ANNEXURE 4

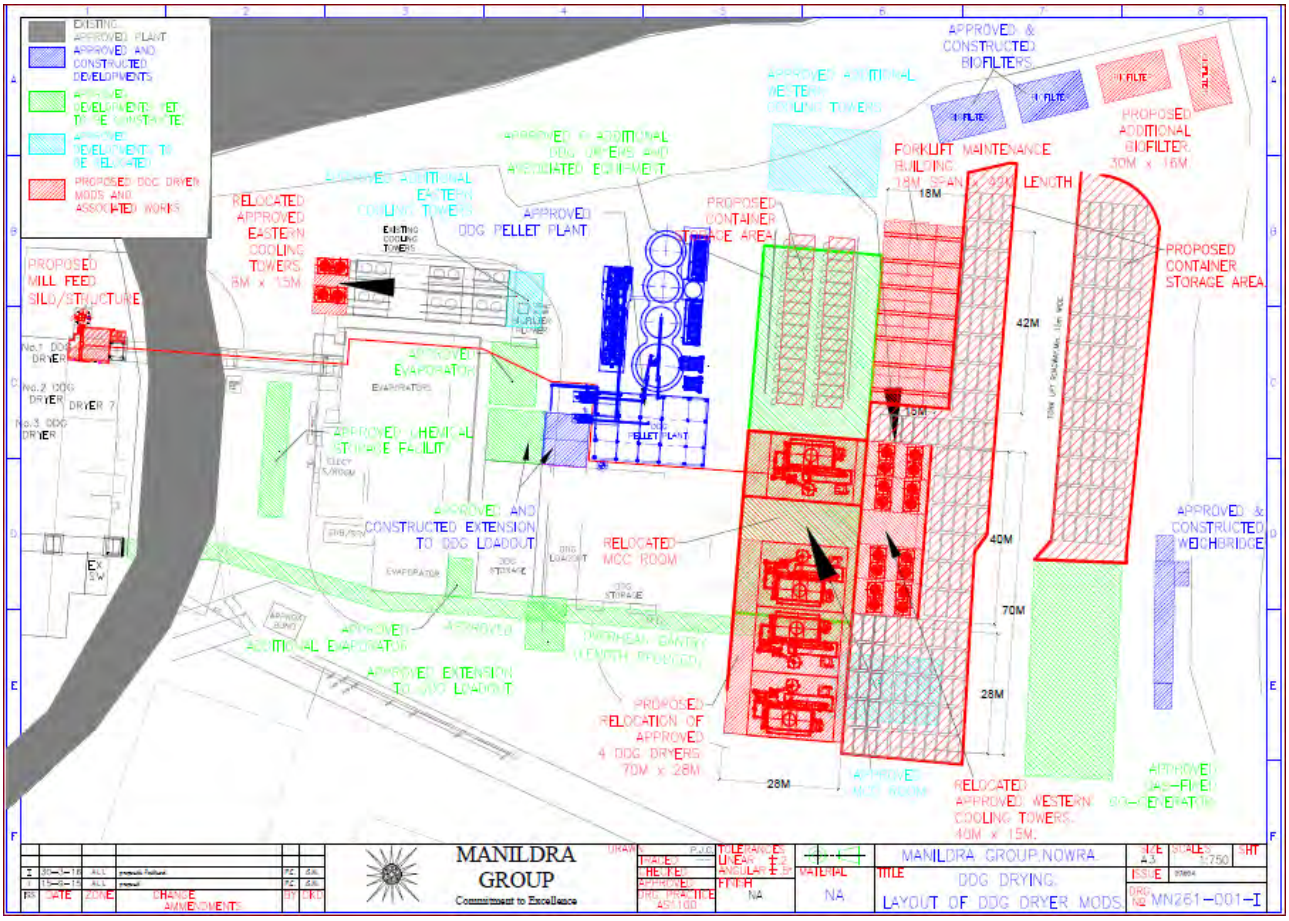
ANNEXURE 4

Flood Impact Assessment

prepared by

WMAwater Pty Ltd

PROPOSED MODIFICATION APPLICATION TO MP06-0228, SHOALHAVEN STARCHES EXPANSION PROJECT, MODIFICATION TO DDG DRYERS AND CONTAINER STORE, FLOOD IMPACT ASSESSMENT



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PROPOSED MODIFICATION APPLICATION TO MP06-0228, SHOALHAVEN STARCHES EXPANSION PROJECT, MODIFICATION TO DDG DRYERS AND CONTAINER STORE, FLOOD IMPACT ASSESSMENT

MAY 2016

Project **Proposed Modification Application To MP06-0228, Shoalhaven Starches Expansion Project, Modification To DDG Dryers and Container Store, Flood Impact Assessment**			**Project Number** **114044-08**
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PROPOSED MODIFICATION APPLICATION TO MP06-0228, SHOALHAVEN STARCHES EXPANSION PROJECT, MODIFICATION TO DDG DRYERS AND CONTAINER STORE, FLOOD IMPACT ASSESSMENT

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EXECUTIVE SUMMARY

Background: Project Approval MP06_0228 was granted by the Minister of Planning on 28th 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 as well as construction of 6 additional DDG Dryers, gas co-generator, cooling towers and additional minor structures.

In January 2016 WMAwater prepared a Flood Assessment Report in support of modifications to the approved Packing Plant and container store on the northern side of Bolong Road. Under this present Modification Application it is proposed to:

- Reduce the number of DDG Dryers from 6 to 4;
- Slightly relocate the DDG Dryers on the site;
- Relocate the eastern and western cooling towers;
- Provide two additional bio-filters;
- Construct a forklift maintenance building;
- Relocate the MCC room;
- Provide a container storage and preparation areas;
- Regularise and expand an emergency coal and woodchip storage area on the environmental farm site located on the northern side of Bolong Road.

The site for the majority of the works is currently part of the existing plant area (Image 1 and Figure 1). The coal and woodchip store will be within the environmental farm site. This report provides an assessment of the impact that the above proposed works (Figure 2 a & b) has on surrounding flood levels.

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);
4. DCP2014 Chapter G9:Flood Compliance Report for Proposed Modification Application to MP06-0228, Shoalhaven Starches Expansion Project, Alterations to Existing Flour Mill, Bolong Road, Bomaderry. Letter to Cowman Stoddart from WMAwater. 25 September 2015 (Reference 4);
5. Proposed Modification Application to MP06-0228, Shoalhaven Starches Expansion Project, Relocation of Product Dryer, Flood Impact Assessment, October 2015 (Reference 5);

6. Proposed Modification Application To MP06-0228, Shoalhaven Starches Expansion Project, Modification To Approved Packing Plant, Flood Impact Assessment, January 2016 (Reference 6).

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. This would also include assessment of the impacts of the works described in References 4 to 6.

Assessment of Impacts of Proposed Development: The results are provided on Figure 3 to Figure 16. In summary the hydraulic impacts of the proposed works located within the existing plant, south of Bolong Road and west of Abernethy's Drain are minimal. This is because the proposed works are largely surrounded by existing or already approved works which minimises the impacts from the new works. The proposed coal and woodchip store within the environmental farm site produces a localised increase in the 1% AEP flood level of 0.1m on Bolong Road and west of the former APM paper mill.

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 28th 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 present Modification Application it is proposed to:

- Reduce the number of DDG Dryers from 6 to 4;
- Slightly relocate the DDG Dryers on the site;
- Relocate the eastern and western cooling towers;
- Provide two additional bio-filters;
- Construct a forklift maintenance building;
- Relocate the MCC room;
- Provide a container storage and preparation areas;
- Regularise and expand an emergency coal and woodchip storage area on the environmental farm site located on the northern side of Bolong Road.

The proposed site west of Abernethy's Drain is partially occupied by approved developments (refer Image 1 and Figure 2a) and there are approvals for works that have not yet been constructed, some of which are to be relocated as part of this Modification Application. Of particular note is the existing coal and woodchip storage area presently located on part of the proposed container store. This will remain in this location until the land is required for container storage. At that time it will be relocated to the environmental farm at 20 Hanigans Lane.

Webb McKeown's May 2008 Report (Reference 3) indicated the hydraulic (flood) impacts of the proposed works for the Shoalhaven Starches Expansion Project under Project Approval MP06_0228 which was granted by the Minister of Planning on 28th January 2009. This assessment was undertaken using the CELLS model (refer Section 1.4.1) but did not include assessment of the following:

- western cooling towers;
- two existing bio-filters;
- MCC room;
- the existing coal and woodchip storage area presently located on part of the proposed container store.

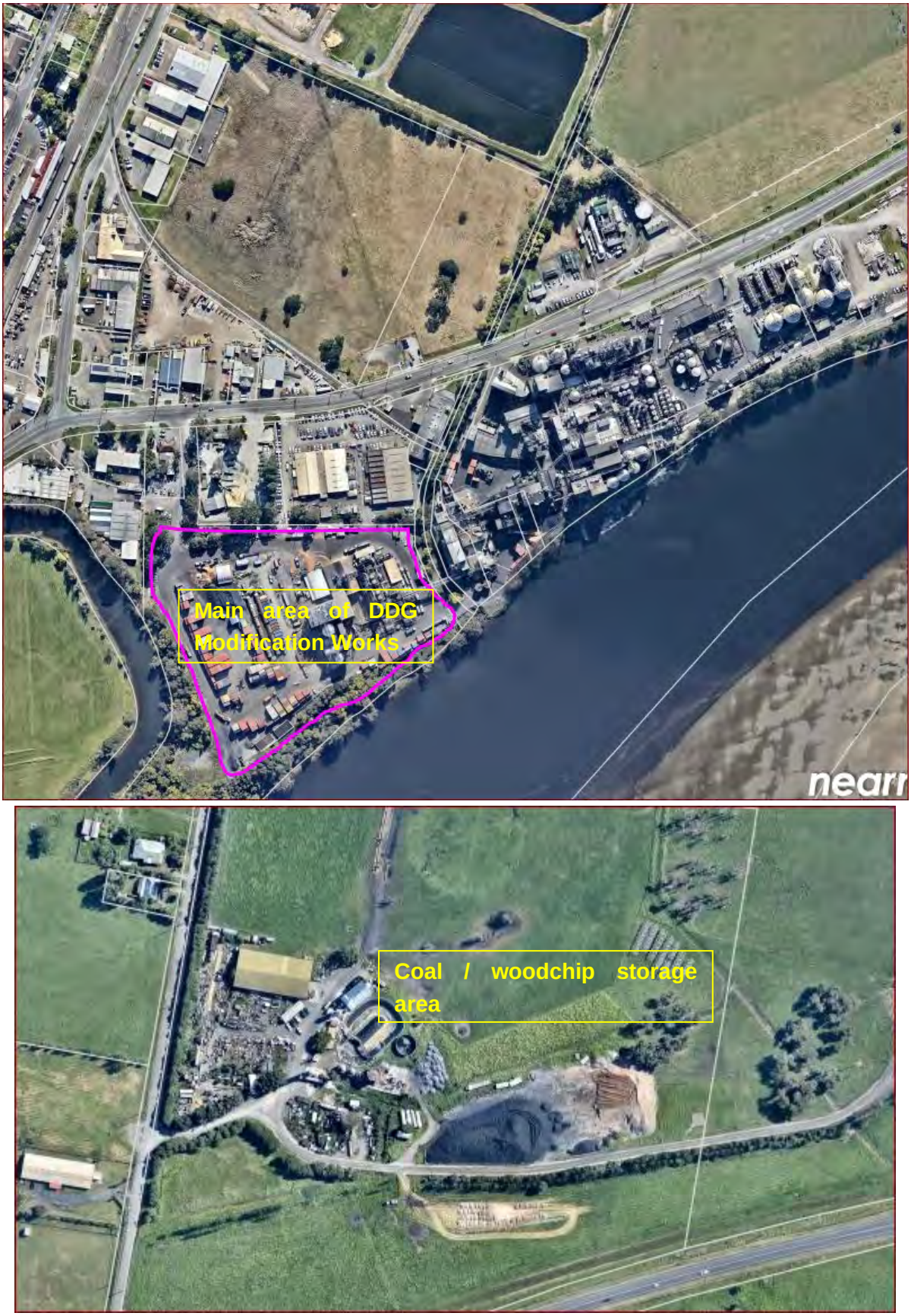


Image 1 - Proposed Development Sites at 32 Bolong Road and 20 Hanigans Lane (NearMap 2015)

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 (January 2016) at the site which included the following;
    - all approved and constructed plant operated by Shoalhaven Starches;
    - all approved and yet to be constructed plant operated by Shoalhaven Starches as located in the original approval (refer Image 1 and Figure 2 a & b);
    - construction of all works as outlined in References 4 to 6.
- assessment of hydraulic impacts (increase in 1% AEP flood level compared to January 2016 existing conditions) of the following development scenarios (refer Figure 2 a & b for locations):
    - **Scenario A**: Relocation of the western and eastern cooling towers, and MCC room and reduction in the number of DDG dryers from 4 to 6 and relocation;
    - **Scenario B1**: as Scenario A plus two additional bio-filters, the forklift maintenance building and the container storage and preparation area;
    - **Scenario B2**: as Scenario B1 but with part of the container storage area occupied by the coal and woodchip storage area;
    - **Scenario C**: as Scenario B1 plus a coal and woodchip storage area on the east side of Hanigans Lane.
- assessment of hydraulic impacts of the above four design Scenarios (increase in 1% AEP flood level) compared to the assumed 1990 floodplain conditions. These results indicate the cumulative impact assessment of works by Shoalhaven Starches and others on the northern floodplain since 1990;
- assessment of the increases in depth of above building floor inundation of the four proposed scenarios.

1.3. Study Area

The two proposed development sites are 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 (refer Reference 2 for further details).

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^2 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 / Webb McKeown & Associates relevant to this project are:

1. Shoalhaven River Flood Study - for Shoalhaven Starches, 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 - for Shoalhaven Starches, May 2008 (Reference 3);

3. DCP2014 Chapter G9:Flood Compliance Report for Proposed Modification Application to MP06-0228, Shoalhaven Starches Expansion Project, Alterations to Existing Flour Mill, Bolong Road, Bomaderry. Letter to Cowman Stoddart from WMAwater. 25 September 2015 (Reference 4);
4. Proposed Modification Application to MP06-0228, Shoalhaven Starches Expansion Project, Relocation of Product Dryer, Flood Impact Assessment, October 2015 (Reference 5);
5. Proposed Modification Application To MP06-0228, Shoalhaven Starches Expansion Project, Modification To Approved Packing Plant, Flood Impact Assessment, January 2016 (Reference 6).

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%, 15, 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 at 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),
- adoption 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.

1.5.3. DCP2014 Chapter G9:Flood Compliance Report for Proposed Modification Application to MP06-0228, Shoalhaven Starches Expansion Project, Alterations to Existing Flour Mill, Bolong Road, Bomaderry. Letter to Cowman Stoddart from WMAwater. 25 September 2015 (Reference 4)

Shoalhaven Starches proposed to undertake modifications to the existing Flour Mill at their Bomaderry plant to increase the amount of flour produced on the site. The proposal involved the installation of additional plant within the confines of the existing Flour Mill building. The only external addition to the existing building footprint was a small (3m by 4m) area located between the silos and the flour mill building.

