GEOFF SLATTERY & PARTNERS

Proposed Residential Subdivision Lot 112 DP 1073791 Lyons Road North Bonville

Report Addressing Flood-Related Items 6.5 & 6.6 of The Director-General of Planning's 'Major Project' Requirements

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1. INTRODUCTION

This report addresses Items 6.5 and 6.6 as detailed in the Department of Planning's letter of 8 July 2010; that is:

"6.5 Provide an assessment of any flood risk on site including the potential effects of sea level rise and an increase in rainfall intensity in consideration of any relevant provisions of the *NSW Floodplain Development Manual (2005)* (**Reference 1**) and *Practical Consideration of Climate Change – Floodplain Risk Management Guideline (DECC, October 2007)* (**Reference 2**) and the draft *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* (**Reference 3**).

6.6 Consider the potential impacts of any filling on the flood regime of the site and adjacent lands."

2. FLOOD LEVEL ASSESSMENTS

2.1 CURRENT 100 YEAR FLOOD LEVELS

As shown in **Appendix A**, Council's 1995 *Bonville Creek Flood Study* mapping (**Reference 4**) shows that part of the area of Lot 112 is within the 100 year floodplain. This portion of Lot 112 is part of a much broader floodprone area which is characterised in the flood study as a "Flood Storage" area; that is, an area which is important "for the temporary storage of floodwaters during a flood" (p. L-2 of **Reference 1**). Due to the potential depth of stored flood waters — that is, very typically greater than one metre in the 100 year event — the area is classified as a "High Hazard Flood Storage" area.

As can be seen in the flood maps produced as part of the 1995 flood study, this high hazard flood storage area is located north of the Bonville Creek channel and upstream (or north) of the North Coast railway line. Since there are a number of flood storage areas in the Bonville Creek floodplain, this 'local' high hazard flood storage area is defined as the Lyons Road flood storage area for the purposes of this report.

The 1995 study report defined the 100 year flood level in the Lyons Road flood storage area as a level pool RL 4.1m AHD.

In the 2005 Floodplain Development Manual it also states that flood storage areas may also be delineated by their adverse impact on flood levels "if completely filled with solid material" (p. L-2, **Reference 1**). Hence the impact of potentially filling such areas needs to be assessed. This is addressed in **Section 3** of this report.

2.2 CLIMATE CHANGE IMPACTS

The 2007 DECC guidelines (**Reference 2**) commences with the following statement: "Climate change is expected to have adverse impacts upon sea levels and rainfall intensities, both of which may have significant influence on flood behaviour at specific locations". In its Section 1, the guideline document calls for flood study sensitivity analysis of the impacts of both future potential increases in flood-producing rainfall intensities and future potential sea level rise. The upper bound scenarios for the sensitivity analyses are given as a 30% increase and 0.91 metres respectively.

2.2.1 Flood Level Sensitivity to a Potential Increase in Design Rainfall Intensities

The 1995 Bonville Creek Flood Study report provides information on peak flows and peak water levels throughout the hydraulic model area. By comparing that information for the reach of Bonville Creek adjacent to the Lyons Road flood storage area, the trend of increasing flows and hence water levels can be readily assessed. This has been achieved by the following comparison of 20 year and 100 year event data and the corresponding design rainfall information.

Table 1: Bonville Creek Peak Flows (Adjacent to Lyons Rd Flood Storage Area)

EXTRAN 'Conduit' Name	20 year (9 hour) Q_p (m^3/s)	100 year (9 hour) Q_p (m^3/s)	% Increase in Flow
92	281	397	41%
94	273	392	44%

Source: Tables H2 & H5, Reference 4

Table 2: Bonville Creek Catchment Design Rainfall Intensities

Geographical Station	20 year, 9 hour (mm/h)	100 year, 9 hour (mm/h)	% Increase in Intensity
Western	23.4	32.3	38%
Eastern	22.2	30.4	37%

Source: Table 2, Reference 4

Not surprisingly, **Tables 1** and **2** reveal very similar percentage increases in peak flows and critical duration rainfall intensities between the 20 year and 100 year events.

Table 3: Bonville Creek Water Levels (Adjacent to Lyons Rd Flood Storage Area)

EXTRAN Junction Name	20 year, 9 hour event (m AHD)	100 year, 9 hour event (m AHD)	Increase in Level between 20y and 100y events (metres)
AREAQ	3.53	4.17	0.64
91	3.51	4.14	0.63
93	3.48	4.10	0.62

Source: Tables H2 & H5, Reference 4

Based on the percentage and water level increases presented in **Tables 1**, **2** and **3**, it follows that the 100 year water level in Bonville Creek might potentially increase by 600mm if the rainfall intensities were to increase by about 40%.

