

TOWARDS BETTER FLOODPLAIN PLANNING

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SUMMARY

This paper questions the traditional view of floodplains as the land inundated below the flood planning level (FPL), and the management of these floodplains by the application of planning controls below a single FPL (usually the 100 year flood level).

A new approach is suggested which considers the flood hazard across the whole floodplain (i.e. up to the PMF) and manages the floodplain by the application of a graded set of planning controls which vary with the flood hazard and land use. The approach is fully consistent with the 1986 Floodplain Development Manual (FPDM) and has been commended as an appropriate application of the principles embodied in the Draft Floodplain Management Manual (1999).

The approach has been encapsulated into a model flood policy which has been developed for all catchments within the Liverpool LGA. The policy is in a generic DCP format and has been adopted by the Western Sydney Regional Organisation of Councils and the Westpool insurance group. The policy has also been endorsed by other authorities.

Specific policies are currently in preparation for a number of NSW councils using the model policy as a 'template'. The model policy could be a valuable resource for any council considering upgrading their existing flood policy.

1. LACK OF APPRECIATION OF THE REAL FLOOD HAZARD BY THE COMMUNITY

In general terms, the real flood hazard within floodplains is poorly understood and appreciated by the community, particularly if significant flooding has not occurred for many decades.

Often the community considers there to be a flood hazard only on land below the flood planning level (FPL) which is the level below which councils place restrictions on development. This FPL is commonly the 100 year average recurrence interval (ARI) flood. In fact, floods can occur well above this level (eg. in the Hawkesbury-Nepean River within the Hawkesbury LGA, the 1867 flood level was 2-3 metres above the FPL in most areas).

Illustration 1 presents the view of flood hazard generally held by the community. The flood hazard extent relates only to the FPL (in this case the 100 year ARI flood). In the community's mind, there is no flood hazard above the 100 year ARI flood level.

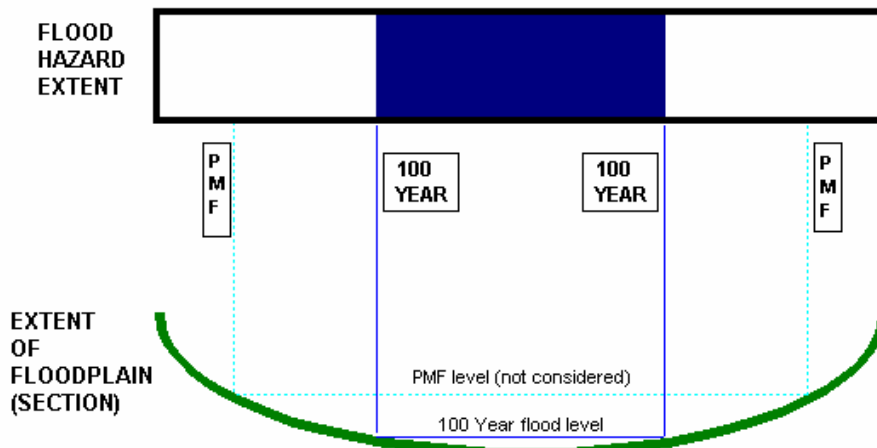


Illustration 1: Typical View of Flood Hazard Currently Held by Community

Throughout this report the term floodplain has been used to define the area inundated in the probable maximum flood (PMF). This very rare flood is the largest that could possibly occur and potentially pose a threat to communities. The PMF level is generally 1–2 metres above the 100 year ARI flood level. Exceptions to this exist. In Liverpool’s Austral study, the PMF level was found to be about 0.5 metres above the 100 year level, whilst on much of the middle Hawkesbury Valley, the PMF level may be more than 9 metres above the 100 year ARI level.

Confusion over the nature of the flood hazard has not been helped by the current procedures for flood notations on Section 149 Certificates under the EPA Act. Whilst councils are required only to use the certificate to advise whether a council **policy** relating to flooding exists, the certificates are often misinterpreted by the community as a statement of whether or not a **flood hazard** exists at the property. Most importantly, when a council does not mention flooding on a certificate, the community may incorrectly assume that there is no flood hazard when in fact (e.g. for properties just above the FPL), the flood hazard may be significant in dimension albeit more rare in occurrence.