The aerial image indicated that the position of the proposed flour mill is surrounded by an extensive array of existing plant and buildings. Thus the flow path of floodwaters from the Shoalhaven River over the river bank and towards Bolong Road is already significantly impeded. In addition the majority of the proposed works are above the PMF (all except the 3m by 4m building extension) thus their construction will have nil impact on flood levels. Construction of the building extension will have an insignificant impact on flood levels due to the density of the surrounding existing plant and the small size of the extension. In conclusion WMAwater considered that there would be no increase in the 1% AEP flood level as a result of the proposed works.

1.5.4. Proposed Modification Application to MP06-0228, Shoalhaven Starches Expansion Project, Relocation of Product Dryer, Flood Impact Assessment, October 2015 (Reference 5)

Under this Modification Application it was proposed to relocate No. 5 Starch Dryer from within the existing Shoalhaven Starches factory site to land on the western side of Abernethy's Creek. The site was partially occupied by a large warehouse and partially by an open space area occupied by staff parking. The proposed No. 5 Starch Dryer would replace the existing warehouse building with a slightly larger building footprint.

In summary the maximum increase in the 1% AEP flood level was between 0.025 and 0.05 m and mainly affected buildings and land owned by Shoalhaven Starches. The increase in flood level relative to building floor levels was provided.

1.5.5. Proposed Modification Application To MP06-0228, Shoalhaven Starches Expansion Project, Modification To Approved Packing Plant, Flood Impact Assessment, January 2016 (Reference 6)

Under this Modification Application it was proposed to:

- increase the floor area of the approved packing plant from 3050m^2 to 6200m^2 (excluding awnings);

- construct 5 storage silos adjacent to the packing plant;
- increase the size of 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 was an open field. In summary the results of modelling indicated a maximum increase in the 1% AEP flood level outside the subject site of 0.05m and mainly affected buildings and land owned by Shoalhaven Starches. The only exception was at 21 Bolong Road and to Bolong Road itself.

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 the consent authorities 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)) have worked 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.

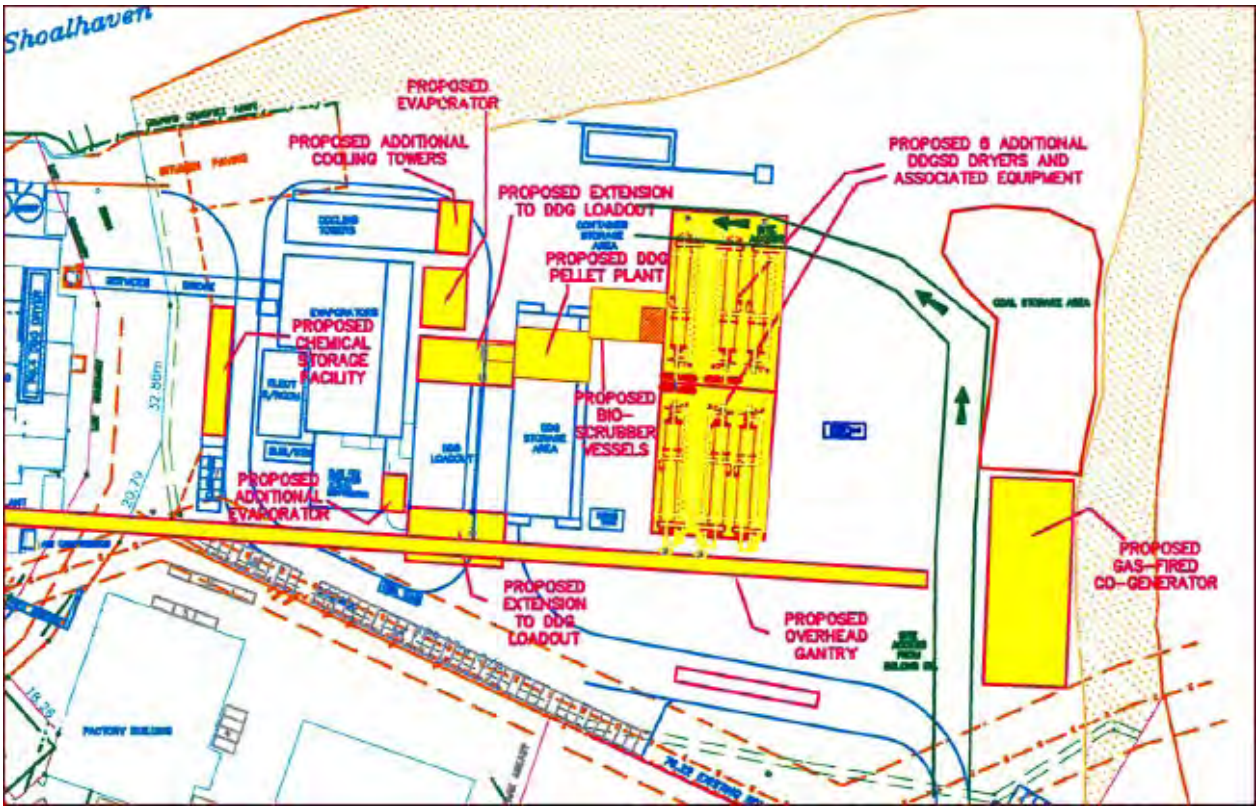


Image 2 - Figure 5a from May 2008 Proposed Ethanol Production Upgrade Report (Reference 3)

The works on the subject site (west of Abernethys Drain and south of Bolong Road), which would impact on flooding (i.e excluding the overhead gantry) as part of this assessment included (refer part of Figure 5a of Reference 3 - Image 2):

- 6 DDG dryers and associated works;
- extension to DDG loadout and pellet plant;
- bio scrubber vessels;
- gas co-generation plant;
- additional cooling towers;
- chemical store;
- evaporator.

It should be noted that the western cooling towers, twin bio-filters and MCC room shown on Figure 2a were not included in the above assessment but were subsequently approved.

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 a & b and plans provided in Appendix B):

- Reduce the number of DDG Dryers from 6 to 4;
- Slightly relocate the DDG Dryers on the site;
- Relocate the eastern and western cooling towers;
- Provide two additional bio-filters;
- Construct a forklift maintenance building;
- Relocate the MCC room;
- Provide a container storage and preparation areas;
- Regularise and expand an emergency coal and woodchip storage area on the environmental farm site located on the northern side of Bolong Road.

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 severely limited 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 3 below (taken from that report) would not require hydraulic modelling to quantify the hydraulic impacts and cumulative effects.

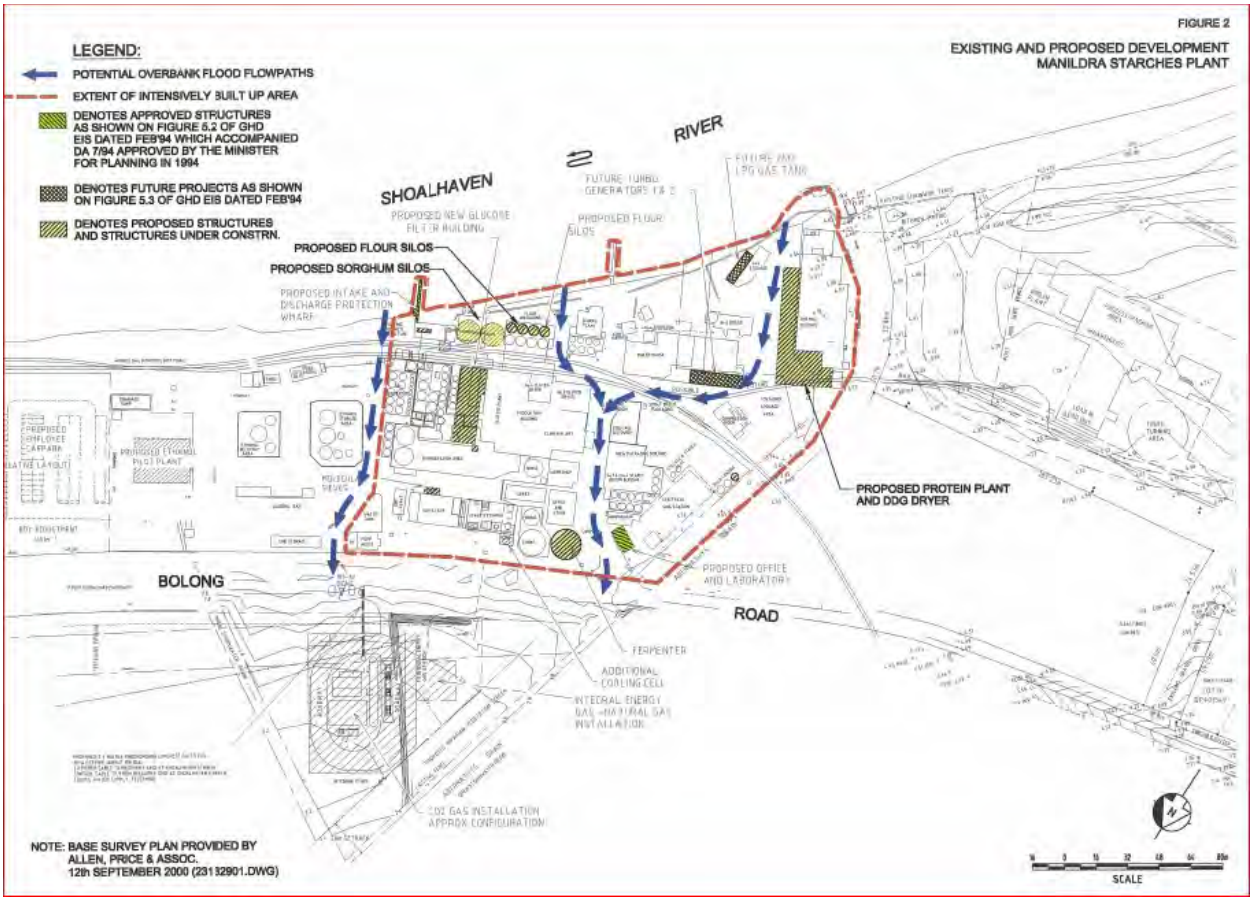


Image 3 - Agreed Extent of Intensively Built-up Area

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 four proposed design Scenarios;
2. comparison of the design flood levels for the design (inclusion of the proposed works Scenarios) to the present day approved extent of development flood levels. This indicates the incremental increase in flood level due to the proposed works;
3. comparison of the design flood levels for the design (inclusion of the proposed works Scenarios) to the 1990 assumed extent of development flood levels. This indicates the cumulative increase in flood level due to all works since 1990;
4. assessment of the increase in above building floor inundation as a result of the proposed Scenarios.

The locations of the proposed works are primarily determined by the availability of land adjacent to the existing Shoalhaven Starches plant. There is no other suitable land available within the local area outside of a high hazard area which can be used for the proposed purposes. Shoalhaven Starches has a Flood Evacuation Plan and this should ensure that the occupants

(and all other personnel at the plant) will be safely evacuated from the floodplain prior to the flood peak arriving.

3. FLOOD IMPACT ASSESSMENT

3.1. Overview

Ponding of water in low lying areas on the northern floodplain occurs following periods of heavy and continuous rain. Some parts of the land are only 1 m above high tide and consequently are frequently inundated. This results from direct rainfall over the area and also overflow from the creeks which flow through the area. In larger floods, both Abernethy's Drain and Bomaderry Creek will overtop their banks and inundate the area. This would have occurred in March 1978 and the other floods which occurred in the 1970's (August 1974, June 1975 and October 1976) as well as the April 1988 event. According to residents' reports none of these floods overtopped the northern river bank, in the vicinity of the Shoalhaven Starches plant or the Paper Mill, to any significant extent.

The existing and proposed works since 1990 on the northern floodplain do not increase flood levels in these "small" floods as there is no significant velocity and the area is a large storage basin. The largest of these events occurred in March 1978 which approximated a 5% AEP flood. For the above reasons, construction of the existing works since 1990 plus the proposed works on the northern floodplain will not cause any significant increases in flood levels for these events. These are the most frequent events that affect the area, and the above five historical events are typical examples. These "small" events contribute the bulk of what is called the "average annual flood damages" to the properties. These can be calculated by multiplying the estimated damages for a flood by the probability of the flood occurring in a given year, and summing across the range of floods. By this means the smaller floods which occur more frequently, are given a greater weighting than the rare catastrophic floods.

However floods larger than March 1978 will occur and they will overtop the bank, causing a significant inflow of floodwaters to the area. In these larger overtopping floods the proposed and existing works since 1990 on the northern floodplain will have an impact upon flood levels by restricting flow and reducing temporary floodplain storage. These are much rarer events and generally the majority of the ground is inundated by up to 3 m depth of water. Some plants (Paper Mill - now owned by Shoalhaven Starches) are already inundated by up to 1.5 m depth of water and consequently the small increase in level caused by the existing and proposed works since 1990 is unlikely to be significant. In the case of the old Dairy Farmers plant, the main building (now owned by Shoalhaven Starches) is elevated above the 1% AEP level and is therefore not inundated except in a rarer event.

The most obvious impact of an increase in flood level is an increase in economic damages due to a greater depth of inundation. These impacts are discussed in Section 3.2. However there are also possible social and environmental impacts and these are discussed in the subsequent Section 3.3.

3.2. Increase in 1% AEP Flood Levels

The following four design scenarios have been investigated:

- **Scenario A**: Reflects the impacts of the relocation of existing approved works not yet built, namely; the western and eastern cooling towers, the MCC room and reduction / relocation of the number of DDG dryers from 4 to 6;
- **Scenario B1**: Reflects the effects of Scenario A plus two additional bio-filters, the forklift maintenance building and the container storage and preparation area;
- **Scenario B2**: Reflects the effects of Scenario B1 but with part of the container storage area (temporarily) occupied by the coal and woodchip storage area;
- **Scenario C**: Reflects the effects of Scenario B1 plus a coal and woodchip storage area on the east side of Hanigans Lane.

The effects of each of the above four scenarios has been compared against the current (January 2016) approved works on the floodplain namely;

- all approved and constructed plant operated by Shoalhaven Starches;
- all approved and yet to be constructed plant operated by Shoalhaven Starches as located in the original approval (refer Image 1 and Figure 2 a & b);
- construction of all works as outlined in References 4 to 6.

In addition the effects of each of the above four scenarios has been compared against the assumed 1990 conditions on the floodplain. In this way the cumulative effects of all known developments on the northern floodplain can be evaluated.

3.2.1. Effect of Scenario A - Relocation of Existing Approved Works not yet Built

The increase in the 1% AEP flood level due to the relocation of existing approved works are shown on Figure 3 (compared to current - 2016 floodplain conditions) and Figure 7 (compared to - 1990 floodplain conditions). Figure 3 indicates that the relocation of existing approved works produces only a minor increase in level along the northern bank of the Shoalhaven River and a minor decrease in level to the north of the subject site.

In effect the relocation has produced a minor "blocking" of the inflows through the subject site and thus there will also be a small increase in flow and level in the Shoalhaven River but as this impact is "spread" across the entire river it is below the threshold level of 0.01m shown on Figure 3.

In summary Scenario A produces no significant incremental (beyond that which exists at January 2016) increase in the flood levels on surrounding properties.

3.2.2. Effect of Scenario B1 - Additional Buildings to Scenario A

The increase in the 1% AEP flood level due to the proposed increase in buildings as well as the relocation of existing approved works (Scenario A) are shown on Figure 4 (compared to current - 2016 floodplain conditions) and Figure 8 (compared to - 1990 floodplain conditions). Figure 4 indicates that Scenario B1 produces similar effects to Scenario A (i.e a minor increase in level along the northern bank of the Shoalhaven River and a minor (but greater than Scenario A) decrease in level to the north of the subject site). Whilst the addition of the large container store and preparation area might suggest an increase in level its hydraulic effects are to a large extent nullified by the presence of the relocated DDG dryers (Scenario A) and the approved gas co-generator building.

