Development Control Plan No 30

Cooks River Floodplain

Flooding in Illawarra Road – circa late 1960s
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This Development Control Plan has been prepared in accordance with section 72 of the Environmental Planning and Assessment Act, 1979 as amended. It was adopted by Council on 15 September 1998 and operates from the public notification on 1 October 1998.

Mayor, Barry Cotter ..... **date** 23/9/98.

1.0 PRELIMINARIES

1.1 CITATION

This plan may be cited as the Marrickville Development Control Plan for the Cooks River Floodplain.

1.2 OBJECTIVES

The objectives of this plan are:-

(a) To reduce the impact of flooding and flood liability on individual owners and occupiers.

(b) To limit the potential risk to life and property resulting from flooding.

(c) To reduce the risk and implications of flooding to existing areas by flood mitigation works where appropriate and other measures.

(d) To prevent the introduction of unsuitable land uses into land identified as being flood liable.

(e) To alert the community to the extent and hazard of flood liable land in the areas.

(f) To inform the community of Council's policy in relation to the development and use of flood liable land.

(g) To define a flood standard.

(h) To encourage development and construction which is compatible with the flood hazard.

1.3 APPLICATION OF THIS PLAN

This plan applies to the development of land within the Cooks River Floodplain and land within the 0.5 m freeboard fringe, which is designated as "flood liable land" by Marrickville Council.

1.4 PURPOSE OF THE PLAN

This plan recognises the extent of investment, both public and private, in existing development in flood liable areas, and takes into account the value of this development when assessing applications for new development or alterations and additions to existing development.

In determining an application for development on land designated as flood liable land, Council shall take into consideration those matters as listed under Section 79C of the Environmental Planning and Assessment Act, 1979 and/or any relevant sections of the Local Government Act, 1993 as appropriate.

1.5 RESPONSIBLE AUTHORITY

The authority responsible for enforcing the observance of this plan is Marrickville Council (hereinafter referred to as 'Council').

1.6 RELATIONSHIP TO OTHER INSTRUMENTS, PLANS AND POLICIES

This DCP supplements the Marrickville Planing Scheme Ordinance and existing Council Plans and Codes. The content of this plan is to be used by Council as a guide only and compliance with this plan does not automatically ensure approval. Each application will be considered upon the merits of the proposal.

1.7 FLOOD STANDARD

Council has adopted for this plan the 1% Annual Exceedance Probability (1%AEP) as the flood standard for all areas (except the Carrington Road area where standards are as described in 3.3).

1.8 CONSIDERATION OF FLOODS LARGER THAN THE STANDARD

It must be stressed that the standard flood is not, the largest flood that can occur. Developments that will have a significant impact on the extent of flooding experienced by adjoining or surrounding properties, should an extreme flood event be experienced, may be required to consider floods larger than the standard flood event. Marrickville Council reserves the right to impose a higher level flood standard depending on the nature and circumstances surrounding each development proposal.

1.9 DEFINITIONS

1% Annual Exeedance Probability (AEP)	a 1% AEP flood has a 1% probability of occurring or being exceeded in each and any year.
Australian Height Datum (AHD)	a common national plane of level corresponding approximately to mean sea level.
Catchment	the area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.
Compatible developments	developments appropriate to both the flood hazard at the development site and to the impact of the development on existing flood levels and flood flows.
Conditional developments	developments likely to cause/suffer excessive flood damage or likely to have an unacceptable impact on flood levels and flood flows.
Consent authority	in relation to a development or construction certificate: • the council having the function to determine the application; or • where an environmental planning instrument specifies a Minister or public authority (other than a council) or the Director (of the Department of Urban Affairs and Planning) as having the function to determine a development application, that Minister or public authority or the Director as the case may be.
design floor level (DFL)	a minimum floor level specified for a building.
designated flood	(see flood standard)
development	the erection of a building or the carrying out of work; or the use of land or of a building or work; or the subdivision of land. **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 other purposes. New developments typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power. **redevelopment:** refers to the rebuilding of 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 major extensions to urban services.