2. THE ROLE OF FLOODPLAIN PLANNING

Floodplain management is about occupying the floodplain and optimising its use in a manner which is compatible with the flood hazard and at a level of risk which is expected by the community.

Floodplain management involves more than setting a FPL. It is about comprehensively managing the risk to people and assets both below and above the FPL, by applying and integrating a range of available measures.

There are different types of flood risks and a range of ways in which each type of flood risk can be managed. This includes floor level controls, flood awareness and warning, evacuation facilities, building design, distributing land uses in a flood compatible manner, subdivision design (eg road layouts), structural works, etc.

Traditional floodplain planning has relied almost entirely on the definition of a singular FPL, which has usually been the 100 year ARI flood level. While such an approach has often been adequate, the approach has not worked well everywhere and has led to a number of problems including:

- < creation of a ‘hard edge’ to development at the FPL;

- < distribution of development within the floodplain in a manner which does not recognise the risks to life or the economic costs of flood damage;
- < unnecessary restriction of some land uses from occurring below the FPL, while allowing other inappropriate land uses to occur immediately above the FPL;
- < polarisation of the floodplain into perceived 'flood prone' and 'flood free' areas;
- < lack of recognition of the significant flood hazard that may exist above the FPL (and as a result, there are very few measures in place to manage the consequences of flooding above the FPL);
- < creation of a political climate where the redefinition of the FPL (due to the availability of more accurate flood behaviour data, or for other reasons) is fiercely opposed by some parts of the community, due to concern about significant impacts on land values — i.e. land which was previously perceived to be 'flood free' will now be made 'flood prone' — (despite the likelihood that such impacts may only be short term).

Accordingly, continuation of the sole reliance on the 100 year ARI FPL is inappropriate, particularly if a generic approach is to be developed.

The current approach to floodplain planning discussed above may be typified by the example shown in **Illustration 2**, which flows from the inappropriate view of flood hazard presented in **Illustration 1**. No development is permitted below the FPL (ie 100 year ARI flood) because of an acknowledgment of the flood hazard. Above the FPL, no flood hazard is perceived and therefore there are no flood-related controls on development. Thus an abrupt change in development control occurs at the FPL.

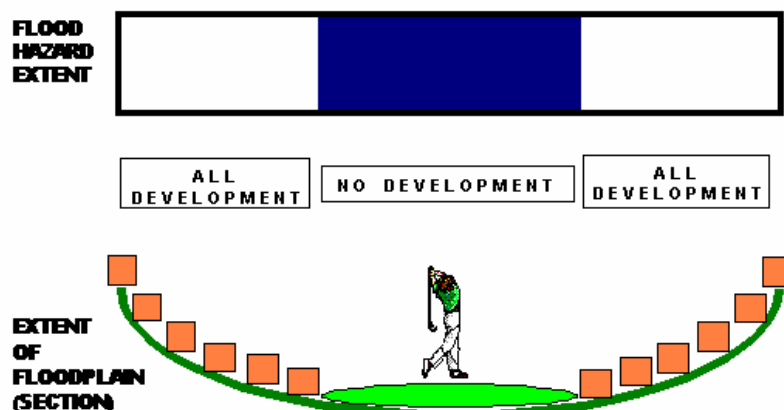


Illustration 2: Current Floodplain Planning

(Derived from an inappropriate view of flood hazard and the use of a singular flood planning level)

In addition, it is rare to find councils which have determined their FPL using the procedures suggested in the State Government's Floodplain Development Manual (1986), ie. by:

"balancing the social, economic and ecological considerations against the consequences of flooding, with a view to minimising the potential for property damage and the risk to life and limb."

By default, most councils have adopted the 100 year FPL, given that this FPL has been widely used across the State and that councils have been unable to carry out the assessment necessary to establish appropriate alternatives. The process suggested in the Manual, being complex and without detailed guidelines for town planners, has been difficult for councils to follow.