In effect the combined changes have produced a minor additional (to Scenario A) "blocking" of the inflows through the subject site and thus there will also be a small additional increase in flow and level in the Shoalhaven River. However as this impact is "spread" across the entire river it is below the threshold level of 0.01m shown on Figure 4.

In summary Scenario B1 produces no significant incremental (beyond that which exists at January 2016) increase in the flood levels on surrounding properties.

3.2.3. Effect of Scenario B2 - Inclusion of Temporary Coal and Woodchip Storage Area to Scenario B1

The increase in the 1% AEP flood level due to the inclusion of the temporary coal and woodchip storage area (refer Image 4 and Appendix B) plus the proposed increase in buildings (Scenario B1) and the relocation of existing approved works (Scenario A) are shown on Figure 5 (compared to current - 2016 floodplain conditions) and Figure 9 (compared to - 1990 floodplain conditions). Figure 5 indicates that the additional impacts of the temporary coal and woodchip storage area to Scenario B1 produces very similar effects to Scenario B1 (i.e a minor increase in level along the northern bank of the Shoalhaven River and a minor (but greater than Scenario A) decrease in level to the north of the subject site).

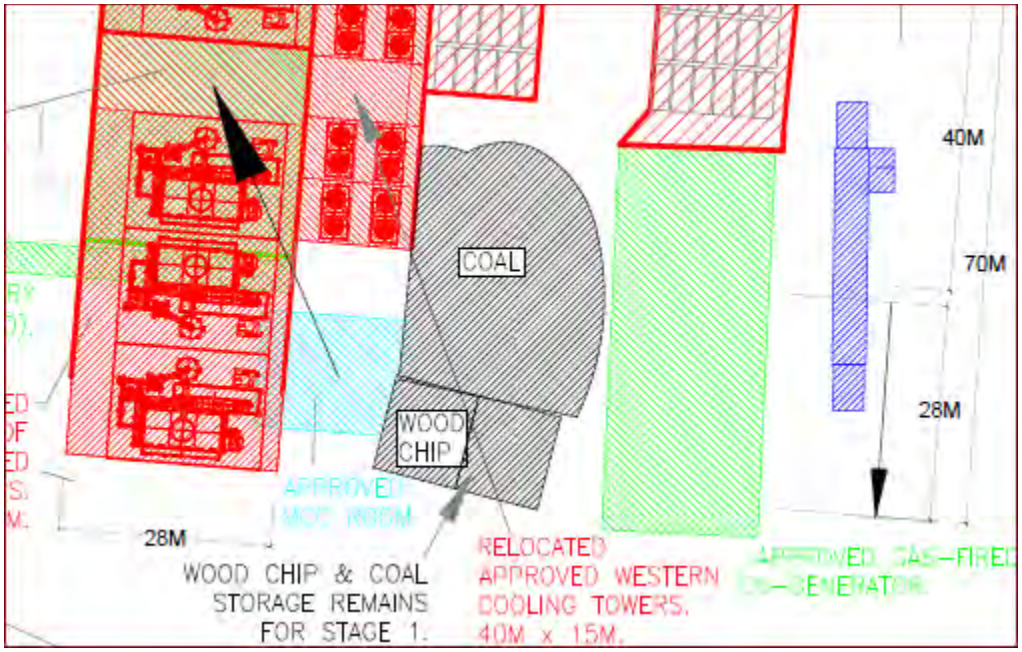


Image 4 - Scenario B2 Temporary Coal and Woodchip Storage Area

In summary Scenario B2 produces no significant incremental (beyond that which exists at January 2016) increase in the flood levels on surrounding properties.

3.2.4. Effect of Scenario C - Inclusion of Coal and Woodchip Storage Area at Hanigans Lane to Scenario B1

Scenario C represents the extent of the proposed developments at this time and assumes Scenario B1 plus the permanent coal and woodchip storage area on the east side of Hanigans Lane. This proposed storage area will occupy approximately 4 hectares (325m by 125m) and is located to the immediate south west of the existing storage ponds.

The increase in the 1% AEP flood level due to the inclusion of the permanent coal and woodchip storage area plus the proposed increase in buildings (Scenario B1) and the relocation of existing approved works (Scenario A) are shown on Figure 6 (compared to current - 2016 floodplain conditions) and Figure 10 (compared to - 1990 floodplain conditions). Figure 6 indicates that the additional impacts of the permanent coal and woodchip storage area (on the east side of Hanigans Lane) to Scenario B1 produces very similar effects to Scenario B1 near the plant however produces over a 0.1m increase on the south side of the proposed permanent coal and woodchip storage area.

3.2.5. Summary of Increase in 1% AEP Flood Levels

- Blocking the flow path of flood waters (at the Shoalhaven Starches plant) in the 1% AEP event into the northern floodplain due to the proposed works will slightly increased flood levels in the immediate upstream area but also results in less flood water entering the northern floodplain and slightly lower flood levels downstream.

- In the 5% AEP event (an event of similar magnitude to the March 1978 flood) there will be no increase in flood level (or consequent changes in extent of inundation etc.) as a result of the constructed and proposed works on the floodplain since 1990 as the northern bank is not overtopped to any great extent. This means that in the smaller more frequent events, up to a 5% AEP, the proposed works on the floodplain have minimal impact. In these small events there is little flow into the northern floodplain from the Shoalhaven River and the floodplain predominantly acts as a flood storage area. In these smaller floods (up to the 5% AEP) the northern floodplain is largely filled by local catchment runoff and particularly from Broughton Creek.
- It should be noted that the incremental effect of the proposed works is small with the majority of the impact occurring on land and buildings owned by Shoalhaven Starches.

3.3. Other Hydraulic Impacts

The other hydraulic impacts of the proposed works (apart from an increase in peak level) can be subdivided into the following categories:

- increase in frequency of inundation;
- increase in duration of inundation;
- increase in extent of inundation at the perimeter of the floodplain;
- increase in velocity of flood waters across the floodplain.

3.3.1. Increase in Frequency of Inundation

An increase in the frequency of inundation occurs as a result of an increase in flood level. For example, a rise in flood level of 0.1m within the 2% to 1% AEP flood range (4.93 mAHD to 5.25 mAHD at the old Paper Mill) would represent an approximate 10 year increase in frequency of inundation (say from a 1 in 70 year to a 1 in 60 year occurrence). This impact is of particular importance in the smaller more frequent floods (say in less than the 5% AEP). However in the 5% AEP and smaller events there will be no impact on flood levels and thus the frequency of inundation as the northern bank of the Shoalhaven River is not overtopped until approximately a 5% AEP event.

3.3.2. Increase in Duration of Inundation

There will be some increase in the extent of inundation at peak levels but this will depend upon the nature of the flood event (quickly rising and falling event or one that rises and falls slowly). Figure 15 provides a Stage (height) hydrograph at the confluence with Bomaderry Creek for the 1% AEP (between 1990 conditions and Scenario C) and indicates that a change in the peak level makes no significant difference to the duration of inundation.

3.3.3. Increase in Extent of Inundation

The northern floodplain is low lying land (ground levels at 2 m AHD or below with no areas of high ground except around the perimeter). It is entirely inundated by floodwaters in say the 5%

AEP event and greater. Thus any increase in flood level, caused by development, will only result in an increase in the extent of inundation around the perimeter of the floodplain. The increased area of inundation will vary between floods and depends upon the grade of the topography at the perimeter and the length of the perimeter. A flat grade will result in a large increase in area, whilst a steep grade will result in only a small increase. The following preliminary assessment provides an indication of the likely extent of any increase.

Assuming a 0.1m rise in flood level and a consequent lateral increase in extent of 2m over approximately 3 kilometres of perimeter will produce an areal increase of approximately 6,000 m^2.

3.3.4. Increase in Velocity of Floodwaters

Comparison of velocities between different floodplain conditions is more complex than comparison of peak levels. The main difference being that the peak flood velocity may not necessarily occur at the same time as the peak flood height. More often than not it will occur when floodwaters first enter an area at a time of very small flow. This velocity is generally not relevant for comparison purposes. A more appropriate velocity is generally that which is experienced at peak flood height since, in combination with the deepest floodwaters this is likely to represent the greatest flood hazard. It should be noted that local velocities between obstructions may be higher than this average velocity obtained from the TUFLOW model.

Figure 16 indicates the change in the 1% AEP peak velocity (between 1990 conditions and Scenario C). The changes in peak velocity are generally less than +/- 0.5m/s except near the storage ponds where the "throttling" of the flow paths caused by the storage ponds and proposed coal and woodchip storage area increases the peak velocities by up to 2 m/s.

3.4. Consequences of Increases in 1% AEP Flood Level

The consequences of an increase in flood level is reflected in an increase in:

- social impacts (stress, risk to life);
- environmental impacts;
- tangible damages at private and public properties. Largely this is due to an increase in above floor level inundation.

3.4.1. Social Impacts

Social impacts (intangible damages) from flooding include stress and anxiety, risk to life, disruption to work and services, isolation and depression. The majority of the buildings in this area are for commercial and/or industrial purposes and thus the social impacts of flooding for these properties relate primarily to loss of productive work and the increase in stress associated with it. However most of the businesses would already be shut down before the cumulative increases produced a significant effect in this regard.

The residential properties experience greater social impacts because of the personal loss involved. For the residential properties affected by the cumulative increases in flood level, there may be increases in damages due to the existing and proposed works. However it is unlikely that the relative increases in level (less than 0.1 m in events up to and including the 1% AEP) will invoke a significant social impact in any particular flood.

Thus there will be no significant or sudden increase in the risk to life as a result of the cumulative increases.

3.4.2. Environmental Impacts

Flooding is a natural part of the life cycle of a floodplain and sustains the ecosystem by providing nutrients to the environment. Prior to European settlement the area around Bolong Road would have been inundated by floods and the flora and fauna would have adapted to this regime. The majority of the area is now developed for rural purposes (primarily by Shoalhaven Starches) with the remainder being used for industrial purposes. The area to the north of Bolong Road consists of cultivated rural grasslands which are irrigated from the storage ponds.

There are three main issues with regard to the impacts of flooding on the environment. The first is the duration of inundation, the second is the depth of inundation and the third is the velocity of flow. The latter has been ignored in this investigation as the cumulative works have negligible impacts upon velocities.

During floods, water can remain over the land for several days causing the non water tolerant flora species on the floodplain to rot, impacting on the water quality of the runoff. However the the existing and proposed works do not affect the rate of low flow runoff. Thus any increases in flood levels will not impact upon the process of flora species decaying as a result of inundation.

The entire northern floodplain is inundated by of the order of three metres of water in a major event, the increase (of typically less than 0.1 m) caused by the cumulative works represents only a small percentage of this. The potential impacts on plants occurs when their roots are submerged for some time which causes non water tolerant species to rot and ultimately die. In this case, the increases in flood levels will not cause a significant increase in the number of plants affected by water inundation.

Therefore, based on the available information, this environment will not sustain any significant ecological impact from an extra 0.1 m depth of floodwaters due to the works.

A further issue is whether the cumulative increases will cause environmental impacts elsewhere. Potentially, flooding causes industrial wastes and gross pollutants to wash downstream. These types of impacts could be attributed to overflows from process plants or solid wastes washing away during floods. Generally these types of impacts would occur at the beginning of a flood event (frequency of about 5% AEP), at which time there would be no impacts from the existing since 1990 and proposed works.

Of possible concern is the release of coal and woodchip from the storage area. However these goods are generally not toxic.

The storage of goods on the western side of Abernethy's Drain in the proposed container preparation and storage area could potentially increase the level of environmental harm if pollutants are released as a result of inundation during a flood. This risk is considered to be low as the material is stored in containers which are unlikely to result in significant "leakage" during a flood. Also the material stored is of a non-toxic nature.

3.4.3. Increase in Tangible Damages at Properties

Flood damages can be subdivided into Tangible (for which a monetary value can be assigned) and Intangible (for which a monetary value cannot be assigned - Section 3.4.1 and 3.4.2). This study has focussed on the potential increases in tangible damages to the nearby largely commercial and industrial buildings. The main tangible damages to these operations and private houses are:

- structural damages to buildings;
- water damage to equipment, carpets, household furniture;
- loss of production because of inundation or restricted access;
- loss/damages to stock;
- loss of wages to workers or the cost to the company of paying staff;
- clean up costs.

Each of the above factors contributes to the economic losses caused by flooding. A significant factor affecting the actual extent of damages experienced is the level of preparedness and responsiveness of the owner to flooding.

It has been assumed in the assessment that the relatively minor increases in flood levels caused by existing and proposed works would have a negligible impact on the likely structural damages to any building. There are formulae and depth v damages graphs for estimating flood damages based upon surveys carried out after past floods. These are appropriate for use on residential properties, but are of less relevance for commercial and industrial properties due to the large range of possible usages and consequent damages (concrete batching plant versus an electrical store, for example).

The increase in damages will depend upon the pre works depth of the above floor inundation. For example, the greatest % increase in damages will occur if the increase in flood level occurs when the peak level is just above the floor (say less than 0.1m) as opposed to when there is already 1 m depth of water above the floor (refer example on Image 5).

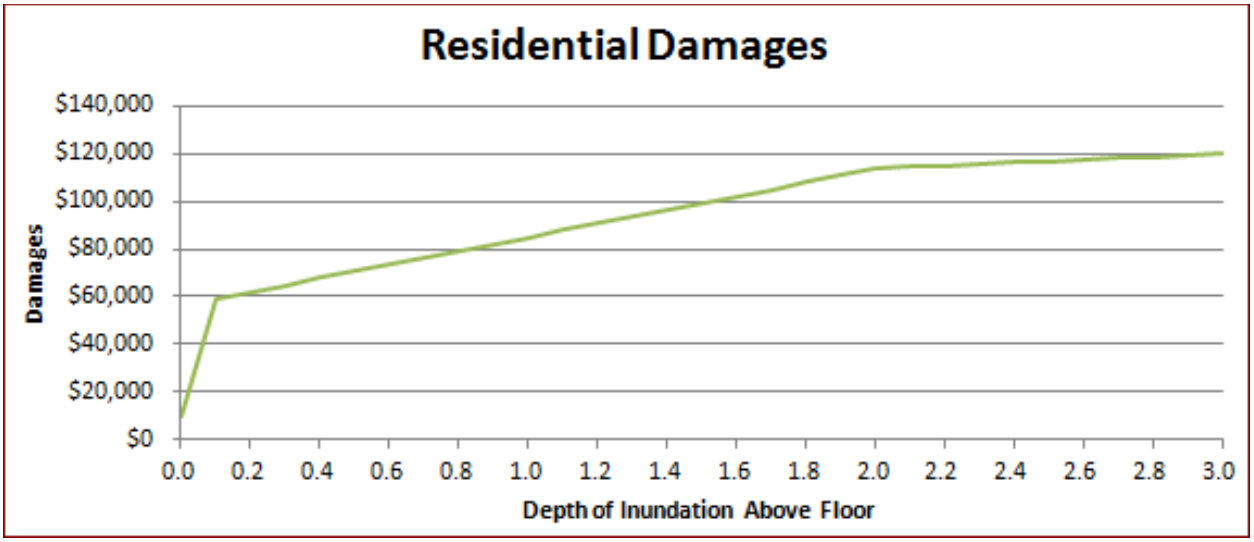


Image 5 - Example of Depth versus Residential Damages

The increases in the depth of above floor inundation (above the existing peak depth from 1990 to January 2016 and for the proposed Scenarios) as well as the reduction in clearance of the floor above the 1% AEP flood level are shown on Figure 11 to Figure 14. It should be noted that the graphs are arranged in order of the greatest depth of above floor inundation where the building is affected by > 0.01m increase in flood level. Thus the building with the greatest depth of inundation does not necessarily have the greatest increase in flood level.