discharge	the rate of flow of water measured in terms of volume over time. It is to be distinguished from the speed or velocity of flow, which is a measure of how fast the water is moving rather than how much is moving.
effective warning time	is equal to the available warning time, less the time taken to alert flood-affected people (by radio, television, loud-hailer or word of mouth), and have them commence effective evacuation procedures.
flood	relatively high stream flow which overtops the natural or artificial banks in any part of a stream or river.
flood awareness	an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning and evacuation procedures. In communities with a high degree of flood awareness, the response to flood warnings is prompt and efficient. In communities with a low degree of flood awareness, flood warnings are liable to be ignored and residents are often confused about when to evacuate, what to take and where it should be taken.
Flooding	the State Emergency Service uses the following definitions in flood warnings: **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 and the upper limit is determined by local conditions. **moderate flooding:** low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered. The range on the reference gauge is determined by local conditions. **major flooding:** extensive areas are flooded with properties, villages and town isolated and/or appreciable urban areas are flooded. The threshold for this class of flooding is the upper limit of moderate flooding.
flood fringe	the remaining area of land affected by flooding, after floodway and flood storage areas have been defined.
flood hazard	potential for damage to property or persons due to flooding.
flood liable land	land which would be inundated as a result of the standard flood.

floodplain	the portion of a river valley, adjacent to the river channel, which is covered with water when the river overflows during floods.
flood proofing	a combination of measures incorporated in the design and/or construction and alteration of individual buildings or structures subject to flooding, for the reduction or elimination of flood damages.
floodplain management measures	the full range of techniques available to floodplain managers. This definition is expanded in Section 2.4 of the NSW Government's Floodplain Development Manual.
floodplain management options	the measures which might be feasible for the management of a particular area.
flood standard (or designated flood)	the flood selected for planning purpose. For Marrickville Council the standard flood is deemed to be the 1% AEP flood for all areas except the Carrington Road area.
flood storage	those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.
floodways	those areas where a significant volume of water flows during floods. They are often aligned with obvious naturally defined channels. Floodways are areas, which, even if only partially blocked, would cause a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, the areas of deeper flow or the areas where higher velocities occur.
freeboard	a factor of safety usually expressed as a height above the designated flood. Freeboard tends to compensate for factors such as wave action, localised hydraulic effects etc.
habitable room	a living area such as a lounge room, dining room, rumpus room, kitchen and bedroom.
high hazard	possible danger to life and limb; evacuation by trucks difficult; potential for structural damage; social disruption and financial losses could be high.
Hydraulic	the term given to the study of water flow in a river, in particular, the evaluation of flow parameters such as stage and velocity.
hydrograph	a graph, which shows how, the discharge changes with time at any particular location.

hydrology	the term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
low hazard	should it be necessary, people and their possessions could be evacuated by trucks. Able-bodied adults would have little difficulty wading.
main stream flooding	inundation of normally dry land occurring when water conveyed to the locality from further upstream overflows the natural or artificial banks of the principal watercourse in the catchment. It generally excludes any water courses constructed with pipes or artificial channels or considered as stormwater channels.
management plan	a document including, as appropriate, both written and diagrammatic information describing how a particular area of land is to be used and managed to achieve defined objectives. It may also include description and discussion of various issues, problems, special features and values of the area, the specific management measures which are to apply and the means and timing by which the plan will be implemented.
mathematical/ computer models	the mathematical representation of the physical processes involved in runoff and stream flow. These models are often run on computers due to the complexity of the mathematical relationships. The models are mainly involved with the determination of rainfall, runoff and stream flow.
peak discharge	the maximum discharge occurring during a flood event.
probable maximum flood	the flood calculated to be the maximum, which is likely to occur.
probability	a statistical measure of the expected frequency or occurrence of flooding.
runoff	the amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
stage	equivalent to “water level”. Both are measured with reference to a specified datum.
stage hydrograph	a graph, which shows how, the water level changes with time. It must be referenced to a particular location and datum.
stormwater flooding	inundation resulting from the incapacity of an urban stormwater drainage system to handle runoff.

survey plan	a plan prepared by a registered surveyor.
water surface profile	a longitudinal plot showing the flood stage at any given location along a watercourse.
wind fetch	the horizontal distance in the direction of wind over which waves are generated by wind.