3. THE PLANNING MATRIX APPROACH

Given that some floodplains have an extensive flood range, and given the difficulty in addressing the associated variability in flood risks with simple rules, the use of the planning matrix approach (D. Bewsher and P.Grech, 1997) is recommended.

The approach distributes land uses within the floodplain and controls development to minimise the flood consequences as depicted in **Illustration 3** below.

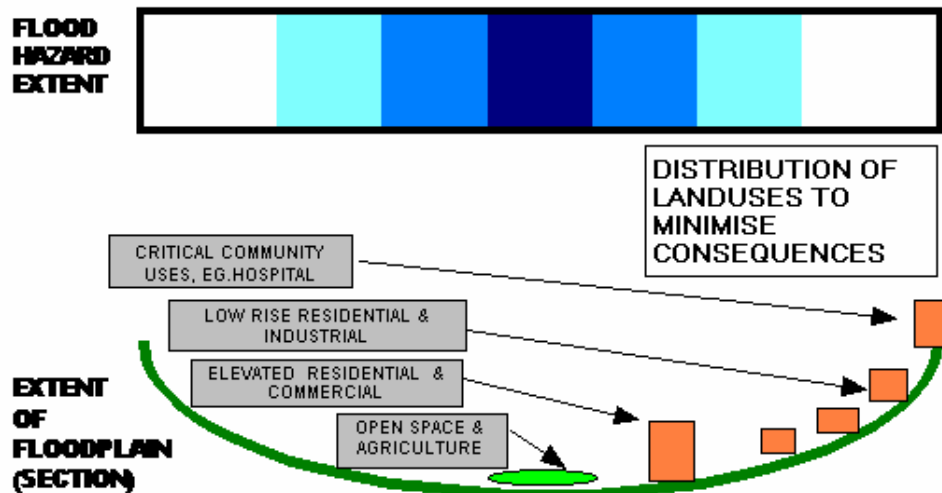


Illustration 3: Distributing Land Uses under the Planning Matrix Approach

Using this approach, a matrix of development controls, based on the flood hazard and the land use, can be developed which balances the risk exposure across the floodplain. This approach has been adopted as part of the Hawkesbury–Nepean Flood Management Strategy announced by Minister Amery in April 1998. It has also been applied within the Blacktown, Narrabri, Scone, Cabramatta Creek (ie Liverpool), Boundary Creek (ie Strathfield), Paterson River, North Wentworthville and Molong Floodplain Management Studies, and the resulting matrix has been pivotal in the new draft DCPs and LEPs recommended for implementation as part of these floodplain management plans (see **Illustration 4**).

The approach is summarised in **Illustration 5**. It is fully consistent with the current Floodplain Development Manual (1986) or its prospective replacement, the draft Floodplain Management Manual (1999).

AREA	GROUND LEVEL OF LAND																													
	LOW HAZARD					MEDIUM HAZARD					HIGH HAZARD					VERY HIGH HAZARD														
	E	C	S	R	C	R	E	S	S	R	C	E	S	S	R	C	E	S	S	R	C	E	S	S	R	C				
FLOOR LEVEL	4																													
BUILDING COMPONENTS	3																													
STRUCTURAL SOUNDNESS	4																													
FLOOD AFFECTATION																														
EVACUATION/ACCESS	2	4																												
FLOOD AWARENESS	3	3	1,3	3	3	3	3																							
MANAGEMENT & DESIGN	1	1																												

DIVIDE FLOODPLAIN INTO BANDS OF DIFFERENT GRADES OF FLOOD HAZARD. THE NATURE OF BANDS WILL VARY WITH LOCAL CIRCUMSTANCES

IDENTIFY AREAS OF EXTREME HAZARD WHERE MOST DEVELOPMENT WOULD BE UNWISE. WITHIN THE HAWKESBURY NEPEAN, THESE AREAS ARE PROPOSED TO BE IDENTIFIED WITHIN NEW DLWC GUIDELINES