In summary Figure 11 to Figure 14 indicates that the incremental increase (beyond the impacts at January 2016) in the 1% AEP flood level at the surveyed buildings for each of the proposed scenarios is relatively minor.

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) advise that the site at 32 Bolong Road is inundated in the 1% AEP event and is described as High Hazard Floodway. The proposed coal and wood chip bulk storage area at 20 Hanigans Lane 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) indicate 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 those performance criteria has not been addressed.

PERFORMANCE CRITERIA	RESPONSE
P1 Development or work on flood prone land will meet the following:	
The development will not increase the risk to life or safety of persons during a flood event on the development site and adjoining land.	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.
The development or work will not unduly restrict the flow behaviour of floodwaters.	Refer Flood Impact Assessment above (Section 3).
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.	The works at 32 Bolong Road are within industrial land partially occupied by constructed or approved to be constructed buildings. The development will have no significant impact on erosion, siltation or destruction of vegetation. Neither will the increase in impervious area cause any significant increase in runoff from the site.

PERFORMANCE CRITERIA	RESPONSE
	The works at 20 Hanigans Lane are on largely grassland but with an adjacent store of used equipment. There is a risk that part of the proposed coal and woodchip store at this location or at the temporary location at 32 Bolong Road may become mobilised.
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.	**A separate structural report will be provided.**
The development will not become unsafe during floods or result in moving debris that potentially threatens the safety of people or the integrity of structures.	**A separate structural report will be provided.**
Potential damage due to inundation of proposed buildings and structures is minimised.	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 and other water sensitive components should as far as possible be raised above the 1% AEP flood level + 0.5m.
The development will not obstruct escape routes for both people and stock in the event of a flood.	The works will not occupy escape routes or cause workers to become trapped.
The development will not unduly increase dependency on emergency services.	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.
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.	Refer Flood Impact Assessment above (Section 3).
The development will not adversely affect the integrity of floodplains and floodways, including riparian vegetation, fluvial geomorphologic	The works will be constructed on land designated as high hazard floodway and high hazard storage in the 1% AEP

PERFORMANCE CRITERIA	RESPONSE
environmental processes and water quality.	event. The site at 20 Hanigans Lane is largely vacant land with no existing vegetation apart from grasses and is beyond the influence of normal fluvial geomorphic processes. The site at 32 Bolong Road is cleared earth with no vegetation cover. The works should not exacerbate the integrity of the floodplain beyond what will already occur during large floods.
P2 Filling or excavation on flood prone land will meet the following:	The works involve minimal earthwork excavation but the buildings and proposed coal and woodchip store will be the equivalent of filling as they will obstruct the existing flood flows.
High hazard floodway areas are kept free of fill and/or obstructions.	The locations are within a high hazard flood storage and floodway areas, however the location of the works is determined by the nearby rail line and other related plant. There is no other location where the works could be situated. The hydraulic impact of the proposed works is minimised by the proposed coal and woodchip store being located in a flood storage rather than a floodway area. The hydraulic effect of the container store is to some extent minimised by being adjacent to the approved DDG works.
The proposed fill or excavation will not unduly restrict the flow behaviour of floodwaters.	Refer Flood Impact Assessment above (Section 3).
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.	Refer Flood Impact Assessment above (Section 3).
The proposed fill or excavation will not exacerbate erosion, siltation and destruction of vegetation caused by floodwaters flowing on the land.	The site at 20 Hanigans Lane is largely vacant land with no existing vegetation apart from grasses and is beyond the influence of normal fluvial geomorphic processes. The site at 32 Bolong Road is cleared earth with no vegetation cover. The works should not

PERFORMANCE CRITERIA	RESPONSE
	exacerbate the integrity of the floodplain beyond what will already occur during large floods.
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.	The locations are within a high hazard flood storage and floodway 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 locations where the works could be situated.
The proposed excavation does not create new habitable rooms, non habitable storage areas or car parks with floor levels below the existing ground level.	The works do not involve habitable or non habitable residential storage areas or below ground car parks.

4.3. 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.

5. 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

4. Letter to Cowman Stoddart Pty Ltd
DCP2014 Chapter G9:Flood Compliance Report for Proposed Modification Application to MP06-0228, Shoalhaven Starches Expansion Project, Alterations to Existing Flour Mill, Bolong Road, Bomaderry
WMAwater, 25 September 2015

5. Shoalhaven Starches
Proposed Modification Application to MP06-0228, Shoalhaven Starches Expansion Project, Relocation of Product Dryer, Flood Impact Assessment
WMAwater, October 2015

6. Shoalhaven Starches
Proposed Modification Application To MP06-0228, Shoalhaven Starches Expansion Project, Modification To Approved Packing Plant, Flood Impact Assessment
WMAwater, January 2016

Figures

FIGURE 1
STUDY AREA

SYDNEY
WOLLONGONG
STUDY AREA
HUSKISSON

BERRY
BOMADERRY CREEK
BOMADERRY
ABERNATHY'S CREEK
BOLONG ROAD
SHOALHAVEN HEADS
SHOALHAVEN RIVER
SHOALHAVEN STARCHES PLANT
PIG ISLAND
TERARA ROAD
RIVERVIEW ROAD
TERARA
NOWRA
NUMBAA
COMERONG ISLAND
BERRYS CANAL
GREENWELL POINT ROAD
GREENWELL POINT
ORIENT POINT
PRINCES HIGHWAY
CROOKHAVEN RIVER
CULBURRA

N

Model Extent
Towns
Railways
Roads
Levee

0 0.5 1 2 3 4 km

J:\Jobs\112040\ArcGIS\ArcMaps\ReportFigures\Figure01_ModelExtent.mxd

EXISTING APPROVED PLANT

APPROVED AND CONSTRUCTED DEVELOPMENTS

APPROVED DEVELOPMENTS YET TO BE CONSTRUCTED

APPROVED DEVELOPMENTS TO BE RELOCATED.

PROPOSED DDG DRYER MODS AND ASSOCIATED WORKS.

PROPOSED MILL FEED SILO/STRUCTURE.

RELOCATED APPROVED EASTERN COOLING TOWERS. 8M x 15M.

APPROVED ADDITIONAL EASTERN COOLING TOWERS

EXISTING COOLING TOWERS

CONC SLAB

BIOFILTER BLOWER

APPROVED 6 ADDITIONAL DDG DRYERS AND ASSOCIATED EQUIPMENT.

APPROVED DDG PELLET PLANT.

DDG PELLET PLANT.

PROPOSED CONTAINER STORAGE AREA.

APPROVED ADDITIONAL WESTERN COOLING TOWERS

APPROVED & CONSTRUCTED BIOFILTERS.

BIOFILTER

BIOFILTER

BIOFILTER

BIOFILTER

PROPOSED ADDITIONAL BIOFILTER. 30M x 16M.

FORKLIFT MAINTENANCE BUILDING. 18M SPAN x 42M LENGTH.

18M

42M

15M

FORK LIFT ROADWAY.Min. 15m WIDE.

PROPOSED CONTAINER STORAGE AREA.

No.1 DDG DRYER

No.2 DDG DRYER

DRYER 7

No.3 DDG DRYER

APPROVED EVAPORATOR

EVAPORATORS

APPROVED CHEMICAL STORAGE FACILITY

ELECT S/ROOM

APPROVED AND CONSTRUCTED EXTENSION TO DDG LOADOUT

SUB/STN

DDG LOADOUT

DDG STORAGE

EVAPORATOR

DDG STORAGE

RELOCATED MCC ROOM

EX SW

APPROX BUND

APPROVED ADDITIONAL EVAPORATOR

APPROVED

OVERHEAD GANTRY (LENGTH REDUCED).

APPROVED EXTENSION TO DDG LOADOUT

PROPOSED RELOCATION OF APPROVED 4 DDG DRYERS. 70M x 28M.

28M

40M

70M

28M

APPROVED MCC ROOM

RELOCATED APPROVED WESTERN COOLING TOWERS. 40M x 15M.

APPROVED & CONSTRUCTED WEIGHBRIDGE

APPROVED GAS–FIRED CO–GENERATOR.

ISS	DATE	ZONE	CHANGE AMMENDMENTS	BY	CKD
I	30–3–16	ALL	proposals finalised.	P.C.	G.M.
I	15–9–15	ALL	proposal	P.C.	G.M.

MANILDRA GROUP

Commitment to Excellence

DRAWN P.J.C.
TRACED
CHECKED
APPROVED
DRG PRACTICE AS1100

TOLERANCES LINEAR ±.2 ANGULAR ±.5

FINISH NA

MATERIAL NA

MANILDRA GROUP.NOWRA.

TITLE DDG DRYING. LAYOUT OF DDG DRYER MODS.

SIZE A3 | SCALES 1:750 | SHT

ISSUE 5765A

DRG. № MN261–001–I

PROPOSED
DDG DRYERS
AND ASSOCIATED WORKS.

SHOALHAVEN RIVER

BOLONG ROAD

WOOD CHIP

COAL

PROPOSED
COAL AND WOOD CHIP
BULK STORAGE AREA.

LANE

HANIGANS

MEADOW

RAILWAY

STREET

COAST

SOUTH

EXISTING
APPROVED PLANT.

APPROVED AND
CONSTRUCTED
DEVELOPMENTS.
MP06-0228.

PROPOSED
DDG DRYERS,ASSOCIATED
WORKS AND COAL
AND WOOD CHIP
STORAGE AREA.

ISS	DATE	ZONE	CHANGE AMENDMENTS	BY	CKD
C	04-09-15	ALL	Silos added,feed to silos added,scale was 1:100.	P.C.	P.G.
B	14-7-15	ALL	Flour mill plan.	P.C.	S.R.
A	2-7-15	ALL	Revised layout.	P.C.	S.R.
1	17-6-15	ALL	Draft.	P.C.	K.L.

MANILDRA GROUP
Commitment to Excellence

DRAWN	P.C.
TRACED	
CHECKED / APPROVED	
DRG PRACTICE	AS1100

TITLE:
SHOALHAVEN STARCHES
ADDITIONAL DDG DRYING.
COAL AND WOOD CHIP BULK STORAGE.

SIZE	A3
SCALE:	1:5000
MANILDRA-5765	
DRG. No:	MN261-007G

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

Impacted Properties (See Figure 11)
Relocated Buildings
Existing Buildings
No Longer Flooded
Newly Flooded

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

N

0 0.25 0.5 1 km

J:\Jobs\114044\ARC\Impacts\Apr16_CFD_Impact\Figure03_Proposal_CFDA_1%AEP_Impact.mxd

FIGURE 4
PEAK FLOOD LEVEL IMPACT
1% AEP EVENT
SCENARIO B1 PROPOSAL AS PER PLAN

Impacted Properties (See Figure 12)
Relocated Buildings
Proposed Buildings
Existing Buildings
No Longer Flooded
Newly Flooded

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

N

0 0.25 0.5 1 km

J:\Jobs\114044\ARC\Impacts\Apr16_CFD_Impact\Figure04_Proposal_CFDB1_1%AEP_Impact.mxd

FIGURE 5
PEAK FLOOD LEVEL IMPACT
1% AEP EVENT
SCENARIO B2 PROPOSAL AS PER PLAN

Impacted Properties (See Figure 13)
Relocated Buildings
Proposed Buildings
Existing Buildings
No Longer Flooded
Newly Flooded

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

N

0 0.25 0.5 1 km

J:\Jobs\114044\ARC\Impacts\Apr16_CFD_Impact\Figure05_Proposal_CFDB2_1%AEP_Impact.mxd

FIGURE 6
PEAK FLOOD LEVEL IMPACT
1% AEP EVENT
SCENARIO C PROPOSAL AS PER PLAN

Impacted Properties (See Figure 14)
Relocated Buildings
Proposed Buildings
Existing Buildings
No Longer Flooded
Newly Flooded

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

N

0 0.25 0.5 1 1.5 km

J:\Jobs\114044\ARC\Impacts\Apr16_CFD_Impact\Figure06_Proposal_CFDC_1%AEP_Impact.mxd

FIGURE 7
PEAK FLOOD LEVEL IMPACT
1% AEP EVENT
SHOALHAVEN STARCHES 1990 SCENARIO A PROPOSAL AS PER PLAN

Impacted Properties (See Figure 11)
Relocated Buildings
Existing Buildings
No Longer Flooded
Newly Flooded

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

N

0 0.25 0.5 1 km

J:\Jobs\114044\ARC\Impacts\Apr16_CFD_Impact\Figure07_Proposal_CFDA_1%AEP_1990_Impact.mxd

FIGURE 8
PEAK FLOOD LEVEL IMPACT
1% AEP EVENT
SHOALHAVEN STARCHES 1990 SCENARIO B1 PROPOSAL AS PER PLAN

Impacted Properties (See Figure 12)
Relocated Buildings
Proposed Buildings
Existing Buildings
No Longer Flooded
Newly Flooded

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

N

0 0.25 0.5 1 km

J:\Jobs\114044\ARC\Impacts\Apr16_CFD_Impact\Figure08_Proposal_CFDB1_1%AEP_1990_Impact.mxd

FIGURE 9
PEAK FLOOD LEVEL IMPACT
1% AEP EVENT
SHOALHAVEN STARCHES 1990 SCENARIO B2 PROPOSAL AS PER PLAN

Impacted Properties (See Figure 13)
Relocated Buildings
Proposed Buildings
Existing Buildings
No Longer Flooded
Newly Flooded

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

N

0 0.25 0.5 1 km

J:\Jobs\114044\ARC\Impacts\Apr16_CFD_Impact\Figure09_Proposal_CFDB2_1%AEP_1990_Impact.mxd

FIGURE 10
PEAK FLOOD LEVEL IMPACT
1% AEP EVENT
SHOALHAVEN STARCHES 1990 SCENARIO C PROPOSAL AS PER PLAN

Impacted Properties (See Figure 14)
Relocated Buildings
Proposed Buildings
Existing Buildings
No Longer Flooded
Newly Flooded

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

N

0 0.25 0.5 1 1.5 km

J:\Jobs\114044\ARC\Impacts\Apr16_CFD_Impact\Figure10_Proposal_CFDC_1%AEP_1990_Impact.mxd

Figure 11 - Peak Flood Level Increases - 1% AEP event - Proposed Scenario A (As Per Plans)