Before the flood a street of 20 houses stood there (Mount Pleasant Street, Maitland, 1995)

2.0 PREFACE

2.1 ISSUES

Major floods in various parts of the State in the late 1940's and the early 1950's gave rise to the construction of works aimed at reducing the effects of flooding. However, despite the expenditure of many millions of dollars the cost of restoration, relief and assistance following floods has continued to grow. While Government expenditure on flood relief has been great, the cost and suffering borne by flood affected individuals has been far greater.

For some time now it has been recognised that, apart from building or construction works to protect existing development, growth in flood losses can only be contained by ensuring that new developments take into account the susceptibility of land to flooding. In particular, it is essential that new developments be designed and constructed in a way that will minimise flood damage and will ensure that flooding conditions at other properties are not made worse.

Household damage due to inundation (Photo courtesy "News & Sunday Mail)

Therefore, an integrated approach to land planning and management is required, which takes into account flooding and its severity along with other relevant planning factors. This has not been undertaken very successfully in the past, largely because the impact of major floods, which are rare, is easily forgotten and because of the difficulty of confidently assessing flood behaviour. Today, much better predictive techniques are available.

In 1994, both Canterbury City Council and Marrickville Council commissioned Webb, McKeown and Associates Pty Ltd to undertake a floodplain management study for the Cooks River which would confidently predict the expected flood behaviour of this watercourse within the respective Local Government

boundaries. Flood levels for the Cooks River are provided in this Study for a range of flood probabilities.

Following the completion of a floodplain management study, both Canterbury City Council and Marrickville Council again commissioned Webb, McKeown and Associates Pty Ltd to prepare a floodplain management plan which identifies methods and techniques to control and minimise the flooding risks along the Cooks River. This plan is now completed and guides both Councils in their assessments of development proposals along this watercourse.

The preparation of the Development Control Plan is a documentation of the recommended management techniques as stated in the Cooks River Floodplain Management Plan.

2.2 BACKGROUND

The Cooks River drains a catchment of approximately 100 square kilometres in the inner south-western suburbs of Sydney. The river begins as a small watercourse near Chullora Railway Workshops and flows some 23 km in a generally eastern direction to enter Botany Bay just south of Kingsford Smith Airport.

Prior to entering Botany Bay, the Cooks River is joined by a number of tributaries, the most important being Cox's Creek which drains the Punchbowl area, Cup and Saucer Creek which enters near Canterbury, Wolli Creek which begins in Beverly Hills and Sheas Creek which drains the Alexandria area and enters the Cooks River via Alexandra Canal.

The catchment map (attached Map 1) shows the main features of the Cooks River Valley.

The catchment has been heavily developed in past years and is home to almost 400,000 people, contains more than 130,000 dwellings and over 100,000 commercial and industrial properties. Little remains of the original landscape and vegetation. The river channel itself has been highly modified and virtually the entire length of the river has been lined. The channel has been straightened and realigned in a number of places.

Despite the heavy development of the catchment, the river has not caused severe flooding problems over the years, mainly because much of the floodplain has been isolated from development for use as recreation or road reserves. The river itself is flanked by parkland and open space for the majority of its length, which is unusual amongst urban watercourses. There are however, some flood liable areas of residential or industrial zoned land as well as a number of isolated flood liable properties.

The history of flooding within the Cooks River catchment is documented in a wide variety of mediums and by many organisations. A compendium of data compiled in October 1983 by the NSW Public Works Department provides a

great amount of detail concerning flooding of the Cooks River including dates of flooding events and levels. In summary, flooding has occurred on the Cooks River in the following years:-

1889	1931	1947	1956	1971
1913	1933	1948	1957	1974
1920	1937	1949	1961	1975
1925	1938	1950	1963	1978
1926	1942	1952	1964	1983
1927	1946	1953	1969	

Some minor flooding has occurred since 1983 but this has caused little damage and the available data is sparse.

It is impossible to calibrate or gauge these floods in terms of Annual Exceedance Probability (AEP) due to unreliable or non-existent water and ground levels for each event. Nevertheless, it is possible to rank some of the floods in order of magnitude. The highest floods since World War II have been (in order) November 1961, February 1956, March 1958, June 1964, January 1949 and March 1983. The highest known flood of the Cooks River occurred in May 1889 in which a Sydney Morning Herald extract gave details of flood deaths at Canterbury. The November 1961 is the second largest flood recorded on the Cooks River.

