreement was reached that any future development within the intensively built-up area, as indicated on Image 2 below (taken from that report) would not require hydraulic modelling to quantify the hydraulic impacts and cumulative effects.

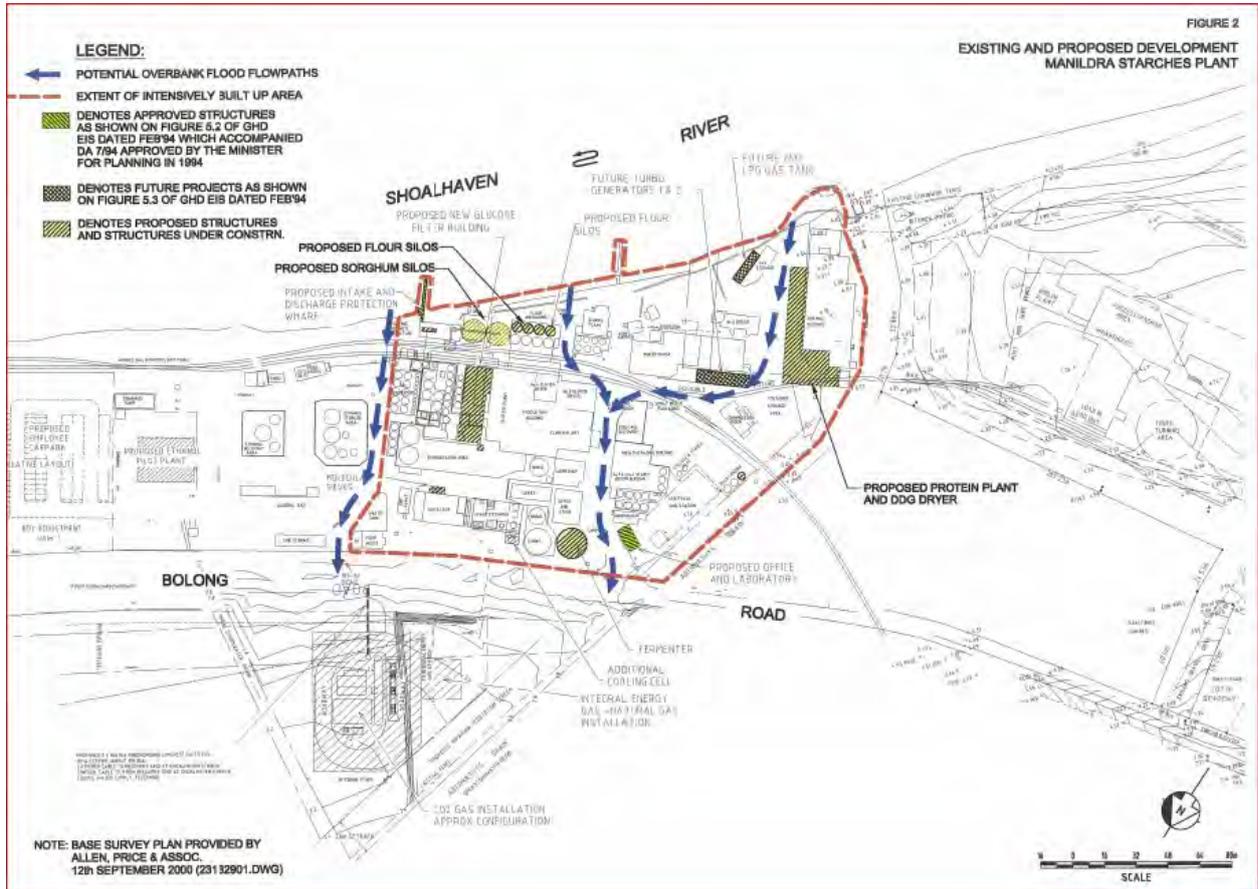


Image 2 - Agreed Extent of Intensively Built-up Area

Thus in simple terms works within this intensively built-up area do not require hydraulic modelling but they do require hydraulic modelling if located outside the intensively built-up area (as are the proposed works).