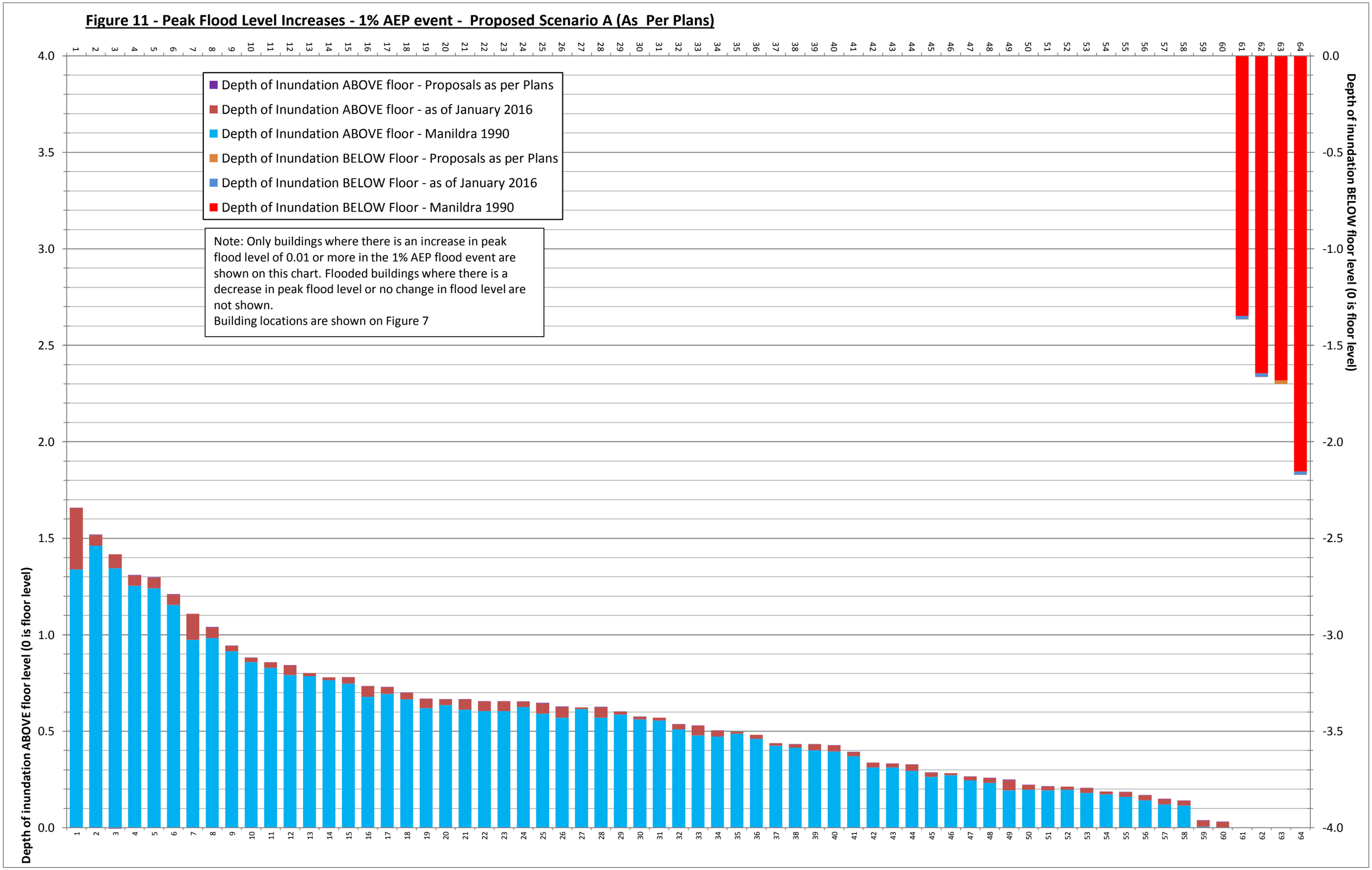


Figure 12 - Peak Flood Level Increases - 1% AEP event - Proposed Scenario B1 (As Per Plans)

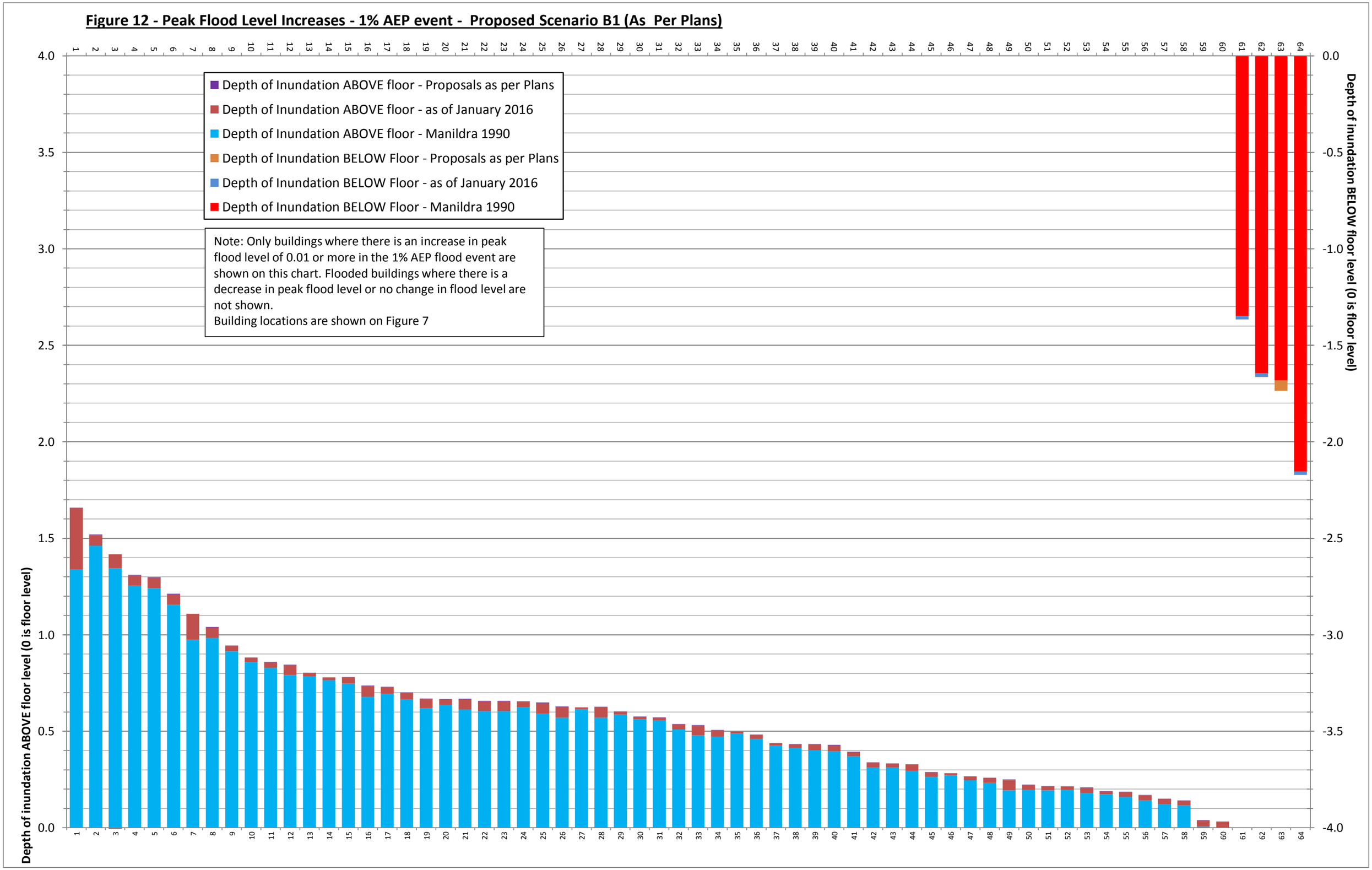


Figure 13 - Peak Flood Level Increases - 1% AEP event - Proposed Scenario B2 (As Per Plans)

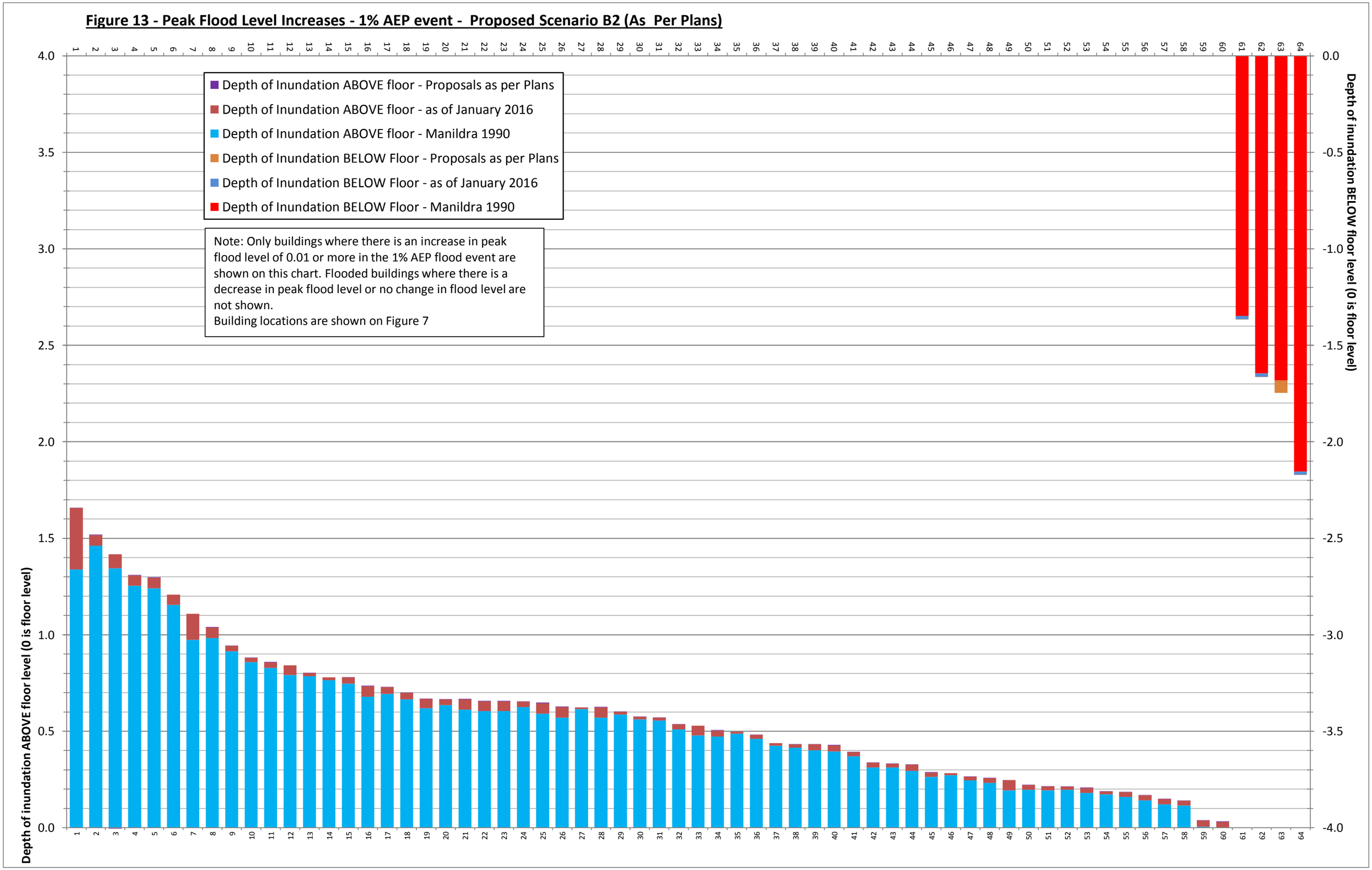
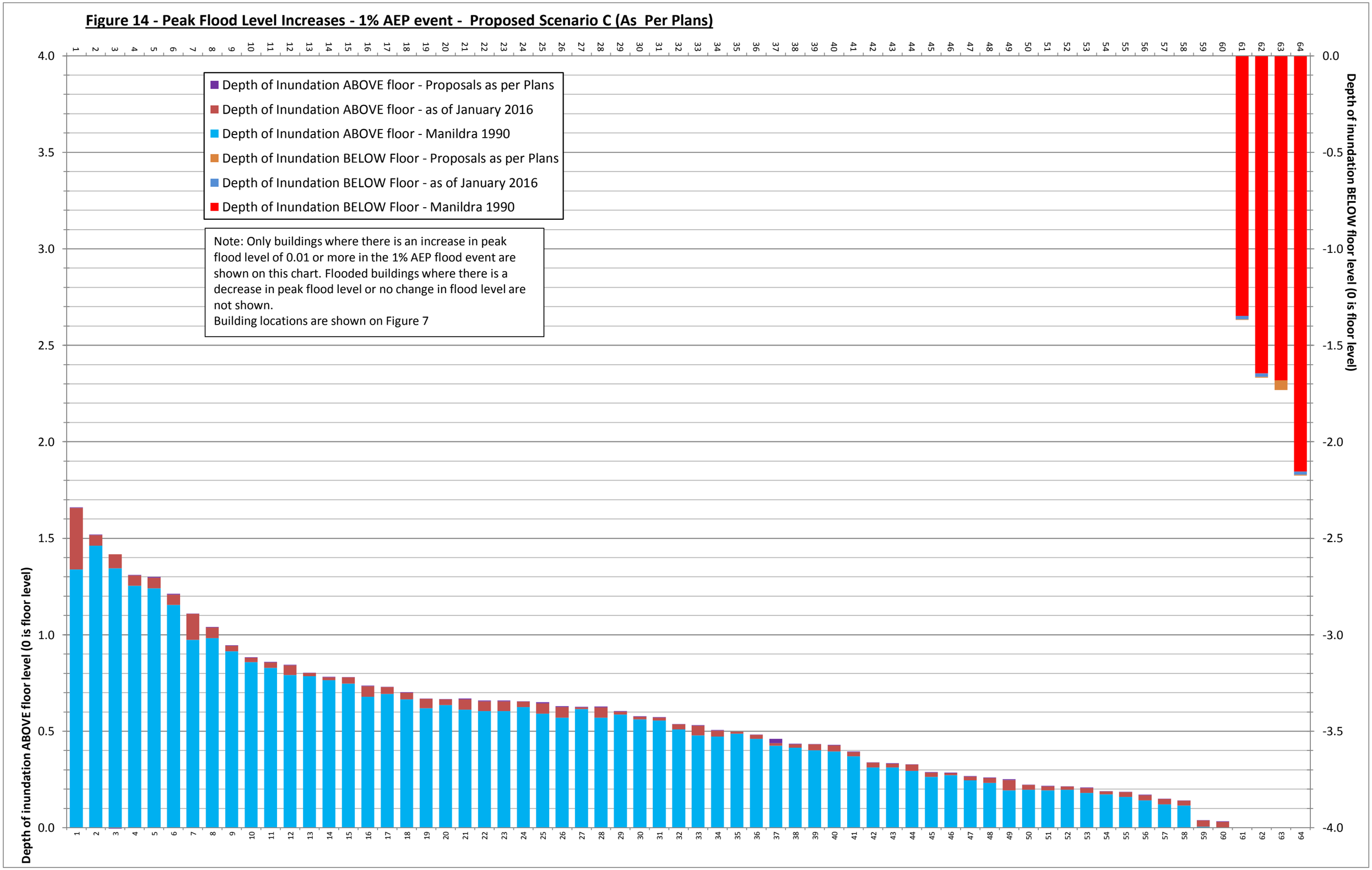


Figure 14 - Peak Flood Level Increases - 1% AEP event - Proposed Scenario C (As Per Plans)