FORMULATE AND PRIORITISE DIFFERENT LANDUSE CATEGORIES BASED ON SENSITIVITY TO THE FLOOD HAZARD HAVING REGARD TO SOCIAL AND ECONOMIC CONSIDERATIONS, FLOOD DAMAGES AND OTHER MATTERS ADDRESSED IN THE FLOODPLAIN MANAGEMENT STUDY

DETERMINE WHICH LANDUSES ARE UNDESIRABLE IN EACH FLOOD HAZARD BAND

NOTES

- NOT RELEVANT
- UNSUITABLE LAND USE

HHF
PMF

REFERS TO THE HIGHEST HISTORICAL FLOOD AS DEFINED IN THE GLOSSARY
REFERS TO THE PROBABLE MAXIMUM FLOOD AS DEFINED IN THE GLOSSARY

- FLOOR LEVEL**
- ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 1 IN 5 YEAR FLOOD PLUS 0.5M (FREEBOARD)
 - HABITABLE FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 1IN 100YR FLOOD PLUS 0.8M (FREEBOARD)
 - AND OTHER FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 1 IN 100 YR FLOOD PLUS 0.5M (FREEBOARD)
 - ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 1 IN 100 YR FLOOD PLUS 0.5M (FREEBOARD)
 - FLOOR LEVELS TO BE AS CLOSE TO THE 1 IN 100 YR FLOOD PLUS 0.5M (FREEBOARD) AS PRACTICABLE
- STRUCTURAL SOUNDNESS**
- ALL STRUCTURES TO HAVE FLOOD COMPATIBLE BUILDING MATERIALS
 - ALL STRUCTURES TO HAVE FLOOD COMPATIBLE BUILDING MATERIALS
 - ALL STRUCTURES TO BE CONSTRUCTED OF FLOOD COMPATIBLE MATERIALS BELOW OR AT THE PMF LEVEL

SPECIFY PLANNING CONTROLS TO BE APPLIED TO LANDUSES TO FACILITATE DEVELOPMENT WITHIN DIFFERENT FLOOD HAZARD BANDS. THE AIM IS TO ACHIEVE LEVELS OF RISK EXPECTED BY THE COMMUNITY

STRUCTURAL SOUNDNESS

- ENGINEERS REPORT TO PROVE ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE 1 IN 100 YR LEVEL CAN WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY
- ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE 1 IN 100 YEAR SHOULD WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY
- ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE HHF SHOULD WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY
- ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCLUDING THE PMF LEVEL SHOULD WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY
- GEOTECHNICAL ENGINEERS REPORT REQUIRED TO SPECIFY APPROPRIATE FILLING/EARTHWORKS & THE MEANS OF RETENTION OF BATTERS AGAINST SCOURING/EROSION

FLOOD EFFECT ON OTHERS

- ENGINEERS REPORT REQUIRED TO PROVE THAT THE DEVELOPMENT OF AN EXISTING ALLOTMENT WILL NOT INCREASE FLOOD AFFECTATION ELSEWHERE
- THE IMPACT OF THE DEVELOPMENT ON FLOOD AFFECTATION ELSEWHERE TO BE CONSIDERED

EVACUATION/ACCESS

- RELIABLE ACCESS FOR PEDESTRIANS REQUIRED DURING FLOODS
- RELIABLE ACCESS FOR PEDESTRIANS & VEHICLES REQUIRED DURING FLOODS
- ELECTRONIC FLOOD WARNING DEVICES TO BE INSTALLED
- CONSIDERATION REQUIRED REGARDING AN APPROPRIATE FLOOD WARNING ROUTE

DETERMINE SPECIFIC CONTROLS ON THE DESIGN AND MANAGEMENT OF DEVELOPMENT THAT CAN BE APPLIED TO DIFFERENT LANDUSES DEPENDING ON THE HAZARD BAND, TO MINIMISE THE POTENTIAL CONSEQUENCES .EG. FLOOR LEVEL CONTROLS TO REDUCE PROPERTY DAMAGE OR EVACUATION ROUTES & PROCEDURES TO MINIMISE RISK TO LIFE