As part of the current study the following have been undertaken:

1. modification of the TUFLOW model to represent the loss of conveyance and temporary floodplain storage due to the proposed works. It should be noted that the modelling only considers the hydraulic effect of the increase in building footprint of the packing shed, fill for construction of the rail line / packing shed / roads etc. and storage of containers as shown on Figure 2 and plans provided in Appendix B;
2. comparison of the design flood levels for the design (inclusion of the proposed works) to the present day approved extent of development flood levels. This indicates the incremental increase in flood level due to the proposed works;
3. assessment of the increase in above floor building inundation as a result of the proposed works.

### 3. FLOOD IMPACT ASSESSMENT

#### 3.1. Increase in 1% AEP Flood Levels

The results from a comparison to present day 2015 approved works are provided on Figure 3. These show that for the majority of the surrounding area there is no change to the 1% AEP flood level. The increases that do occur are predominantly to land and buildings owned by Shoalhaven Starches. It should be noted that the works will only increase flood levels in events that overtop the northern river bank (approximately a 5% AEP event) and floodwaters flow across the site and towards Bolong Road. Thus in smaller events (all historical floods since March 1978) the works would have no impact on flood levels.

The maximum increase in the 1% AEP flood, on land not owned by Shoalhaven Starches, is up to 0.05m and occurs on Bolong Road between the railway line crossing and Abernethy's Drain (Creek) crossing adjacent to the Shoalhaven Starches plant and on 21 Bolong Road (refer Image 3 which is taken from Figure 3).



Image 3 - Copy from Figure 3

#### 3.2. Increases in Above Floor Inundation

The only building potentially affected by the proposed works is at 21 Bolong Road (red outline on Image 3). This building (refer Image 4) is a two storey commercial premise. The surveyed ground floor level is at 4.91 m AHD and the upper floor is at 6.91 m AHD.



Image 4 - 21 Bolong Road taken from Google StreetView

Council's flood certificates (Appendix D) indicates a 1% AEP flood level of approximately 5.6 m AHD at this location. Thus the ground floor will be inundated by approximately 0.7m and the upper floor will not be inundated. Image 3 ( taken from Figure 3) indicates that the ground floor is at the very periphery of the affected area and thus may or may not be subject to any flood level increase due to the proposed works.

## 4. COMPLIANCE WITH SHOALHAVEN CITY COUNCIL'S CHAPTER G9: DEVELOPMENT ON FLOOD PRONE LAND (DCP2014)

### 4.1. Council Flood Certificate

Council's flood certificates (Appendix D) advises that the site is inundated in the 1% AEP event and is described as High Hazard Flood Storage. It should be noted that Council's description of the hydraulic and hazard categorisation is based on CELLS model results from the 1990 Lower Shoalhaven River Flood Study (Reference 1). However the CELLS model could not accurately define these categorisations due to its limited model structure (refer Section 1.4.1).

Council's flood certificates (Appendix D) indicates that the 2050 projected sea level rise estimate of 0.4m due to climate change will not increase the 1% AEP flood level at this site as it is too far upstream from the ocean.

### 4.2. Compliance

The following sections describe compliance with Chapter G9: Development on Flood Prone Land of Council's DCP 2014. As the works will not involve subdivision of lands compliance with these performance criteria has not been addressed.

PERFORMANCE CRITERIA	RESPONSE
<b>P1 Development or work on flood prone land will meet the following:</b>	
<b>The development will not increase the risk to life or safety of persons during a flood event on the development site and adjoining land.</b>	The works are such that their construction will not significantly increase the number of workers on the site (beyond that under Project Approval MP06_0228) or additionally threaten their safety during a flood.
<b>The development or work will not unduly restrict the flow behaviour of floodwaters.</b>	Refer Flood Impact Assessment above (Section 3).
<b>The development or work will not unduly increase the level or flow of floodwaters or stormwater runoff on land in the vicinity. The development or work will not exacerbate the adverse consequences of floodwaters flowing on the land with regard to erosion, siltation and destruction of vegetation.</b>	The works are within industrial land clear of vegetation and due to their relatively small footprint will have no significant impact on erosion or siltation. Neither will the increase in impervious area cause any significant increase in runoff from the site.
<b>The structural characteristics of any building or work that are the subject of the application are capable of withstanding flooding in accordance with the requirements of the Council.</b>	<b>A separate structural report will be provided.</b>
<b>The development will not become unsafe during</b>	<b>A separate structural report will be</b>