J:\Jobs\114044\Excel\BomaderryStageHydrograph.xlsx

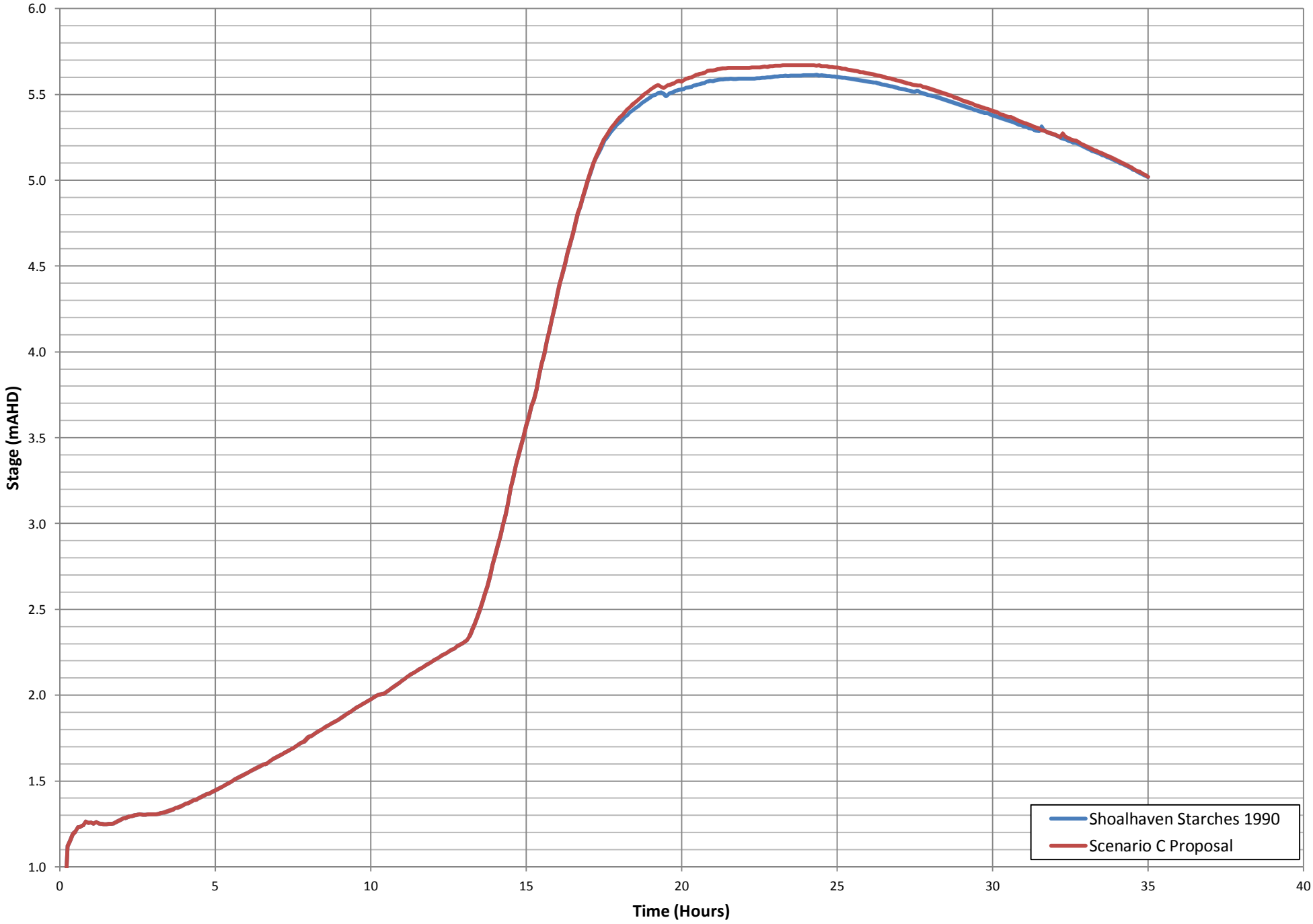


FIGURE 15

Stage Hydrograph Bomaderry Creek Confluence
1% AEP event
Shoalhaven Starches 1990 and Proposed Scenario C (As Per Plans)

FIGURE 16
PEAK FLOOD VELOCITY IMPACT
1% AEP EVENT
SHOALHAVEN STARCHES 1990 SCENARIO C PROPOSAL AS PER PLAN

Impacted Properties (See Figure 14)
Relocated Buildings
Proposed Buildings
Existing Buildings

Change in Velocity (m/s)

- < -2.0
- -2.0 - -1.5
- -1.5 - -1.0
- -1.0 - -0.5
- -0.5 - -0.1
- No Impact
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

N

0 0.25 0.5 1 1.5 km

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Appendix A

APPENDIX A: GLOSSARY

Taken from the Floodplain Development Manual (April 2005 edition)

acid sulfate soils	Are sediments which contain sulfidic mineral pyrite which may become extremely acid following disturbance or drainage as sulfur compounds react when exposed to oxygen to form sulfuric acid. More detailed explanation and definition can be found in the NSW Government Acid Sulfate Soil Manual published by Acid Sulfate Soil Management Advisory Committee.
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 m^3/s has an AEP of 5%, it means that there is a 5% chance (that is one-in-20 chance) of a 500 m^3/s or larger event occurring in any one year (see ARI).
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average Annual Damage (AAD)	Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time.
Average Recurrence Interval (ARI)	The long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
caravan and moveable home parks	Caravans and moveable dwellings are being increasingly used for long-term and permanent accommodation purposes. Standards relating to their siting, design, construction and management can be found in the Regulations under the LG Act.
catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
consent authority	The Council, Government agency or person having the function to determine a development application for land use under the EP&A Act. The consent authority is most often the Council, however legislation or an EPI may specify a Minister or public authority (other than a Council), or the Director General of DIPNR, as having the function to determine an application.
development	Is defined in Part 4 of the Environmental Planning and Assessment Act (EP&A Act). **infill development:** refers to the development of vacant blocks of land that are generally surrounded by developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development. **new development:** refers to development of a completely different nature to that associated with the former land use. For example, the urban subdivision of an area previously used for rural purposes. New developments involve rezoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power. **redevelopment:** refers to rebuilding in an area. For example, as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either rezoning or major extensions to urban services.
disaster plan (DISPLAN)	A step by step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of

	connected emergency operations, with the object of ensuring the coordinated response by all agencies having responsibilities and functions in emergencies.
discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
ecologically sustainable development (ESD)	Using, conserving and enhancing natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be maintained or increased. A more detailed definition is included in the Local Government Act 1993. The use of sustainability and sustainable in this manual relate to ESD.
effective warning time	The time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions.
emergency management	A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.
flash flooding	Flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain.
flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
flood awareness	Flood awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures.
flood education	Flood education seeks to provide information to raise awareness of the flood problem so as to enable individuals to understand how to manage themselves an their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.
flood fringe areas	The remaining area of flood prone land after floodway and flood storage areas have been defined.
flood liable land	Is synonymous with flood prone land (i.e. land susceptible to flooding by the probable maximum flood (PMF) event). Note that the term flood liable land covers the whole of the floodplain, not just that part below the flood planning level (see flood planning area).
flood mitigation standard	The average recurrence interval of the flood, selected as part of the floodplain risk management process that forms the basis for physical works to modify the impacts of flooding.
floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.
floodplain risk management options	The measures that might be feasible for the management of a particular area of the floodplain. Preparation of a floodplain risk management plan requires a detailed evaluation of floodplain risk management options.
floodplain risk management plan	A management plan developed in accordance with the principles and guidelines in this manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.

flood plan (local)	A sub-plan of a disaster plan that deals specifically with flooding. They can exist at State, Division and local levels. Local flood plans are prepared under the leadership of the State Emergency Service.
flood planning area	The area of land below the flood planning level and thus subject to flood related development controls. The concept of flood planning area generally supersedes the Aflood liable land@ concept in the 1986 Manual.
Flood Planning Levels (FPLs)	FPL=s are the combinations of flood levels (derived from significant historical flood events or floods of specific AEPs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans. FPLs supersede the Astandard flood event@ in the 1986 manual.
flood proofing	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.
flood prone land	Is land susceptible to flooding by the Probable Maximum Flood (PMF) event. Flood prone land is synonymous with flood liable land.
flood readiness	Flood readiness is an ability to react within the effective warning time.
flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below. **existing flood risk:** the risk a community is exposed to as a result of its location on the floodplain. **future flood risk:** the risk a community may be exposed to as a result of new development on the floodplain. **continuing flood risk:** the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.
flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
floodway areas	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flows, or a significant increase in flood levels.
freeboard	Freeboard provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the flood planning level.
habitable room	**in a residential situation:** a living or working area, such as a lounge room, dining room, rumpus room, kitchen, bedroom or workroom. **in an industrial or commercial situation:** an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
hazard	A source of potential harm or a situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to

	the community. Definitions of high and low hazard categories are provided in the Manual.
hydraulics	Term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.
hydrograph	A graph which shows how the discharge or stage/flood level at any particular location varies with time during a flood.
hydrology	Term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
local overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
local drainage	Are smaller scale problems in urban areas. They are outside the definition of major drainage in this glossary.
mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
major drainage	Councils have discretion in determining whether urban drainage problems are associated with major or local drainage. For the purpose of this manual major drainage involves: • the floodplains of original watercourses (which may now be piped, channelised or diverted), or sloping areas where overland flows develop along alternative paths once system capacity is exceeded; and/or • water depths generally in excess of 0.3 m (in the major system design storm as defined in the current version of Australian Rainfall and Runoff). These conditions may result in danger to personal safety and property damage to both premises and vehicles; and/or • major overland flow paths through developed areas outside of defined drainage reserves; and/or • the potential to affect a number of buildings along the major flow path.
mathematical/computer models	The mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain.
merit approach	The merit approach weighs social, economic, ecological and cultural impacts of land use options for different flood prone areas together with flood damage, hazard and behaviour implications, and environmental protection and well being of the State=s rivers and floodplains. The merit approach operates at two levels. At the strategic level it allows for the consideration of social, economic, ecological, cultural and flooding issues to determine strategies for the management of future flood risk which are formulated into Council plans, policy and EPIs. At a site specific level, it involves consideration of the best way of conditioning development allowable under the floodplain risk management plan, local floodplain risk management policy and EPIs.
minor, moderate and major flooding	Both the State Emergency Service and the Bureau of Meteorology use the following definitions in flood warnings to give a general indication of the types of problems expected with a flood: **minor flooding:** causes inconvenience such as closing of minor roads and the submergence of low level bridges. The lower limit of this class of flooding on the reference gauge is the initial flood level at which landholders and townspeople

	begin to be flooded. **moderate flooding:** low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic routes may be covered. **major flooding:** appreciable urban areas are flooded and/or extensive rural areas are flooded. Properties, villages and towns can be isolated.
modification measures	Measures that modify either the flood, the property or the response to flooding. Examples are indicated in Table 2.1 with further discussion in the Manual.
peak discharge	The maximum discharge occurring during a flood event.
Probable Maximum Flood (PMF)	The PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event should be addressed in a floodplain risk management study.
Probable Maximum Precipitation (PMP)	The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to PMF estimation.
probability	A statistical measure of the expected chance of flooding (see AEP).
risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
stage	Equivalent to Awater level@. Both are measured with reference to a specified datum.
stage hydrograph	A graph that shows how the water level at a particular location changes with time during a flood. It must be referenced to a particular datum.
survey plan	A plan prepared by a registered surveyor.
water surface profile	A graph showing the flood stage at any given location along a watercourse at a particular time.
wind fetch	The horizontal distance in the direction of wind over which wind waves are generated.

Appendix B

EXISTING APPROVED PLANT

APPROVED AND CONSTRUCTED DEVELOPMENTS

APPROVED DEVELOPMENTS YET TO BE CONSTRUCTED

APPROVED DEVELOPMENTS TO BE RELOCATED.

PROPOSED DDG DRYER MODS AND ASSOCIATED WORKS.

PROPOSED MILL FEED SILO/STRUCTURE.

RELOCATED APPROVED EASTERN COOLING TOWERS. 8M x 15M.

APPROVED ADDITIONAL EASTERN COOLING TOWERS

EXISTING COOLING TOWERS

CONC SLAB

BIOFILTER BLOWER

APPROVED 6 ADDITIONAL DDG DRYERS AND ASSOCIATED EQUIPMENT.

APPROVED DDG PELLET PLANT.

DDG PELLET PLANT.

PROPOSED CONTAINER STORAGE AREA.

APPROVED ADDITIONAL WESTERN COOLING TOWERS

APPROVED & CONSTRUCTED BIOFILTERS.

BIOFILTER

BIOFILTER

BIOFILTER

BIOFILTER

PROPOSED ADDITIONAL BIOFILTER. 30M x 16M.

FORKLIFT MAINTENANCE BUILDING. 18M SPAN x 42M LENGTH.

18M

42M

15M

FORK LIFT ROADWAY.Min. 15m WIDE.

PROPOSED CONTAINER STORAGE AREA.

No.1 DDG DRYER

No.2 DDG DRYER

DRYER 7

No.3 DDG DRYER

APPROVED EVAPORATOR

EVAPORATORS

APPROVED CHEMICAL STORAGE FACILITY

ELECT S/ROOM

APPROVED AND CONSTRUCTED EXTENSION TO DDG LOADOUT

SUB/STN

DDG LOADOUT

DDG STORAGE

EVAPORATOR

DDG STORAGE

RELOCATED MCC ROOM

EX SW

APPROX BUND

APPROVED ADDITIONAL EVAPORATOR

APPROVED

OVERHEAD GANTRY (LENGTH REDUCED).

APPROVED EXTENSION TO DDG LOADOUT

PROPOSED RELOCATION OF APPROVED 4 DDG DRYERS. 70M x 28M.

28M

40M

70M

28M

APPROVED MCC ROOM

RELOCATED APPROVED WESTERN COOLING TOWERS. 40M x 15M.

APPROVED & CONSTRUCTED WEIGHBRIDGE

APPROVED GAS–FIRED CO–GENERATOR.

ISS	DATE	ZONE	CHANGE AMMENDMENTS	BY	CKD
I	30–3–16	ALL	proposals finalised.	P.C.	G.M.
I	15–9–15	ALL	proposal	P.C.	G.M.

MANILDRA GROUP

Commitment to Excellence

DRAWN P.J.C.
TRACED
CHECKED
APPROVED
DRG PRACTICE AS1100

TOLERANCES LINEAR ±.2 ANGULAR ±.5

FINISH NA

MATERIAL NA

MANILDRA GROUP.NOWRA.

TITLE DDG DRYING. LAYOUT OF DDG DRYER MODS.

SIZE A3 | SCALES 1:750 | SHT

ISSUE 5765A

DRG. № MN261–001–I

EXISTING APPROVED PLANT

APPROVED AND CONSTRUCTED DEVELOPMENTS

APPROVED DEVELOPMENTS YET TO BE CONSTRUCTED

APPROVED DEVELOPMENTS TO BE RELOCATED.

PROPOSED DDG DRYER MODS AND ASSOCIATED WORKS.

PROPOSED MILL FEED SILO/STRUCTURE.

No.1 DDG DRYER

No.2 DDG DRYER

DRYER 7

No.3 DDG DRYER

EX SW

RELOCATED APPROVED EASTERN COOLING TOWERS. 8M x 15M.

APPROVED ADDITIONAL EASTERN COOLING TOWERS

EXISTING COOLING TOWERS

CONC SLAB

BIOFILTER BLOWER

APPROVED 6 ADDITIONAL DDG DRYERS AND ASSOCIATED EQUIPMENT.