Would however the peak water level in the adjacent Lyons Road flood storage area also increase by 600mm? This question has been assessed by firstly, estimating the increase in Bonville Creek flood flow volume and then secondly, converting that volume into a depth increase in the flood storage area by assuming that all of the additional flow volume would be conveyed into the Lyons Road flood storage area. (It is noted that this latter assumption is conservative since a significant portion of that extra volume would continue to be conveyed along the creek channel alignment rather than be conveyed into the flood storage area.)

Additional Flow Volume Calculation

As detailed earlier, the 100 year peak flood level is RL 4.1m AHD). The increase in flood flow volume above RL 4.1m has been estimated on the basis of the following:

- a 160m^3/s increase in the peak 100 year flow (i.e. a 40% increase relative to the **Table 1** value of about 400m^3/s);
- the flood peak is preserved for say a period of 15 minutes; and
- the flood flow equals or exceeds 400m^3/s for say two hours.

Based on those allowances, the additional flow volume above the current 100 year flood peak is about 650,000 cubic metres.

Incremental Flood Depth Calculation

The surface area of the Lyons Road flood storage area is 1.53 square kilometres (as derived from Sheets 6 & 7 presented in the 1995 flood study report). Based on that surface area, the increase in the 'level pool' flood level over that area would be a maximum of 650,000/1,532,000 = 0.42m. The addition of 0.42m to the current flood storage area peak level of 4.1m generates a new RL of about 4.5m.

It is therefore considered that the 100 year flood level in the Lyons Road flood storage area might increase to a maximum of RL 4.5m AHD if the rainfall intensities were to increase by about 40%. However since the upper bound percentage increase in the DECC 2007 guideline is 30%, it also follows that a flood level of RL 4.5m is conservative relative to the DECC upper bound guideline.

(The above findings have also been compared with the explicit analysis undertaken on the neighbouring Boambee Creek floodplain (**Reference 5**). The 2009 study of Boambee Creek examined the impacts of all three rainfall intensity increases which are listed in the 2007 DECC guidelines (see Table 12 of **Reference 5**). For the upper bound scenario — that is, a 30% increase in intensities — the Boambee Creek flood model calculated the following:

- that the 100 year flood level increase was 0.27m some 2.4 kilometres upstream of the ocean entrance;
- the same relative increase applied to the next 2.8 kilometres; and
- therefore, as far as 5.2 kilometres from the ocean entrance, the increase was still 0.27m.

Now the 'downstream end' of the Lyons Road flood storage area corresponds to the railway bridge crossing of Bonville Creek and this is some 4.4 kilometres from the ocean entrance. Since the Boambee Creek and Bonville Creek (excluding Pine Creek) catchments are very similar in size and their ocean entrance conditions are similar it is considered that the likely impact of a 30% rainfall intensity increase would also be similar; i.e. about 0.3m. The resultant flood level in the Lyons Road flood storage area would therefore be RL 4.1 + 0.3 = RL4.4m AHD.)

2.2.2 Flood Level Sensitivity to a Potential Increase in Sea Level

Since there has been no Bonville Creek assessment of the impact of potential sea level change, the results of a similar assessment for the neighbouring Boambee Creek catchment have been reviewed.

The 2009 study of Boambee Creek examined the impacts of all three seal level rise scenarios that are presented in the 2007 DECC guidelines (see Table 12 of Reference 5). For the upper bound scenario – that is, a sea level rise of 0.91m – the Boambee Creek flood model calculated the following:

- that the 100 year flood level increase was 0.63m some 2.4 kilometres upstream of the ocean entrance;
- the same relative increase applied to the next 2.8 kilometres; and
- therefore, as far as 5.2 kilometres from the ocean entrance, the increase was still 0.63m.

As noted earlier, the 'downstream end' of the Lyons Road flood storage area is some 4.4 kilometres from the ocean entrance. Since the Boambee Creek and Bonville Creek (excluding Pine Creek) catchments are very similar in size and their ocean entrance conditions are similar it is considered that the likely impact of a 0.91m sea level rise would also be similar; i.e. about 0.6m. The resultant flood level in the Lyons Road flood storage area would therefore be RL 4.1 + 0.6 = RL 4.7m AHD.