PERFORMANCE CRITERIA	RESPONSE
<b>floods or result in moving debris that potentially threatens the safety of people or the integrity of structures.</b>	<b>provided.</b>
<b>Potential damage due to inundation of proposed buildings and structures is minimised.</b>	There will potentially be some damage to electrical and other components, including the stored containers and these are considered in Shoalhaven Starches Flood Plan. Electrical components should as far as possible be raised above the 1% AEP flood level + 0.50m.
<b>The development will not obstruct escape routes for both people and stock in the event of a flood.</b>	The works will not occupy escape routes or cause workers to become trapped.
<b>The development will not unduly increase dependency on emergency services.</b>	The works are such that their construction will not significantly increase the number of workers on the site (beyond that under Project Approval MP06_0228), additionally threaten their safety during a flood or increase the need for emergency services.
<b>Interaction of flooding from all possible sources has been taken into account in assessing the proposed development against risks to life and property resulting from any adverse hydraulic impacts.</b>	Refer Flood Impact Assessment above (Section 3).
<b>The development will not adversely affect the integrity of floodplains and floodways, including riparian vegetation, fluvial geomorphologic environmental processes and water quality.</b>	The works will be constructed on land designated as high hazard flood storage in the 1% AEP event. The site is vacant land with no existing vegetation apart from grasses and is beyond the influence of normal fluvial geomorphic processes. The works will employ measures to ensure no impact on water quality.
<b>P2 Filling or excavation on flood prone land will meet the following:</b>	The works involve earthworks, including significant filling but limited excavation.
<b>High hazard floodway areas are kept free of fill and/or obstructions.</b>	The location is within a high hazard flood storage area, however the location of the works is determined by the nearby rail line and other related

PERFORMANCE CRITERIA	RESPONSE
	plant. There is no other location where the works could be situated. The hydraulic impact of the proposed works is miminised by being located in a flood storage rather than a floodway area.
<b>The proposed fill or excavation will not unduly restrict the flow behaviour of floodwaters.</b>	Refer Flood Impact Assessment above (Section 3).
<b>The proposed fill or excavation will not unduly increase the level or flow of floodwaters or stormwater runoff on land in the vicinity, including adjoining land.</b>	Refer Flood Impact Assessment above (Section 3).
<b>The proposed fill or excavation will not exacerbate erosion, siltation and destruction of vegetation caused by floodwaters flowing on the land.</b>	The site is vacant grassed land and is beyond the influence of normal fluvial geomorphic processes.
<b>The proposed fill or excavation will not be carried out on flood prone land if sufficient flood free area is available for development within the subject property.</b>	The location is within a high hazard flood storage area, however the location of the works is determined by the nearby rail line and other related plant. Other sites have been evaluated and the outcome is that there is no other location where the works could be situated.
<b>The proposed excavation does not create new habitable rooms, non habitable storage areas or car parks with floor levels below the existing ground level.</b>	The works do not involve habitable or non habitable residential storage areas or below ground car parks.

## **5. NSW OFFICE OF ENVIRONMENT AND HERITAGE LETTER OF 9 NOVEMBER 2015**

The NSW Office of Environment and Heritage in their letter of 9<sup>th</sup> November 2015 advised that the following issues should be considered for the full range of floods up to the Probable Maximum Flood (PMF).

### **5.1. The Impact of Flooding on the Development**

Flooding will impact on the development. In events greater than the 5% AEP it is likely that the Shoalhaven Starches plant will be shut down and all workers will be evacuated from the site. Initially this will result in loss of production and possible damage to stored products and equipment in larger events up to the PMF. These issues have been addressed in an updated (to include these works) Shoalhaven Starches Flood Plan.

The works have been raised to reduce the frequency of inundation but cannot be removed from the floodplain to eliminate the risk of flooding. It is impractical to raise the works to the PMF to eliminate flood damages.

Following each flood Shoalhaven Starches undertakes a review of its flood related procedures, as was undertaken for the event of 26<sup>th</sup> August 2015.