FLOOD AWARENESS

- RESTRICTIONS TO BE PLACED ON TITLE ADVISING OF MINIMUM FLOOR LEVELS REQUIRED RELATIVE TO THE FLOOD LEVEL
- S149(2) CERTIFICATES TO NOTIFY AFFECTATION BY THE 1 IN 100 YEAR FLOOD
- S149(2) CERTIFICATES TO NOTIFY AFFECTATION BY THE PMF FLOOD

MANAGEMENT & DESIGN

- FLOOD PLAN REQUIRED WHERE FLOOR LEVELS ARE BELOW THE DESIGN FLOOR LEVEL
- APPLICANT TO DEMONSTRATE THAT THERE IS AN AREA WHERE GOODS MAY BE STORED ABOVE THE 1 IN 100 YEAR FLOOD LEVEL PLUS 0,5M(FREEBOARD) DURING FLOODS.
- NO EXTERNAL STORAGE OF MATERIALS BELOW THE 1 IN 100 YEAR LEVEL PLUS 0.5M(FREEBOARD) WHICH MAY BE POTENTIALLY HAZARDOUS DURING FLOODS
- APPLICANT TO DEMONSTRATE THAT POTENTIAL DEVELOPMENT AS A CONSEQUENCE OF A SUBDIVISION PROPOSAL CAN BE UNDERTAKEN IN ACCORDANCE WITH THIS POLICY

Illustration 4: Planning Matrix and Explanation

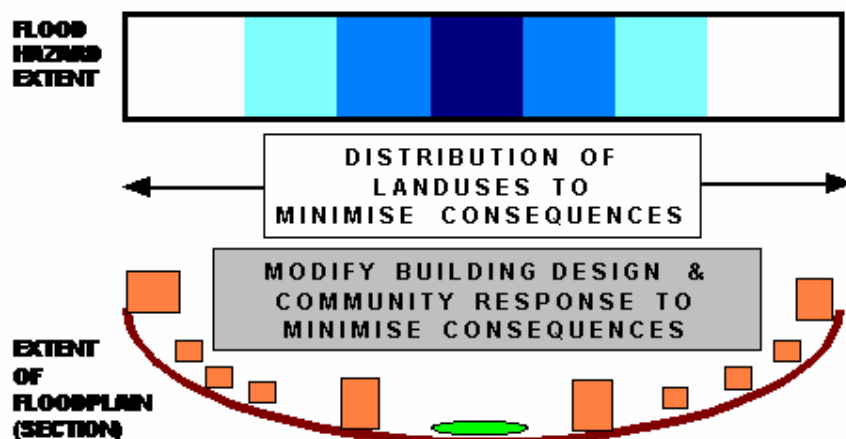


Illustration 5: The Planning Matrix Approach to Floodplain Planning

4. DEVELOPING GENERIC FLOODPLAIN PLANNING POLICIES

As a council often has a number of catchments within its LGA, there is merit in developing a generic floodplain planning policy which can be applied to all catchments whilst considering the local differences of each catchment. This is the approach which the authors have pursued at Liverpool which has five unique catchments, and for which only two have had comprehensive floodplain management plans prepared.

Following the development of this generic policy within the Liverpool LGA, it has been extended to other LGA's and the Western Sydney Regional Organisation of Councils (WESROC), the WestPool insurance group, the Upper Parramatta River Catchment Trust (UPRCT) and other groups have either adopted or endorsed the generic policy.

The development and adoption of a generic policy and its application to local catchments allows the "merits" approach of the Government's policy to be applied whilst ensuring uniformity and consistency across a LGA, or in the case of WESROC and UPRCT, many LGA's.

5. STEPS IN DEVELOPING A GENERIC POLICY

5.1 Categorising the Floodplain

The first stage in developing a generic policy is to delineate each of the floodplains to be subject to the preparation of a "planning matrix", while the second stage is to divide the floodplains into areas (or bands) of differing hazard.

The aim is to prepare a single policy document which has a common preamble, objectives and general policies, while specific controls for each floodplain are reflected within a planning matrix prepared for each individual floodplain and annexed to the principal document.