APPROVED DDG PELLET PLANT.

DDG PELLET PLANT.

APPROVED EVAPORATOR

EVAPORATORS

APPROVED CHEMICAL STORAGE FACILITY

ELECT S/ROOM

SUB/STN

APPROVED AND CONSTRUCTED EXTENSION TO DDG LOADOUT

EVAPORATOR

DDG STORAGE

DDG LOADOUT

DDG STORAGE

APPROX BUND

APPROVED ADDITIONAL EVAPORATOR

APPROVED

APPROVED EXTENSION TO DDG LOADOUT

OVERHEAD GANTRY (LENGTH REDUCED).

RELOCATED MCC ROOM

PROPOSED RELOCATION OF APPROVED 4 DDG DRYERS. 70M x 28M.

28M

APPROVED MCC ROOM

WOOD CHIP & COAL STORAGE REMAINS FOR STAGE 1.

APPROVED & CONSTRUCTED BIOFILTERS.

BIOFILTER

BIOFILTER

BIOFILTER

BIOFILTER

APPROVED ADDITIONAL WESTERN COOLING TOWERS

PROPOSED CONTAINER PREPARATION AREA.

FORKLIFT MAINTENANCE BUILDING. 18M SPAN x 42M LENGTH.

18M

42M

15M

PROPOSED ADDITIONAL BIOFILTER. 30M x 16M.

FORK LIFT ROADWAY:Min. 15m WIDE.

PROPOSED CONTAINER STORAGE AREA.

APPROVED & CONSTRUCTED WEIGHBRIDGE

COAL

WOOD CHIP

RELOCATED APPROVED WESTERN COOLING TOWERS. 40M x 15M.

40M

70M

28M

APPROVED GAS-FIRED CO-GENERATOR.

ISS	DATE	ZONE	CHANGE AMMENDMENTS	BY	CKD
K	8-4-16	BS	Wording changed.	P.C.	C/ Stad.
I	15-9-15	ALL	proposal	P.C.	G.M.

MANILDRA GROUP

Commitment to Excellence

DRAWN P.J.C.
TRACED ----
CHECKED
APPROVED
DRG PRACTICE AS1100

TOLERANCES
LINEAR ±.2
ANGULAR ±.5

FINISH NA

MATERIAL NA

MANILDRA GROUP.NOWRA.

TITLE DDG DRYING.STAGE 1
LAYOUT OF DDG DRYER MODS.

SIZE A3 | SCALES 1:750 | SHT

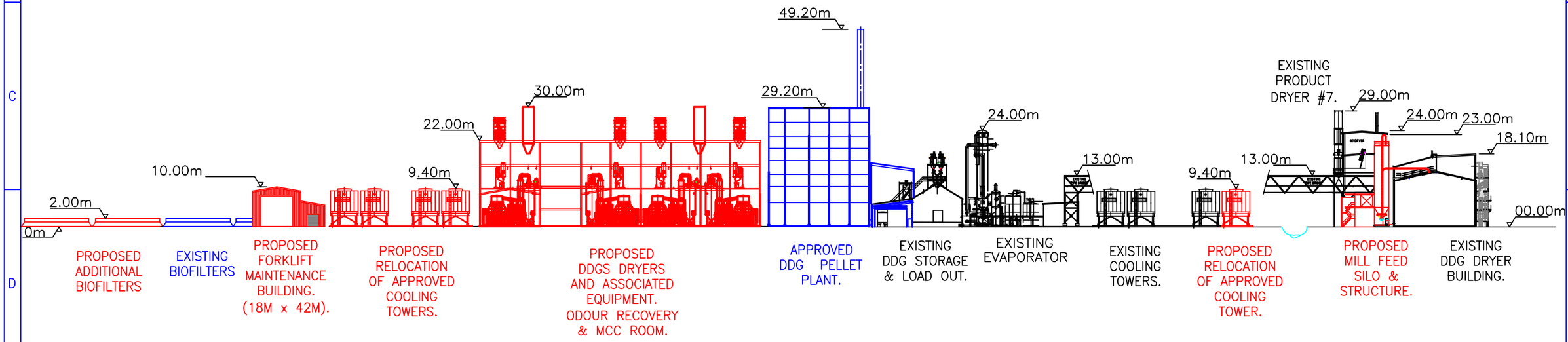
ISSUE 5765A

DRG № MN261-001-K

EXISTING APPROVED PLANT.

APPROVED AND CONSTRUCTED DEVELOPMENTS. MP06–0228.

PROPOSED DDG DRYER MODS AND ASSOCIATED WORKS.



TYPICAL ELEVATION
SHOWING EXISTING AND PROPOSED
IN THE SURROUNDING AREA OF
THE PROPOSED WORK.

ISS	DATE	ZONE	CHANGE AMMENDMENTS	BY	CKD
I	15–9–15	ALL	proposal	P.C.	G.M.

PC Drafting. 0439 436508 Est. 2001

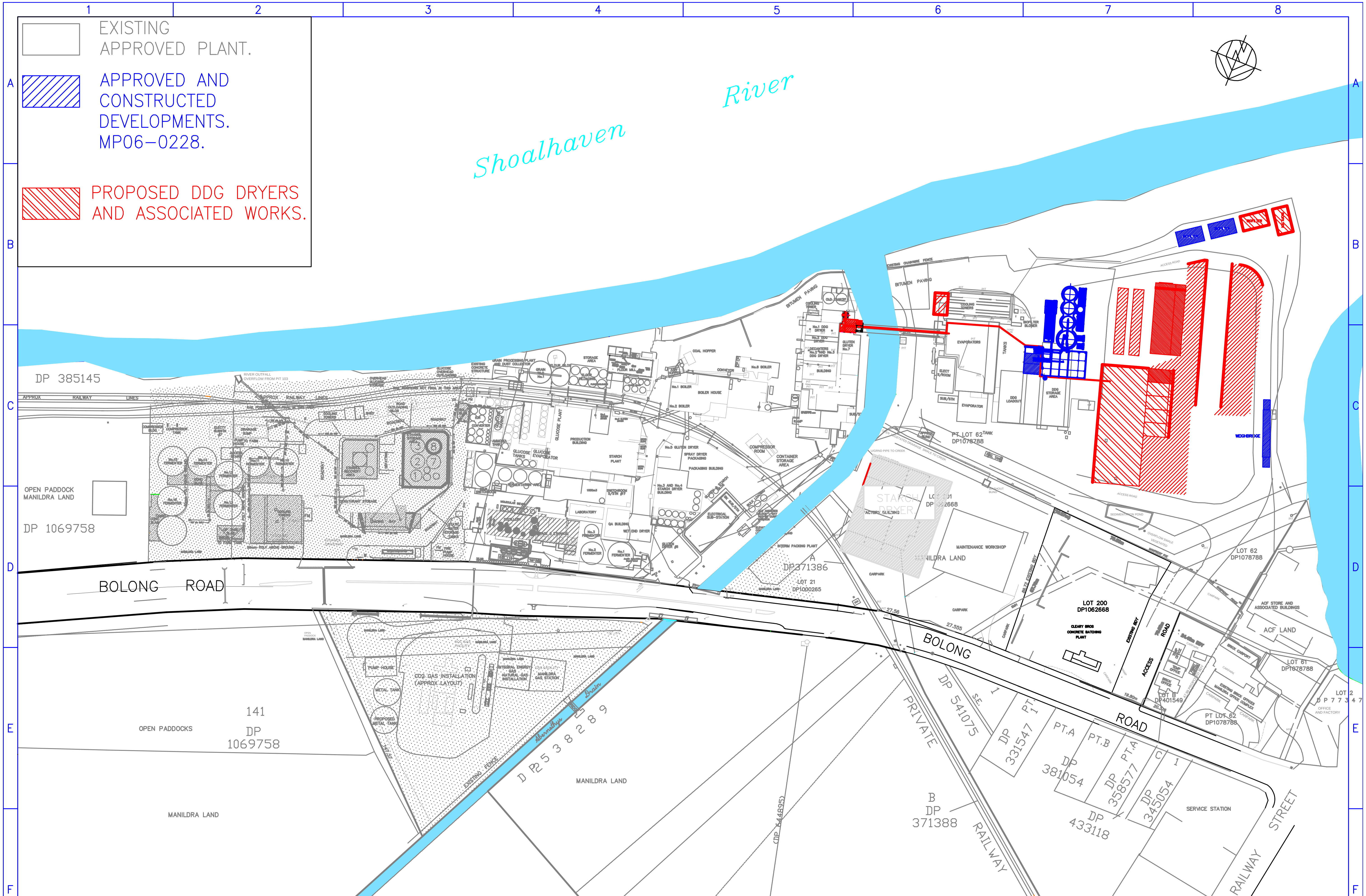
Commitment to Excellence — GEM OF THE WEST

MANILDRA GROUP
100% AUSTRALIAN

DRAWN	P.J.C.	TOLERANCES
TRACED	----	
CHECKED		
APPROVED		FINISH NA
DRG PRACTICE	AS1100	

TITLE: SHOALHAVEN STARCHES
ADDITIONAL DDG DRYING.
SOUTHERN ELEVATION.

SIZE	SCALES	SHT
A3	1:1000	
ISSUE	5765	
DRG. Nº	MN261–002G	



ISS	DATE	ZONE	CHANGE AMENDMENTS	BY	CKD
C	04-09-15	ALL	Silos added, feed to silos added, scale was 1:100.	P.C.	P.G.
B	14-7-15	ALL	Flour mill plan.	P.C.	S.R.
A	2-7-15	ALL	Revised layout.	P.C.	S.R.
1	17-6-15	ALL	Draft	P.C.	K.L.

MANILDRA GROUP

Commitment to Excellence

DRAWN P.C.
TRACED ----
CHECKED / APPROVED
DRG PRACTICE AS1100

TITLE: SHOALHAVEN STARCHES
ADDITIONAL DDG DRYING.
SITE PLAN.

SIZE A3 | SCALE: 1:2000

MANILDRA–5765

DRG. No. MN261–003G

PROPOSED
DDG DRYERS
AND ASSOCIATED WORKS.

SHOALHAVEN RIVER

BOLONG ROAD

WOOD CHIP

COAL

PROPOSED
COAL AND WOOD CHIP
BULK STORAGE AREA.

LANE

HANIGANS

MEADOW

RAILWAY

STREET

COAST

SOUTH

EXISTING
APPROVED PLANT.

APPROVED AND
CONSTRUCTED
DEVELOPMENTS.
MP06-0228.

PROPOSED
DDG DRYERS,ASSOCIATED
WORKS AND COAL
AND WOOD CHIP
STORAGE AREA.

ISS	DATE	ZONE	CHANGE AMENDMENTS	BY	CKD
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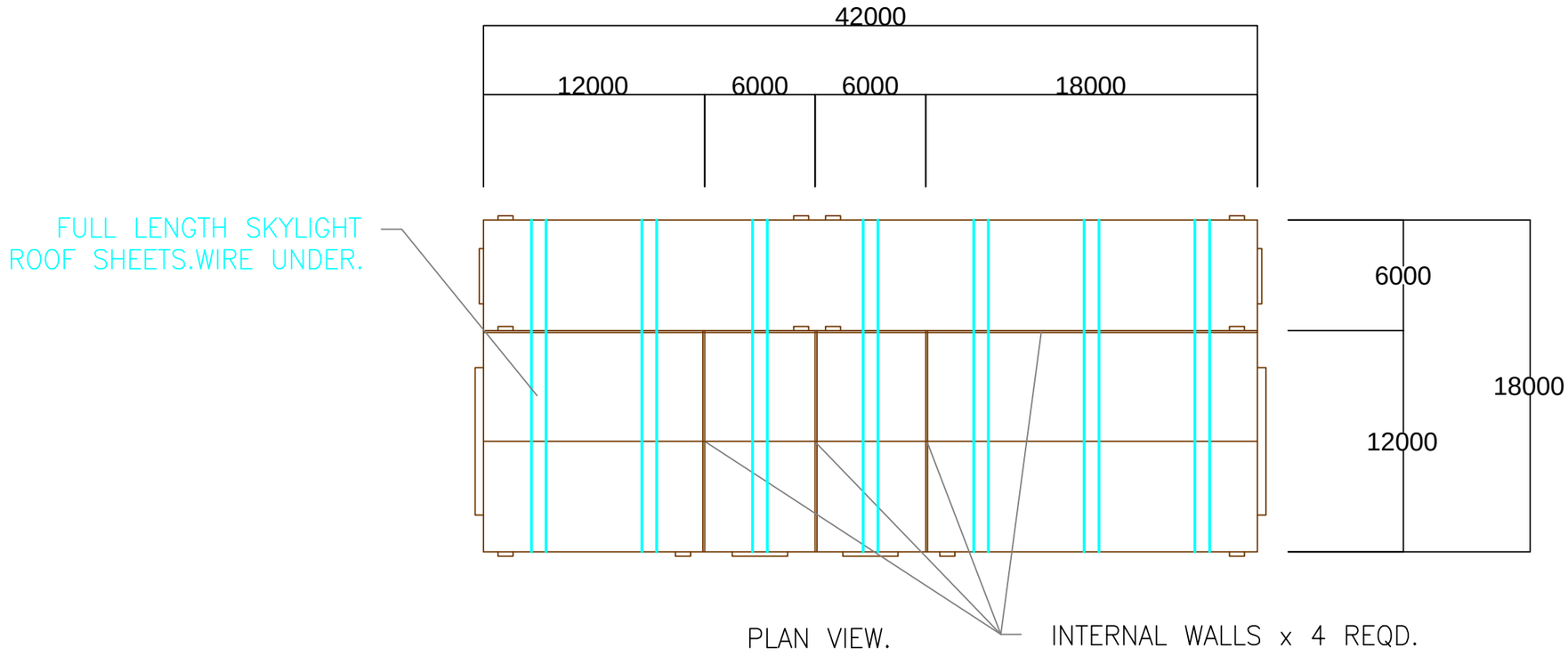
A	2-7-15	ALL	Revised layout.	P.C.	S.R.
1	17-6-15	ALL	Draft.	P.C.	K.L.

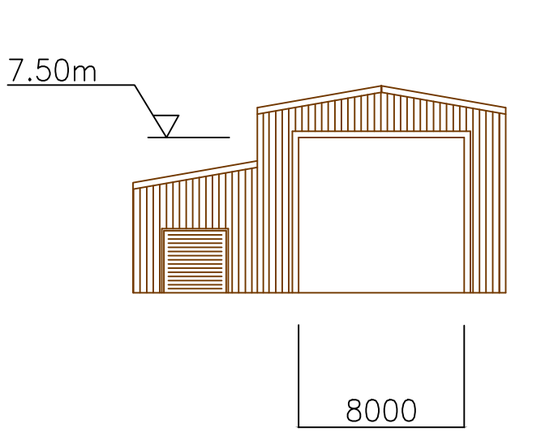
MANILDRA GROUP
Commitment to Excellence

DRAWN	P.C.
TRACED	
CHECKED / APPROVED	
DRG PRACTICE	AS1100

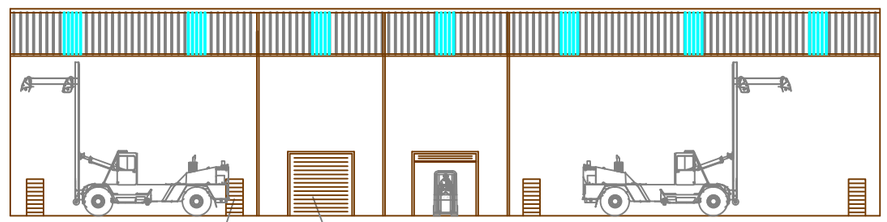
TITLE:
SHOALHAVEN STARCHES
ADDITIONAL DDG DRYING.
COAL AND WOOD CHIP BULK STORAGE.