Flooding profiles (ie a long-section of the Cooks River showing flood levels) have been prepared in the Cooks River Floodplain Study for the 1961, 1956, 1958, 1964 and 1983 events (in order of magnitude). Flood profiles have also been derived for the 1, 2, 5% AEP events and an extreme flood event.

3.0 FLOOD LIABLE LANDS

3.1 RIVERSIDE CRESCENT AREA, DULWICH HILL (including Tennyson Street)

Flood Classification - Low to High Hazard Flood Fringe

Flood Description

Approximately 13 dwellings are inundated above floor level in a 1% flood in Riverside Crescent (8 buildings) and Dibble Avenue (5 buildings). The depth of flooding ranges from 0.4m to 1.1m above floor level in a 1% flood. Nine houses are inundated by up to 0.5m above floor level in a 5% flood. The houses are brick, more than 20 years old and generally single storey.

The pavement on Riverside Crescent is at the same level or lower than the adjoining golf course and is inundated two or three times a year.

This area is classified as ranging from *Low to High Hazard Flood Fri*nge. Pedestrian access to high ground is not available from some dwellings during a flood. For others access is possible through yards and across fences however, this is not a practical route for the elderly, infirm or young children. Vehicular access is limited as Riverside Crescent will become hazardous in floods greater than a 5% event.

3.2 ILLAWARRA ROAD/WHARF STREET AREA, MARRICKVILLE

Flood Classification - Low to High Hazard Flood Fringe

Flood Description

Approximately 19 dwellings and 5 industrial or commercial premises in Wharf Street, Illawarra Road and Hill Street are inundated above floor level in a 1% flood. The maximum depth of inundation is 0.6m. Two dwellings are inundated in a 5% flood (by 0.1m).

Until 1995 Illawarra Road was closed approximately 12 times per year by flooding from high tides. It has now been raised approximately 0.8m to a minimum level of 1.7mAHD. At the same time Wharf Street was raised to 1.5mAHD. While it is no longer flooded by high tides, Illawarra Road is still inundated by up to 1.3m in a 1% flood and 0.8 m in a 5% flood.

Pedestrian access to high ground is not available for many of the properties along Illawarra Road. The road itself will be flooded early in a major event and the properties back onto a near vertical cliff. Vehicular access along Illawarra Road and Wharf Street is not possible during floods.

3.3 CARRINGTON ROAD AREA, MARRICKVILLE

Flood Classification - Low Hazard Flood Fringe

Flood Description

A levee has been constructed along the foreshore at Mackey Park. The crest of the levee varies between 2.5mAHD and 2.7mAHD. The levee is scheduled to be raised above the 1% river level (2.7mAHD) as an ancillary work to the New Southern Railway project. Two Sydney Water drains, one on each side of the Carrington Road Valley, transport much of the locally generated run-off directly to the river. The remaining run-off is directed to a Sydney Water pumping station in Mackey Park. The buildings located behind by the levee (over 30) are predominantly commercial or industrial premises together with a few dwellings.

The 1% flood level in the river peaks at 2.7mAHD, overtopping the levee by up to 0.2m. This overtopping would only occur for 1 hour with a design flood hydrograph and the water level behind the levee only rises to about 1.3mAHD. At this level there is flooding of streets but only minimal inundation of private property.

The Carrington Road area needs special consideration in setting the level of the Flood Standard. The adopted 1% flood produces little or no main river flood effect, and there are no damages at the modelled level of 1.3mAHD. However, the level of 1.3mAHD has **NOT** been adopted for planning purposes for the following reasons:-

(a) the flood level behind the levee is more sensitive than usual to any variation in the 1% flood estimate within the river. For example, if the true 1% flood in the river were 0.3m higher (which is within the error band of the flood estimate), the level in Carrington Road would increase to 2.4 mAHD and there would be considerable property damage. On the other hand if the river level were 0.3m lower, there would be no main river flooding in Carrington Road area at all, ie. the levee would not overtop in a 1% event;
(b) the maximum flood level is very dependent on the duration of overtopping. If the levee was overtopped for a longer period then the Carrington Road area level could rise considerably;
(c) the levee may fail;
(d) the maximum flood level behind the levee will rise significantly and rapidly for floods greater than a 1% flood causing a large increase in flood damages and hazard.