2.2.3 Summary of Climate Change Impacts on Flood Levels

Table 4 summarises the findings of **Sections 2.2.1** and ***2.2.2***. From the table it can be seen that the various estimates vary between RL 4.4m AHD and RL 4.7m AHD.

For the purposes of this report, a value of RL 4.7m AHD has been adopted.

Table 4: Summary of Climate Change Impacts

2007 DECC Guideline Scenario	Assessment Approach	Estimate of 100y Flood Level in Lyons Road Flood Storage Area
Upper bound increase in rainfall intensity	Bonville Creek flood volume	RL 4.5m AHD
Upper bound increase in rainfall intensity	Extrapolation of Boambee Creek flood study finding	RL 4.4m AHD
Upper bound increase in sea level	Extrapolation of Boambee Creek flood study finding	RL 4.7m AHD

3. POTENTIAL IMPACT OF THE DEVELOPMENT

3.1 LOSS OF FLOODPLAIN STORAGE

Table 5 lists the total fill volumes relative to different design flood level scenarios which would be associated with the development.

Table 5: Floodplain Fill Volumes

Flood Level (m AHD)	Approx. Fill Volume below Flood Level (m^3)	Approx. Range of Fill Height (m)
4.1	13,000	0-2.0
4.7	24,000	0-2.6

The fill volumes listed in **Table 5** have been compared with the overall size of the Lyons Road flood storage area and the results are presented in **Table 6**.

Table 6: Impact on Lyons Road Flood Storage Area Capacity

Flood Level (m AHD)	Approx. Lyons Road Flood Storage Compartment over Fill Range	Percentage of Total Volume Occupied by Proposed Fill
4.1	3.06 million cubic metres	0.4%
4.7	3.98 million cubic metres	0.6%

As shown in **Table 6**, the percentage loss of floodplain storage is very small and therefore there would effectively be no adverse impact on the flood regime.

3.2 POTENTIAL CUMULATIVE IMPACT OF OTHER SIMILAR DEVELOPMENTS

In line with one of the requirements of the NSW Floodplain Development Manual, the cumulative impact of other potential large scale subdivisions possibly filling the fringe area of the Lyons Road flood storage area has been reviewed. With regard to the possibility of similar works being proposed it is noted that:

- Approximately 80% of the perimeter of the flood storage area lies within the Bongil Bongil National Park;

- another 6% of the perimeter – that is, the remainder of area lying within the North Bonville Masterplan area - has already been developed; and

- the remaining 14% lies within this subject development

It therefore follows that the total length of development related fill works around the perimeter of the Lyons Road flood storage area would only be related to this subject development. Hence the overall potential cumulative loss of floodplain storage in the Lyons Road flood storage area would only be the 0.6% listed in **Table 6.**

4. POTENTIAL IMPACT ON THE DEVELOPMENT

4.1 FLOOD DAMAGES

All of the developable areas will have ground levels of at least RL 5.50m AHD and habitable floor levels will be not less than RL 5.80m AHD. This means that the minimum subdivision ground levels represent freeboards of 1.4 metres relative to the current 100 year flood level and 0.8 metres relative to the potential climate change 100 year flood level. It also follows that there will be nil flood damages for all flood events up to and including RL 5.50m AHD.

4.2 CONSIDERATION OF LARGER FLOOD EVENTS

The 2005 Floodplain Development Manual also requires the consideration of floods bigger than the design (i.e.100 year) event. However since the 1995 Bonville Creek flood study did not model events larger than the 100 year flood, the flood levels actually associated with such very rare events are unknown.

The principal planning issue associated with these rare events is whether evacuation routes are available. In this regard it is noted that the subdivision design is such that road levels are a minimum of approximately RL 5.50 AHD and constantly rising to the ridge line which corresponds to the alignment of Lyons Road. Hence there are no situations where residents might potentially be trapped through living in neighbourhoods where road access might be cut and hence access to higher flood free areas might be denied.