A key component of this process is to identify different bands, reflective of variable flood hazard within each of the separate floodplains. Whilst the bands are unique to each floodplain, the following three bands are often appropriate:

- < the Outer Floodplain – being the area above the 100 year ARI flood plus 0.5 metres to the PMF
- < the Flood Fringe – between the high hazard area to the 100 year ARI flood plus 0.5 metres

- < the Floodway – being the high hazard area determined in accordance with the procedures identified in the FPDM.

Further, as required by the FPDM, the delineation of the high hazard area (floodway) on a map will need to consider emergency evacuation measures and other criteria (in addition to depth and velocity, hydraulic factors).

5.2 Prioritising Land Uses in the Floodplain

The next component in the preparation of the planning matrix is to prioritise land uses within the floodplain. This is achieved by identifying discreet categories of land uses (as defined in the LEP), with similar levels of sensitivity to the flood hazard. The following categories are typical of those often adopted:

- < Essential community facilities
- < Critical utilities
- < Subdivision and filling
- < Residential
- < Commercial or industrial
- < Open space/rural or non-urban uses
- < Minor development.

These categories are then listed under each hazard band in the planning matrix dependent upon the level of flood risk which is considerable acceptable by the community (see **Illustration 4**). This provides a basis for specifying whether certain categories are unsuitable land uses in different parts of the floodplain or whether they are suitable subject to varying degrees of development control.

Prioritisation of land uses is identified through the normal community consultation process which forms part of most floodplain management studies.

5.3 Controls to Modify Building Form and Community Response

The next component in the preparation of the planning matrix is to assign different planning controls to modify building form and the ability of the community to respond in times of flooding, depending upon the type of land use and the location of that land use within the floodplain. The type of controls can be categorised under seven main headings, being:

- < Floor levels
- < Flood compatible building components
- < Structural soundness
- < Flood effect on others
- < Evacuation/access
- < Flood awareness
- < Management and design.

There will be varying severity of development controls reflecting the sensitivity of the land use category to the flood hazard, and the location of the land use within the floodplain.

5.4 Implementation

The most appropriate mechanism for the implementation of the flood policy is normally its adoption as a DCP. The DCP could also include general policies of a council such as their criteria for rezoning applications within the floodplain, which while not specifically relevant to the assessment of development applications, provide a holistic approach to a council's policies for the management of the floodplain. There would be no legal impediment to the inclusion of such additional matters within the DCP document.

Those floodplains for which Floodplain Management Plans have not been prepared should be the subject of an interim flood policy as required by the FPDM. For the purposes of preparing such an interim policy, it is recommended that the adopted planning matrix be monitored and modified over time depending upon any further studies and reviews undertaken, as council resources permit.

In addition to the preparation of DCP's, council will often need to undertake discreet changes to its LEP's in order to ensure consistency with definitions, land use prohibitions, special flood development control clauses, and to modify boundaries which have been based on previous flood lines.

6. CASE STUDY

The following component of this paper will provide a case study of a proposed development which is received by a council as a development application (DA) and requires assessment under the provisions of the new policy/DCP which has been prepared as described above. The example chosen follows on from that outlined within the corresponding paper presented to the 1999 Flood Conference entitled "*Minimising Legal Liability Risk when Disseminating Flood Data*" prepared by the same authors.

6.1 Description of Proposal

The proposal involves the erection of a four storey building incorporating ground level car parking plus three levels of residential flat units above. The property adjacent to the main creek is left relatively undisturbed, conserving existing riparian vegetation and incorporating this area into the landscape open space grounds for the residential flat building. Access is available directly out to the frontage of the site, abutting a public road. The site characteristics are diagrammatically depicted upon **Illustrations 6-9**.