### **5.2. The Impact of the Development on Flood Behaviour Including any Management Measures to Mitigate Adverse Flood Impacts**

The impacts of the proposed works have been evaluated using the TUFLOW hydraulic model and the results are provided in Section 3.

No mitigation works are possible but management measures to address the impact of flooding on the safety of workers and damage to the plant are addressed in the Shoalhaven Starches Flood Plan.

### **5.3. The Impact of Flooding on the Safety of People/Users of the Development**

Flooding will potentially impact on the safety of personnel on the site at the time of the event and has been addressed in the Shoalhaven Starches Flood Plan. In summary due to a relatively long available warning time (of the order of 12 to 24 hours) there is ample opportunity to enact the Flood Plan and in this way safely remove personnel from the site prior to any inundation.

#### **5.4. The Development Control Plans or Policies of Shoalhaven City Shire Council (SCC) in Relation to the Management of Flood Risk**

This has been addressed in Section 4.

#### **5.5. The Best Available Flood Information for the Area from SCC**

As noted previously the best available design flood information is provided in Reference 2 which supersedes that undertaken previously for Shoalhaven City Council (Reference 1).

#### **5.6. The SCC's Requirements for Flood Investigations To Support Development, Whether Flood Information is Currently Available or Not**

This has been addressed in Section 4.

#### **5.7. The Full Range of Flood Events, up to and Including the Probable Maximum Flood (PMF)**

The increase in flood level has only been considered for the 1% AEP event. In the 5% AEP event there will be no increase in flood level as it is only in greater events that the river bank is overtopped.

Events greater than the 1% AEP (up to the PMF) have been considered for damage and evacuation purposes in the Shoalhaven Starches Flood Plan. For evacuation all staff will be removed from the site prior to the site first becoming inundated. Thus there will be no additional risk to staff with a larger event.

In events larger than the 1% AEP it is likely that additional damages to contents and structures will be incurred on the site. These damages cannot be protected by any reasonable means.

#### **5.8. The Flood Hazard in the Area Including the Hydraulic Hazard, Floodways, Flood Readiness, Flood Warning Time, Rate Of Rise Of Floodwater, Flood Duration and Type of Development**

Council's flood certificates (Appendix D) advises that the site is inundated in the 1% AEP event and is described as High Hazard Flood Storage. However the proposed location of the works is determined by the nearby rail line and other related plant. Other sites have been evaluated and the outcome is that there is no other location where these particular works could be situated.

Shoalhaven Starches has a Flood Plan which will be updated to include the proposed additional plant and storage areas. Due to the relatively large catchment area of the Shoalhaven River (7,000 km<sup>2</sup>) there is of the order of 12 to 24 hours advance warning of a flood. Shoalhaven

Starches Flood Plan will ensure that all staff are removed from the site in advance of any site inundation. The duration of inundation will make no significant impact on the level of flood damages or risk to life.

As the proposed development is a packing shed and storage area for goods there will be a high loss if inundation occurs. This has been considered in development of the plans and floor levels but these damages cannot be protected by any reasonable means

### 5.9. The Flood Hazard of Any Access Routes

The Flood Plan requires evacuation of staff west along Bolong Road to high ground (refer Image 5). Evacuation of staff should occur prior to any overtopping of the river bank but the short length of travel along a sealed road and with rising flood access minimises the risks.



Image 5 - Evacuation Route to High Ground

### 5.10. The Implications of Climate Change on Flooding

Possible changes to design flood levels (sea level rise and rainfall intensity increase) have been evaluated in Reference 2. The results indicated that sea level rise would have negligible impact on flood levels at the site due to the considerable distance upstream from the Pacific Ocean. Any increase in design rainfall intensities will increase design flood levels. Reference 2 indicates that a 10%, 20% and 30% increase in design rainfalls will increase 1% AEP flood

levels by approximately 0.1m, 0.2m and 0.3m respectively at the site.

Council's flood certificates (Appendix D) indicates that the 2050 projected sea level rise estimate of 0.4m due to climate change will not increase the 1% AEP flood level at this site as it is too far upstream from the ocean.