5. REFERENCES

1. NSW Government (2005) *NSW Floodplain Development Manual*

2. DECC NSW (2007) *Practical Consideration of Climate Change – Floodplain Risk Management Guideline.* October

3. DoP NSW (2009) *NSW Coastal Planning Guideline: Adapting to Sea Level Rise.* Draft

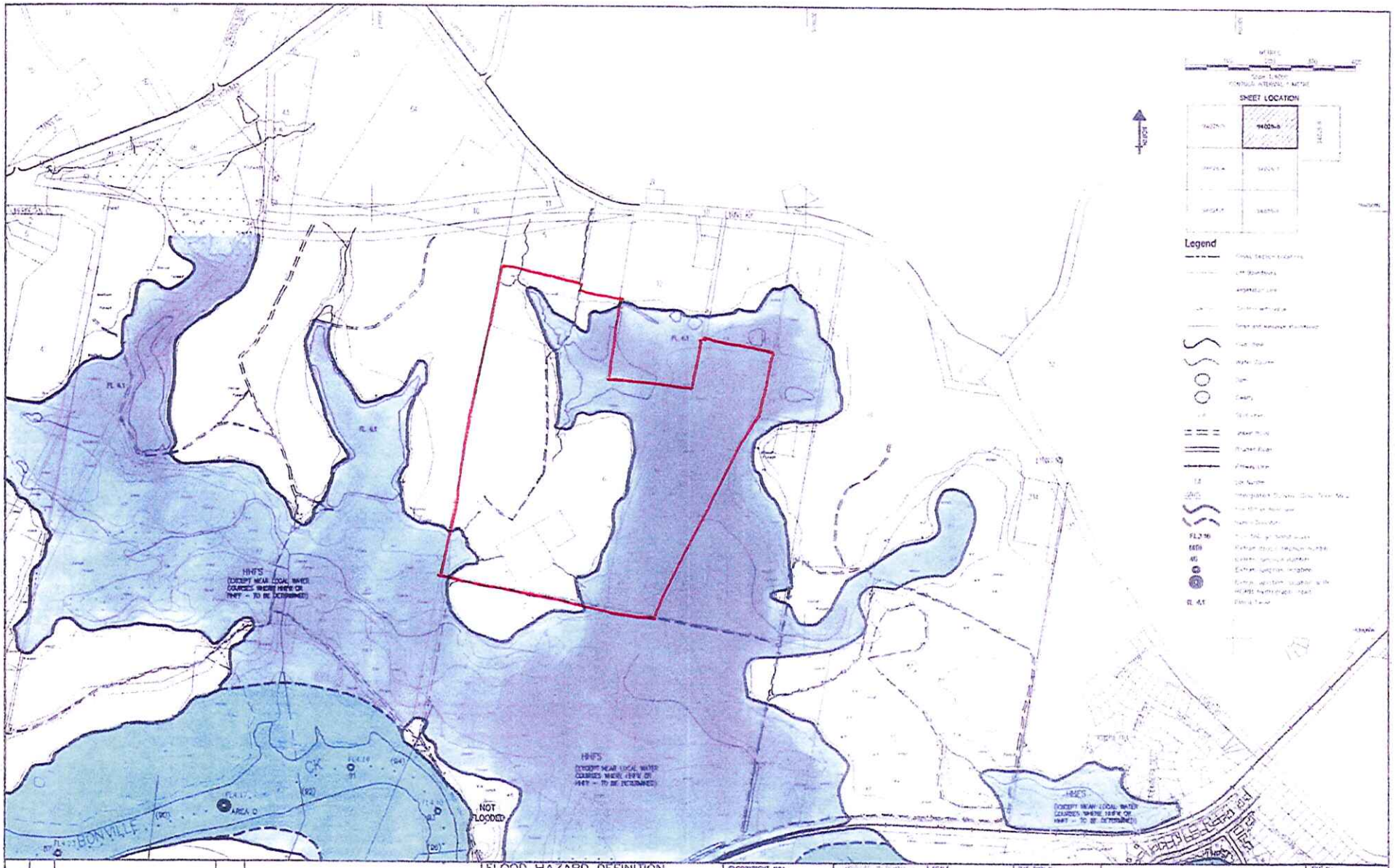
4. Coffs Harbour City Council (1995) *Bonville Creek Flood Study.* October

5. WMAwater (2009) *Boambee Creek and Newport Creek Flood Study.* Draft final report. September.

APPENDIX A

LOCATION OF LOT 112 RELATIVE TO THE LYONS ROAD FLOOD STORAGE AREA

(BASE MAP IS SHEET 6 OF 1995 BONVILLE CREEK FLOOD STUDY REPORT)



BONVILLE CREEK FLOODSTUDY
PLAN (SHEET 4 OF 7)

FLOOD HAZARD DEFINITION
LHFF – LOW HAZARD FLOOD FRINGE
LHFW – LOW HAZARD FLOODWAY
LHFS – LOW HAZARD FLOOD STORAGE
HHFF – HIGH HAZARD FLOOD FRINGE
HHFW – HIGH HAZARD FLOODWAY
HHFS – HIGH HAZARD FLOOD STORAGE

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