SIZE	A3
SCALE:	1:5000
MANILDRA-5765	
DRG. No:	MN261-007G

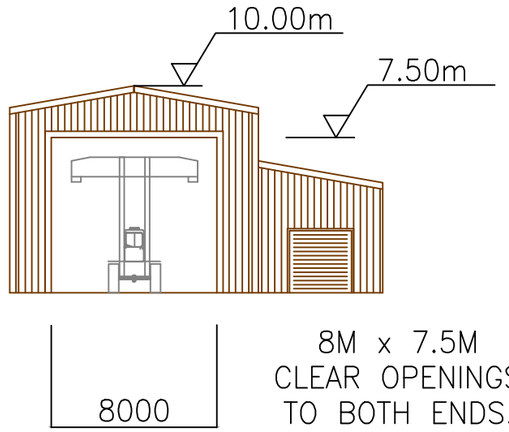




END ELEVATION.



SIDE ELEVATION.



8M x 7.5M
CLEAR OPENINGS
TO BOTH ENDS.

END ELEVATION.

18M SPAN x 42M.
HEIGHT TO SUIT 7.5M END OPENING.
ALL EXTERNAL FINISHES
COLORBOND JASPER.

ISS	DATE	ZONE	CHANGE AMMENDMENTS	BY	CKD
1	15-9-15	ALL	proposal	P.C.	G.M.

PC Drafting, 0439 436508 Est. 2001

Commitment to Excellence
GEM OF THE WEST

MANILDRA GROUP
100% AUSTRALIAN

DRAWN P.J.C.
TRACED
CHECKED
APPROVED
DRG PRACTICE AS1100
TOLERANCES
FINISH GAL/C-BOND
MATERIAL MS

MANILDRA GROUP.NOWRA.
FORKLIFT MAINTENANCE BUILDING.
BUILDING DETAIL.

SIZE A3 | SCALES 1:300 | SHT
ISSUE 5765
DRG. Nº MN267-004A

3. CONCLUSIONS

3.1 Proposed Development

For the reasons detailed above, and as agreed in consultation with Council and DLWC, hydraulic modelling of the proposed development has not been undertaken. There is a need however, to consider (amongst other things) the flood hazard and structural assessment (with regard to velocity of floodwaters and impact by flood debris) of the proposed development. In quantifying the flood hazard, some important issues for consideration include:

- damage to the plant, including as a result of flood debris or structural failure,
- damage to the plant due to the possible buoyancy of equipment,
- malfunction of the plant (or any services on which the plant relies for operation) as a result of inundation and the associated risk of such malfunction to other users of the floodplain,
- access and evacuation.

3.2 Future Development

In consultation with Council and the DLWC, it is agreed that any future development of the Manildra Starches Plant within the intensively built-up area, as defined on Figures 2 and 4, will not require hydraulic modelling to quantify the hydraulic impacts and cumulative effects. The hydraulic impacts and cumulative effects of such developments are considered to be insignificant given the intensive development already present. As mentioned in previous sections, the only opportunity for floodwaters to pass through the intensively built-up area of the site is through the limited number of gaps or openings between the plant and associated buildings. Although these gaps or openings may be relocated to accommodate any future development, the movement of overland floodwaters will never be completely blocked, as gaps or openings similar to those which currently exist will always be maintained for trafficability requirements.

Any proposed future development is not exempt from flood hazard and structural assessment as outlined in Section 3.1

3.3 Future Development on the Northern Floodplain

This study has identified that there is no need for hydraulic modelling of the proposed, or any future proposed development within the existing intensively built-up area of the Manildra Starches Plant (shown on Figures 2 and 4). However during the course of this investigation, and in consultation with Council and the DLWC, it should be noted that any further development upon the northern floodplain (outside the built-up area shown on Figures 2 and 4), and in particular any development adjacent to the river bank, has the potential to increase the cumulative impact on flood levels and velocities.

The main areas of concern on the northern river bank are the unrestricted low lying areas between high ground and the existing developments, termed flowpaths or floodways. The bank is relatively

Appendix D

Shoalhaven City Council

Bridge Rd, Nowra NSW 2541 **02 4429 3111**
Deering St, Ulladulla NSW 2539 **02 4429 8999**
Address all correspondence to
The General Manager, PO Box 42, Nowra NSW 2541 Australia
DX5323 Nowra Fax 02 4422 1816

COUNCIL REFERENCE: 28112E (D16/83304)
CONTACT PERSON: Kate Britton
DATE: 30 March 2016

Stephen Richardson
PO BOX 738
Nowra NSW 2541

Thank you for your recent inquiry in relation to flood data held by Shoalhaven City Council.

Please find below the original details of your inquiry, some general information on flooding as well as the requested property specific Flood Certificate.

Details of Inquiry:

Name of Inquirer	Stephen Richardson	**Date Requested:** 14 Mar 2016
Reason for Enquiry	New Construction	
Contact Details	Phone: 02 4423 6198 Email: steve@cowmanstoddart.com.au Postal: PO BOX 738 Nowra	
Preferred Response	Email	
Notes		
Survey Detail	Not Provided	
Flood Safety Tip	**Causeways can kill! Never drive through flood waters! Wait and be safe!**	
General Flood Information	Shoalhaven City Council in conjunction with SES has produced site specific flood brochures for Shoalhaven Heads, Nowra / Bomaderry / Terara, Greenwell Point/Orient Point and Sussex Inlet. General Flood Information booklets, such as “What to do before, during & after a flood” prepared by Emergency Management Australia are also available. You can pick up free copies of all brochures at the City Administration Building in Nowra.	

FLOOD CERTIFICATE

According to the *Lower Shoalhaven River Floodplain Risk Management Plan – Climate Change Assessment (2011)* this property, 20 Hanigans Lane, BOLONG - Lot 1 DP 131008, **is affected by the 1% AEP flood event.**

FLOOD INFORMATION

Year	Existing	Projected 2050	Projected 2100
Flood Planning Level	Not applicable	5.5m AHD	5.6m AHD
Hazard Category	High	High	High
Hydraulic Category	Flood Storage	Flood Storage	Flood Storage
1% AEP Flood Level	5.0m AHD	5.0m AHD	5.1m AHD

SITE SPECIFIC CONSIDERATIONS

Current NSW Government legislation requires climate change to be considered as part of this Floodplain Risk Management Study and Plan. Climate change related information evolves with time and it is expected that existing flood behaviour and levels may change in the future.

All applications for buildings, and the like, must take into account the projected 2050 flood information. All subdivision and other long-term planning must take into account the projected 2100 flood information.

Information provided in this flood certificate uses previous State Government sea level rise benchmarks (400mm and 900mm for the 2050 and 2100 horizon's respectively). On Tuesday 10th February 2015 Council's Policy & Resources Committee resolved to no longer use State Government benchmarks and to "Establish a sea level rise benchmarks for planning purposes based on a 2030 horizon 100 mm, a 2050 horizon of 230 mm and 360 mm horizon for 2100". The new benchmarks will be incorporated into the flood information in future. Until studies incorporating the new benchmarks are undertaken Council will continue to use the best available information.

STANDARD CONSIDERATIONS

Properties below the Flood Planning Level:
Council considers the land in question to be below the flood planning level and therefore subject to flood related development controls. The conditions as set out below will reduce flood risk in flood events up to the Flood Planning Level, however the property may still be subject to flooding at higher levels during rare flood events.

Development controls apply to flood affected properties.

Development conditions will vary depending on flood hazard, hydraulic category as well as the type of development that is proposed. Please refer to the following documents for information on Council's flood related development controls and the NSW State Government's Floodprone Land Policy.

- Shoalhaven Development Control Plan – Chapter 9: Development on Flood Prone Land http://dcp2014.shoalhaven.nsw.gov.au/main-category/whole-document
- NSW Floodplain Development Manual 2005: http://www.environment.nsw.gov.au/floodplains/manual.htm

DISCLAIMER

Your enquiry relating to the likelihood of the land specified in the application being flooded has been referred to the Council's Floodplain Engineer.

In responding to your application the Council seeks to bring to your attention the fact that pursuant to s.733 of the Local Government Act a council does not incur liability in respect of the giving of any advice furnished in good faith by the Council relating to the likelihood of any land being flooded or the nature or extent of any such flooding.

The Council does not have a legal obligation to provide advice to you and to the extent that this reply is giving advice, the Council provides that advice in good faith with the intention of preserving, so far as is legally possible, the Council's immunity from liability pursuant to s.733 of the Local Government Act.

While all reasonable care has been taken to ensure the accuracy of the information given in this reply, its purpose is to provide a general indication of flood risk in the area. Flood lines shown on Council maps indicate the approximate extent of flooding only in relation to the abovementioned land.

The information provided may contain errors or omissions and the accuracy may not suit the purposes of all users. A site survey and further investigation are strongly recommended before commencement of any project based on this data.

The information given is the most current information at the time of the request. It is to be noted, however, that flood information is constantly reviewed and updated and as such, the information contained in this regard is current only on the day of issue.

Before acting upon the information provided in this reply, the Council urges you to obtain separate and independent advice as Council, in giving this information, does not intend it to be relied upon in such a fashion as to impose liability upon the Council.

Should you not be prepared to accept the information contained in this reply upon that basis then you should immediately notify Council.

GLOSSARY

AEP (Annual Exceedance Probability) means the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage – for example a 1% AEP flood event has a 1% chance of occurring in any one calendar year.

AHD (Australian Height Datum) is a common national surface level datum corresponding approximately to mean sea level.

Flood fringe is the part of the floodplain remaining after the floodway and flood storage areas have be defined.

Flood planning area is any land identified as being flood affected in the 1% AEP flood event plus freeboard.

Flood planning level (FPL) is the 1% AEP flood level plus freeboard. The FPL is used for planning purposes, as determined in floodplain risk management studies and incorporated in floodplain risk management plans.

Flood prone land means any land susceptible to flooding up to the probable maximum flood event (that is, land within the floodplain) as identified in an adopted Council flood study or floodplain risk management study and plan.

Flood storage areas are those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.

Flood study is a technical investigation of flood behaviour. It defines the nature of flood risk by establishing the extent, level and velocity of floodwaters. The study also provides information on the distribution of flood flows across various sections of the flood plain for the full range of flood events up to and including the PMF.

Floodplain risk management plan is a plan developed in accordance with the principles and guidelines contained in the NSW Government Floodplain Management Manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.

Floodplain risk management study is a study that identifies and compares various risk management options. This includes an assessment of their social, economic, ecological and cultural impacts, together with opportunities to maintain and enhance river and floodplain environments.

Floodway means those parts of the floodplain where a significant discharge of water occurs during floods. They are often aligned with natural defined channels. Floodway's are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.

Freeboard is currently 0.5m for all catchments in the Shoalhaven. Freeboard is a factor of safety used to set the FPL (i.e. FPL = 1% AEP flood level plus freeboard (0.5m)). Freeboard takes into account uncertainties in flood modelling and climate change predictions, local factors that cannot be included in the flood model or wave action caused by wind, boats or vehicles driving through flood waters.

Hazard category represents the risk or danger to personal safety, evacuation movements and buildings and structures within the Flood Planning Area during the 1% AEP flood. There are only two possible hazard categories – high or low.

Hydraulic category describes the function of a specific part of the Flood Planning Area in conveying flood waters during a 1% AEP flood. There are three possible hydraulic categories – floodway, flood storage or flood fringe.

Probable maximum flood (PMF) is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain.

Provisional is used for hazard categories that have been determined in a flood study. Hazard categories are provisional until the floodplain risk management study and plan has been completed and adopted by Council, as this document considers additions risks, not considered during the flood study.

Shoalhaven City Council

Bridge Rd, Nowra NSW 2541 **02 4429 3111**
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Address all correspondence to
The General Manager, PO Box 42, Nowra NSW 2541 Australia
DX5323 Nowra Fax 02 4422 1816

COUNCIL REFERENCE: 28112E (D16/83260)
CONTACT PERSON: Kate Britton
DATE: 29 March 2016

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PO BOX 738
Nowra NSW 2541

Thank you for your recent inquiry in relation to flood data held by Shoalhaven City Council.

Please find below the original details of your inquiry, some general information on flooding as well as the requested property specific Flood Certificate.

Details of Inquiry:

Name of Inquirer	Stephen Richardson	**Date Requested:** 14 Mar 2016
Reason for Enquiry	New Construction	
Contact Details	Phone: 02 4423 6198 Email: steve@cowmanstoddart.com.au Postal: PO BOX 738 Nowra	
Preferred Response	Email	
Notes		
Survey Detail	Not Provided	
Flood Safety Tip	**Causeways can kill! Never drive through flood waters! Wait and be safe!**	
General Flood Information	Shoalhaven City Council in conjunction with SES has produced site specific flood brochures for Shoalhaven Heads, Nowra / Bomaderry / Terara, Greenwell Point/Orient Point and Sussex Inlet. General Flood Information booklets, such as “What to do before, during & after a flood” prepared by Emergency Management Australia are also available. You can pick up free copies of all brochures at the City Administration Building in Nowra.	

FLOOD CERTIFICATE

According to the *Lower Shoalhaven River Floodplain Risk Management Plan – Climate Change Assessment (2011)* this property, 32 Bolong Rd, BOMADERRY - Lot 62 DP 1078788, **is affected by the 1% AEP flood event.**

FLOOD INFORMATION

Year	Existing	Projected 2050	Projected 2100
Flood Planning Level	Not applicable	6.3m AHD	6.3m AHD
Hazard Category	High	High	High
Hydraulic Category	Floodway	Floodway	Floodway
1% AEP Flood Level	5.8m AHD	5.8m AHD	5.8m AHD

SITE SPECIFIC CONSIDERATIONS

1. Current NSW Government legislation requires climate change to be considered as part of this Floodplain Risk Management Study and Plan. Climate change related information evolves with time and it is expected that existing flood behaviour and levels may change in the future.
   All applications for buildings, and the like, must take into account the projected 2050 flood information. All subdivision and other long-term planning must take into account the projected 2100 flood information.
   Information provided in this flood certificate uses previous State Government sea level rise benchmarks (400mm and 900mm for the 2050 and 2100 horizon's respectively). On Tuesday 10th February 2015 Council's Policy & Resources Committee resolved to no longer use State Government benchmarks and to "Establish a sea level rise benchmarks for planning purposes based on a 2030 horizon 100 mm, a 2050 horizon of 230 mm and 360 mm horizon for 2100". The new benchmarks will be incorporated into the flood information in future. Until studies incorporating the new benchmarks are undertaken Council will continue to use the best available information.

2. Not all of the property is categorised high hazard floodway. Part of the property is categorised high hazard flood storage, part of the property is categorised low hazard flood storage and part of the property is above the flood planning level. For more specific information regarding the different hazard and hydraulic categorisations on this property please contact Council's Natural Resource and Floodplain Unit on (02) 44293392.

STANDARD CONSIDERATIONS

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