## 6. REFERENCES

1. Public Works Department  
**Lower Shoalhaven River Flood Study**  
Report No. PWD 87049, ISBN 724028692, April 1990
2. Shoalhaven Starches  
**Shoalhaven River Flood Study**  
WMAwater, March 2013
3. Shoalhaven Starches  
**Proposed Ethanol Production Upgrade Including Proposed Odour Reduction and Wastewater Treatment Measures for Existing and Proposed Shoalhaven Starches Operations - Bolong Road, Nowra. Hydraulic, Economic, Social and Environmental Impacts of Flooding**  
Webb McKeown & Associates, May 2008



FIGURE 1  
STUDY AREA

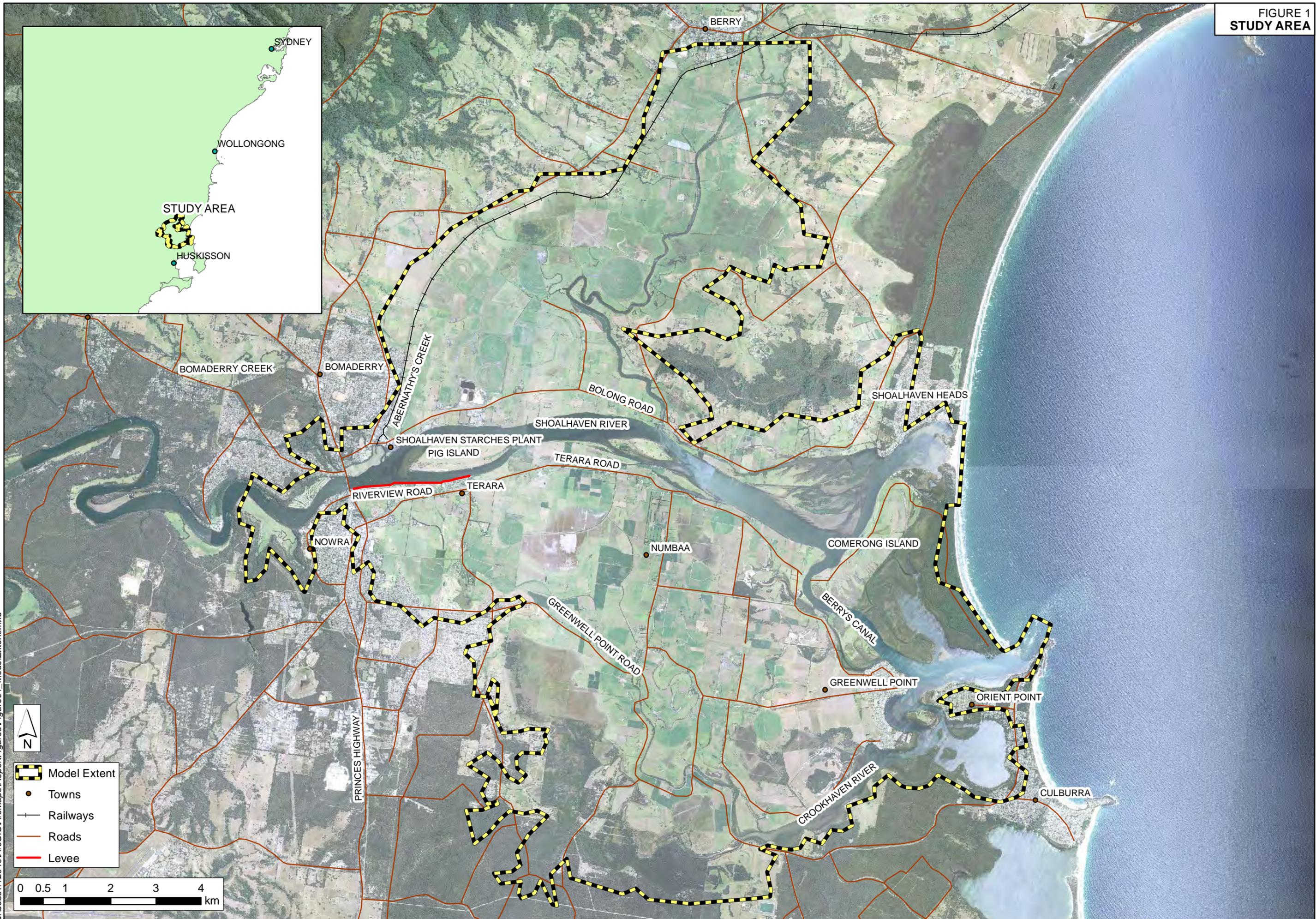


FIGURE 2  
LAYOUT OF PROPOSED EXTENSION



**PRELIMINARY VOLUMES:**  
 AREA ■ 66,820m<sup>2</sup>  
 CUT ■ 3,480m<sup>3</sup>  
 FILL ■ 17,020m<sup>3</sup>  
 NET ■ 13,540m<sup>3</sup> FILL

**NOTE:**  
 DRAWING IS NOT IN A COORDINATE SYSTEM AND ORIGIN LEVELS ARE PRELIMINARY ONLY AND A DETAILED DESIGN WILL NEED TO BE DONE.