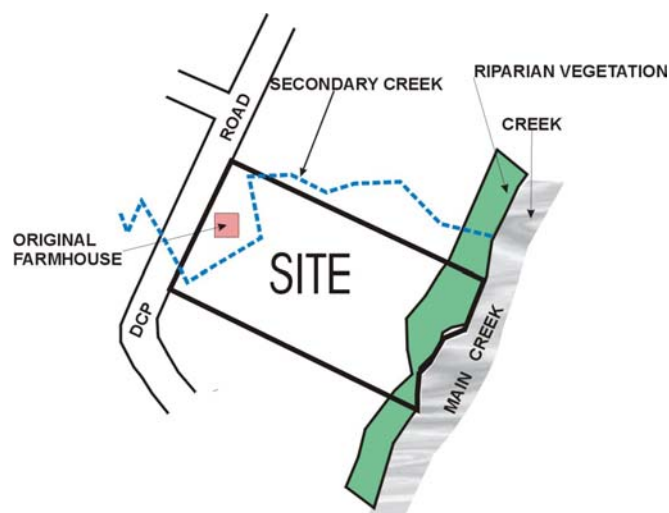


Illustration 6: Site Features

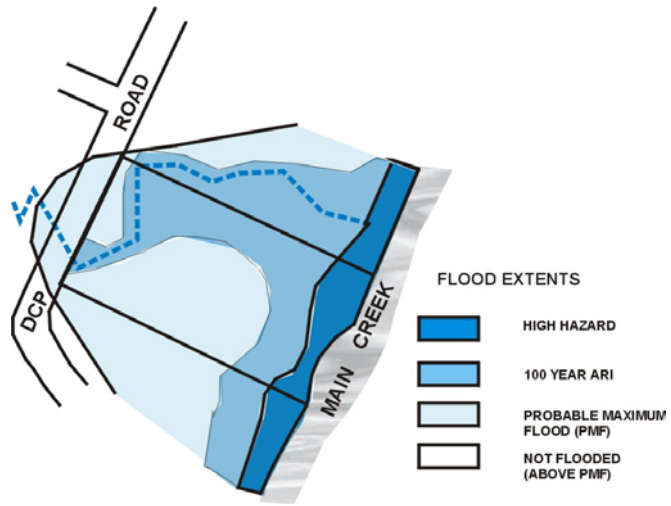


Illustration 7. Flood Map

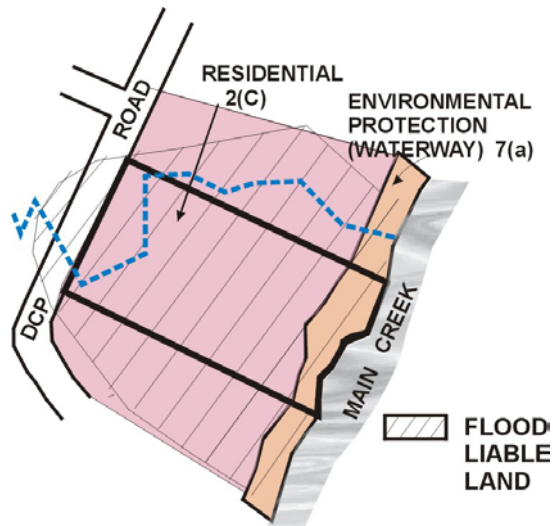


Illustration 8 Zoning

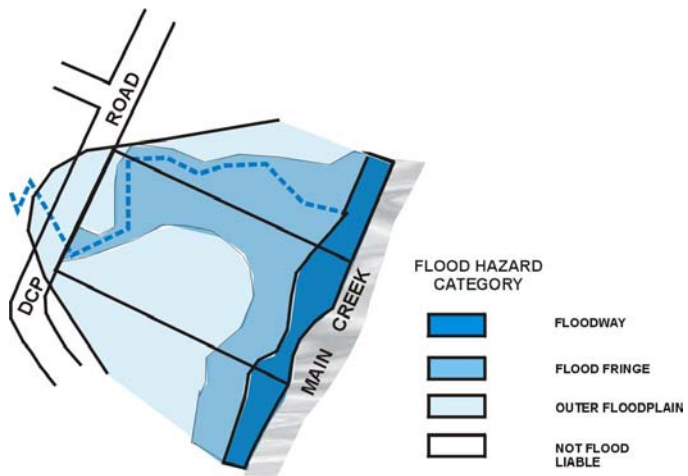


Illustration 9: DCP Map

6.2 Information Submitted with Application

As required by the new policy/DCP, and as confirmed by enquiries made with Council, the following information was submitted with the application, with regard to the issue flooding:

- < details regarding the proposed finished floor levels having regard to flood levels;
- < details regarding flood compatible materials to be used below habitable floor level;
- < an engineer's report which confirms the structural soundness of the proposed building. Note this is only a basic report outlining that the general principles have been adhered to in the design as a detailed engineer's report is not required because no part of the building was to be located within the floodway. However, the proposed access driveway across the secondary creek which included a component of high hazard floodway required the engineer's to prove its structural soundness;
- < as the proposal involves some filling of the land, the engineer's report analysed the potential affectation on others;
- < flood plan was also provided outlining evacuation procedures.

6.3 Who Assesses the Application?

The Council town planners are principally responsible for the assessment of the application. As the application was accompanied by an engineer's report, this was referred onto Council's flood engineers for evaluation. Should an engineer's report not be required in accordance with the provisions of the Policy, the application would not necessarily need referral to Council's flood engineers unless there were variations to the Policy which were questionable.

6.4 Assessment of Application

Zoning

The zoning (provided by the Local Environmental Plan - LEP) places restrictions on the development within land zoned 7(a) which incorporated the area identified as high hazard floodway, as well as that affected by other criteria such as significant riparian vegetation. No development was proposed within the 7(a) zone, other than utilisation of the area for passive open space purposes associated with the residential flat building, and therefore the use was permissible with consent.

Floor Level and Flood Compatible Materials

The lowest habitable floor level of the proposed residential flat building was above the 100 year flood plus 0.5 metres freeboard. That part of the building below this level was utilised mainly for access, laundry and car parking, and details were provided which demonstrated suitable flood compatible materials were to be used. Therefore the proposal complied.

Structural Soundness and Flood Affect on Others

The proposal provided for minimal filling of the land, sufficient only to level out any irregularities to allow for adequate external open space areas and building platforms. The driveway access was not constructed over filled land and bridged over the secondary creek. The required filling approaches and bridging were calculated by the consultant's engineer to result in unreasonable affectation on others in the floodplain. Accordingly, only a low level causeway crossing was proposed which would not have any affectation on others and was demonstrated to be structurally sound. All other proposed structures including the residential flat building, were determined by the consultant's engineer to be able to withstand the force of flood waters.

Evacuation on Others

The access way which provided only a low level causeway crossing over the secondary creek and adjacent lands being identified containing a high hazard floodway and land affected by the 100 year flood was assessed as being unsatisfactory. This is because the access would fall before rising again to

higher ground and would result in persons evacuating when flood levels reached habitable floor levels being stranded or subject to unreasonable risk if attempting to travel across the driveway at such times.

As bridging and filling would result in unreasonable impact upon others in the floodplain, alternate access was required. The applicant was advised of this problem, and alternate access was sought. Alternate access was obtained by purchasing of a right of way across the adjoining property to provide access to higher ground along a route of continual rise (refer to **Illustration 10**).



Illustration 10: Resultant Development

Management and Design

The ground floor level of the residential flat building was designed to minimise potential for storage of valuable goods and each unit was provided with appropriate storage areas. The flood plan provided for procedures for evacuation of the residential flat buildings upon notification by the SES or Police. The flood plan included a set of evacuation procedures (similar to a fire drill) which was exhibited in the lobby area and provided to residents upon arrival, by the Body Corporate.

Other necessary procedures were also incorporated in the flood plan including the removal of cars to higher ground, the turning off of power, securing of garden equipment, storage sheds, etc. As the first floor level would be flooded by a flood event of magnitude approaching the PMF, the flood plan identified this concern and emphasised the need for evacuation when appropriate warnings were provided.

Accordingly, by following the required procedures both the applicant and Council officers were able to ensure that the resultant development and its future occupants were subjected to minimal acceptable risk, in conformity with Council's Floodplain Management Plan.

7. REFERENCES

(Due to space limitations, references have not been included. However a comprehensive list is available directly from the authors).