For the purposes of this plan, the flood standard for the Carrington Road area has been set at 2.5m AHD with the minimum floor level set at 3.0m AHD (ie Flood Standard + 0.5m AHD).

3.4 BAY STREET AREA, TEMPE

Flood Classification – Low to High Hazard Flood Fringe

Flood Description

This area encompasses Bay Street, Old Street and Holbeach Avenue at Tempe. It is a mixture of residential and non-residential buildings, which are generally over 40 years old. Flooding in the Cooks River is influenced to some extent by levels in Botany Bay. An increase in ocean levels resulting from the Greenhouse Effect might marginally raise design flood levels in this area.

Three residential buildings in Bay Street are inundated above floor level by up to 1.1m in a 1% flood. One non-residential building, the Motor Boat Club, is inundated by a maximum of 0.2m in a 1% flood.

Pedestrian access from some of the residential buildings to high ground will be limited to yards and across fences, which will be difficult for the elderly, infirm, or young children. Vehicular access will be restricted in 5% or greater events.

Social and economic devastation resulted by flood (Lismore, 1974)

4.0 DEVELOPMENT CONTROL

4.1 GENERAL REQUIREMENTS

For land considered flood liable land and land within 0.5 m freeboard fringe, consideration will be given to such matters as depth and nature of floodwaters, flood classification of the area and the nature and risk posed to the development by floodwaters.

The applicant shall be required to demonstrate to the satisfaction of Council:-

(a) That the development will not increase the flood hazard or risk to other properties as well as including details on the structural adequacy of any building works associated with the development with regard to the effects of floodwaters.

(b) That the proposed building materials are suitable.

(c) That the development/building is sited in the optimum position to avoid flood waters and allow evacuation.

All applications for development shall be accompanied by a survey plan including relevant levels to AHD. Council shall also take into consideration whether structures or filling are likely to affect flood behaviour and whether consultation with other authorities is considered necessary, eg Department of Land and Water Conservation.

4.2 SPECIFIC REQUIREMENTS

4.2.1 Residential – New Development

(a) Floor levels of habitable rooms shall be a minimum of 0.5m above the standard flood level at that locality;
(b) Any portion of buildings classified as being flood liable shall be constructed from flood compatible materials;
(c) All electrical services associated with the development shall be adequately flood proofed;
(d) Flood free access shall be provided where practicable.

4.2.2 Residential – Minor Extensions

(a) **Once** only extensions with a habitable floor level of up to 30 square metres may be approved with floor levels below the standard flood level at that locality, if the applicant can demonstrate that no practical alternatives exist for constructing the extension above the standard flood;
(b) Extensions greater than 30 square metres will be treated as Residential - New Development as per Section 4.2.1;
(c) Any portion of buildings subject to inundation shall be constructed from flood compatible materials (see Appendix 1);
(d) All electrical services associated with the development shall be adequately flood proofed.

4.2.3 Non Habitable Extensions or Alterations

(a) All electrical services shall be adequately flood proofed;
(b) All flood sensitive equipment shall be located above the standard flood level at that locality;
(c) Any portion of buildings subject to inundation shall be built from flood compatible materials.

4.2.4 Industrial/Commercial – New Development

(a) Floor levels shall be at least 0.5m above the standard flood (except access) or the buildings shall be flood proofed to at least 0.5m above the standard flood;
(b) Flood free access shall be provided where practicable.

4.2.5 Industrial/Commercial – Extensions

Where the application is for an extension to an existing building on flood liable land, Council may approve the development with floor levels below the standard flood if the applicant can demonstrate that all practical measures will be taken to prevent or minimise the impact of flooding. In considering such applications and determining the required floor level Council shall take into account such matters as:-

(a) The nature of the business to be carried out (eg. hazardous material which may cause pollution);
(b) The frequency and depth of flooding;
(c) The potential for personal and property loss;
(d) The suitability of the building for its proposed use;
(e) Whether the filling of the site or raising of the floor levels would render the development of the property unworkable or uneconomical.