**ELEVATIONS LEGEND:**

NUMBER	MINIMUM ELEVATION (m)	MAXIMUM ELEVATION (m)	COLOUR	AREA (m <sup>2</sup> )
1	-0.200m	-0.200m	Green	35.2m <sup>2</sup>
2	0.200m	+1.200m	Orange	288.2m <sup>2</sup>
3	+1.200m	+1.200m	Yellow	85.2m <sup>2</sup>
4	+1.200m	+4.200m	Light Yellow	130.2m <sup>2</sup>
5	+4.200m	+5.200m	Yellow-Green	90.2m <sup>2</sup>
6	+5.200m	+5.200m	Light Blue	1478.4m <sup>2</sup>
7	+5.200m	+7.200m	Blue	478.4m <sup>2</sup>
8	+7.200m	+7.200m	Dark Blue	480.2m <sup>2</sup>
9	+7.200m	+8.200m	Pink	478.2m <sup>2</sup>
10	+8.200m	+8.200m	Red	480.2m <sup>2</sup>

**BEWARE!**  
 THE CONTRACTOR IS TO VERIFY THE LOCATION OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION AND SHALL BE RESPONSIBLE, AT THE CONTRACTOR'S EXPENSE, FOR ANY REPAIRS TO DAMAGE CAUSED DURING CONSTRUCTION.

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LAYOUT PLAN  
 SCALE 1:800



SCALE  
 1:800  
 (AT A1 ORIGINAL)