Any portion of the proposed building extension located within flood liable land shall be built from flood compatible materials.

4.2.6 Change of Use of Existing Buildings

Development consent for change of use of an existing building with floor levels below the standard flood will only be given where the applicant can demonstrate that:-

(a) There is no foreseeable risk of pollution associated with the proposed use of the building in the event that the standard flood occurs;
(b) In determining whether or not to grant development consent for a change of use of an existing building which has floor level below the standard flood, Council may take into consideration whether the proposed development would result in increasing the flood risk on the property or other land. In this regard, Council will take into consideration the following matters;-

i. The nature of the proposed use and the manner in which it is proposed to be carried out within the building or on the land, and
ii. The foreseeable risk of pollution associated with the proposed use of the building/land in the event that the standard flood occurs.

4.2.7 Rezoning of Land

Direction G25 – Flood Liable Land, Section 117 of the Environmental Planning and Assessment Act, 1979, applies to the rezoning of flood liable land. Under that Direction a draft local environmental plan shall not contain provisions which inter alia:-

(a) Permit a significant increase in the development of that land ; and
(b) Are likely to result in a substantially increased requirement for Government spending on flood mitigation measures or infrastructure or on services.

NOTE: A full extract of the relevant section 117 Direction is attached (Appendix 2).

4.2.8 Subdivision

(a) A person must not subdivide flood liable land without the consent of the Council.

NOTE:
i. The subdivision of land requires a separate approval from the Council under Environmental Planing and Assessment Act 1979 (as amended);
ii. The strata subdivision of a building requires a separate approval from the Council under Strata Schemes (Freehold Development) Act, 1973 or Strata Schemes (Leasehold Development) Act 1986.

(b) Subclause (a) above does not apply to a subdivision of land for the purpose of:-

i. widening a public road;
ii. making an adjustment to a boundary between allotments, being an adjustment that does not involve the creation of any additional allotment;
iii. rectifying an encroachment upon an allotment;
iv. creating a public reserve;
v. consolidating allotments; or
vi. excising from an allotment land, which is or is intended to be used for public purposes, including drainage purposes, bush fire brigade or other rescue service purposes or public conveniences.

(c) In considering an application to subdivide land, the Council must take into consideration the following matters in addition to any relevant matter in Section 79C of the Act relating to the application:-

i. Whether the land to which that development application relates is unsuitable for that development by reason of its being or likely to be, subject to flooding;
ii. Whether the carrying out of the proposed subdivision and any associated site works would adversely impede the flow of flood water on the land or land in its immediate vicinity;
iii. Imperil the safety of persons on that land or land in its immediate vicinity in the event of the lands being inundated with flood water;
iv. Aggravate the consequences of flood water flowing on that land or land in its immediate vicinity with regard to erosion or siltation.

4.2.9 Filling of Flood Liable Land

Council will not grant consent to filling of flood ways or high flood hazard areas. The filling of other flood liable land will generally not be supported, however, a merits based approach is adopted. In particular, an application to fill land shall also incorporate the purpose for which the filling is to be undertaken. Council may consider such an application when the following criteria are met:-

(a) Flood levels are not increased by more than 0.1m by the proposed filling;
(b) Downstream velocities are not increased by more than 10% by the proposed filling;
(c) Proposed filling does not redistribute flows by more than 15%;
(d) The potential for cumulative effects of possible filling proposals in that area is minimal;
(e) The development potential of surrounding properties is not adversely affected by the filling proposal;
(f) The flood liability of buildings on surrounding properties is not increased;
(g) The filling creates no local drainage flow/runoff problems.

The above criteria can only be addressed and satisfied by the submission of a detailed flood study report by an appropriate consulting engineer. The flood study report would involve both hydrologic and hydraulic analysis of the floodplain and the effects of the proposed filling on flood levels. The report needs to address all items from (a) to (g) listed above.

Flood studies invariably involve complex computer model analysis and are time consuming and expensive. A considerable amount of data has to be collected, examined and incorporated into the various flood study models.

Data to be collected includes:-

(a) Survey cross-sections of the river system to provide representative topographic information;
(b) Resident interviews on past flood behaviour;
(c) Flood records in newspapers and Council archives.

The various models have to be calibrated against recorded flood data, inconsistent data has to be identified and discrepancies have to be explained.

Cooks River flood

APPENDIX 1
Draft Flood Proofing Code

Adequate flood proofing of buildings in flood liable areas is an effective and equitable means of reducing flood damage to the structure or buildings. It is essential that flood proofing be a condition of both compatible and conditional developments in flood liable areas.

A draft flood proofing code is incorporated in Table 10. This code is based on the Australian Department of Housing and Construction "Housing in Flood Prone Areas 1975". It is included as an example of the type of information and conditions that should be required for buildings on flood liable land. Action is currently being taken by the Australian Standards Association to produce an official flood proofing code.

F1 Construction Methods and Materials

Construction methods and materials are graded into four classes according to their resistance to floodwaters.

Suitable – the materials or products which are relatively unaffected by submersion and unmitigated flood exposure and are the best available for the particular application.

Mild effects – where the most suitable materials or products are unavailable or economic considerations prohibit their use, these materials or products are considered the next best choice to minimise the damage caused by flooding.

Marked effects – as for "2nd preference" but considered to be more liable to damage under flood conditions.

Severe effects – the materials or products listed here are seriously affected by floodwaters and in general have to be replaced if submerged.

F2 Electrical and Mechanical Equipment

For dwellings constructed on flood liable land, the electrical and mechanical materials, equipment and installation should conform to the following requirements.

Main power supply – Subject to the approval of the relevant county council the incoming main commercial power service equipment, including all metering equipment, shall be located above the DFL. Means shall be available to easily disconnect the dwelling from the main power supply.

Wiring – All wiring, power outlets, switches, etc., should, to the maximum extent possible, be located above the DFL. All electrical wiring installed below the DFL should be suitable for continuous submergence in water and should contain no fibrous components. Only submersible-type splices should be used below the DFL. All conduits located below the DFL should be so installed that they will be self-draining if subjected to flooding.

Equipment – All equipment installed below or partially below the DFL should be capable of disconnection by a single plug and socket assembly.

Reconnection – Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.

F3 Heating and Air Conditioning System

Heating and air conditioning systems should, to the maximum extent possible, be installed in areas and spaces of the house above the DFL. When this is not feasible every precaution should be taken to minimise the damage caused by submersion according to the following guidelines.

Fuel – Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.

Installation – The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to an elevation of 600 millimetres above the DFL.

Ducting – All ductwork located below the DFL should be provided with opening for drainage and cleaning. Self draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must past through a water-tight wall or floor below the DFL, a closure assembly operated from above DFL should protect the ductwork.

APPENDIX 2
G25, Section 117 Direction

[110,125] G25 Flood liable land

(1) This direction applies to flood liable land as defined substantially in accordance with the principles contained in the Floodplain Development Manual published in the Gazette in pursuance of s 582A(4) of the Local Government Act 1919 on 6 February 1987.

(2) Except where the council can satisfy the director that any particular provision or area should be varied or excluded having regard to the provisions of s 5 of the Environmental Planning and Assessment Act 1979:

Draft local environmental plans shall not –

(a) rezone flood liable land from a zone described as special uses – flood liable, rural, open space, scenic protection, conservation, environment protection, water catchment or coastal lands protection or by a similar description, to a zone described as residential, business, industrial, special use, village or by a similar description;

(b) contain provisions which apply to flood liable land and which –

(i) permit a significant increase in the development of that land;

(ii) are likely to result in a substantially increased requirement for government spending on flood mitigation measures, on infrastructure or on services; or

(iii) permit development to be carried out without development consent except development for the purposes of agriculture (not including dams, drainage canals, levees, buildings or structures in floodways, high hazard flood fringe or high hazard floor storage areas) minor development and additions as defined in the Flood Plain Development Manual.