DATE: AUSTRALIAN HEIGHT DATUM  
 ORIGIN: SSM RL  
 DATE OF PLAN: DECEMBER 2015

DATE	BY	DATE
DESIGN	CLG	
DRAWN	CLG	
CHECKED	MP	

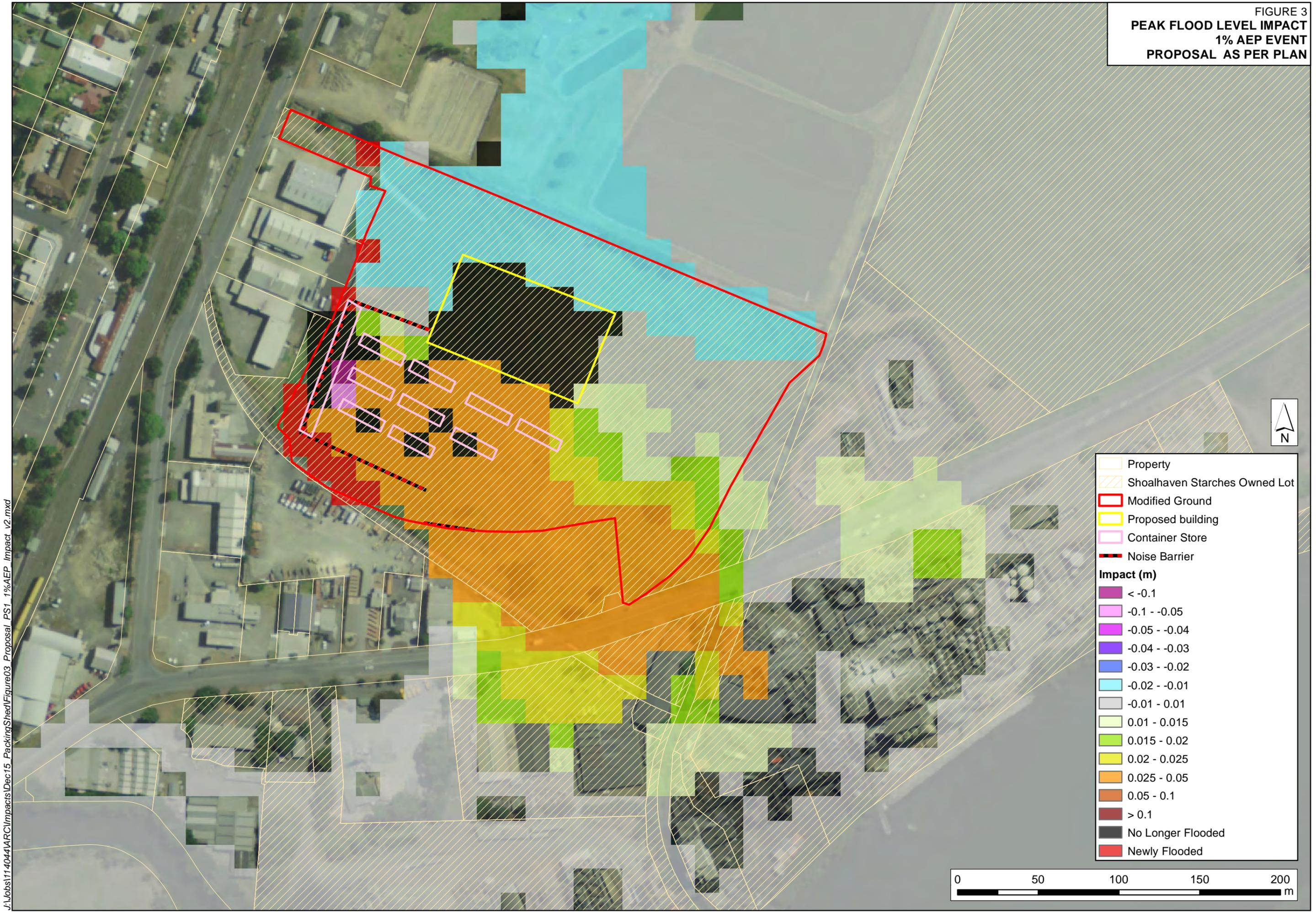
**aps** allen price & scarratts  
 land and development consultants  
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 Waverley Branch: 5/125 Tambourine Street, Waverley NSW 2244  
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PROPOSED MODIFICATION APPLICATION FOR PACKING FACILITY, MANILDRA - SHOALHAVEN STARCHES PTY LTD  
 PRELIMINARY BULK EARTHWORKS SHADING LAYOUT PLAN FOR THE MANILDRA GROUP

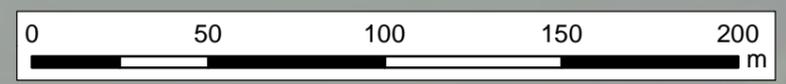
DRAWING STATUS: **PRELIMINARY**  
 NOT TO BE USED FOR CONSTRUCTION PURPOSES

DRAWING NUMBER: 25003-200\_S01  
 SHEET 1 OF 1  
 REVISION: P2

FIGURE 3  
PEAK FLOOD LEVEL IMPACT  
1% AEP EVENT  
PROPOSAL AS PER PLAN



-  Property
-  Shoalhaven Starches Owned Lot
-  Modified Ground
-  Proposed building
-  Container Store
-  Noise Barrier
- Impact (m)**
-  < -0.1
-  -0.1 - -0.05
-  -0.05 - -0.04
-  -0.04 - -0.03
-  -0.03 - -0.02
-  -0.02 - -0.01
-  -0.01 - 0.01
-  0.01 - 0.015
-  0.015 - 0.02
-  0.02 - 0.025
-  0.025 - 0.05
-  0.05 - 0.1
-  > 0.1
-  No Longer Flooded
-  Newly Flooded



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