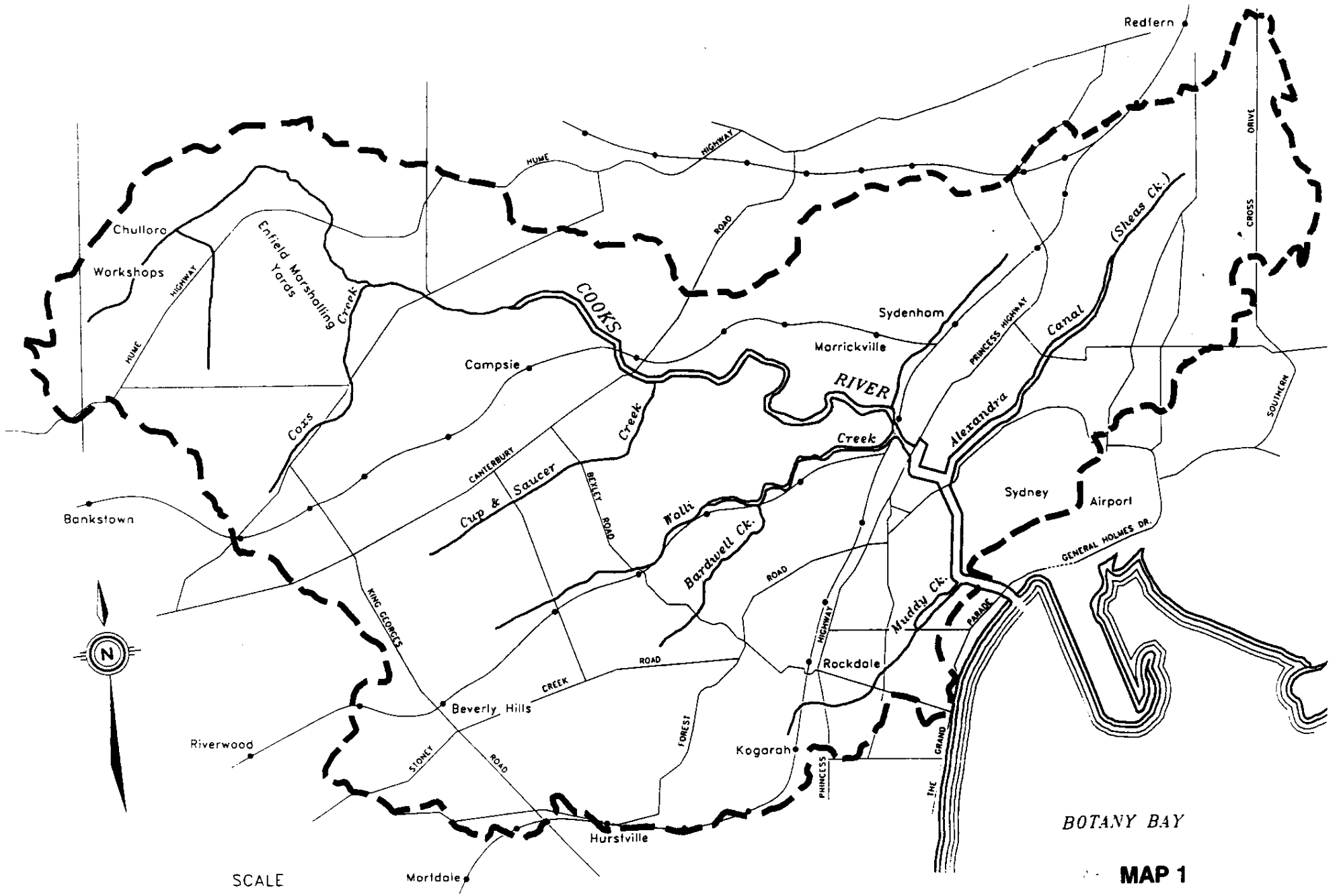
(3) Land defined substantially in accordance with the principles contained in the Floodplain Development manual as high hazard flood liable land or as floodway shall be zoned in draft local environmental plans as special uses – high hazard flood liable or special uses floodway, rural, open space, scenic protection, conservation, environment protection, water catchment or coastal land protection or as a zone having a similar description.

[G25 – 19 August 1986 – Circular 122 – replaced with new direction – flood liable land – 1 June 1987 – Circular 130]

TABLE 1. Draft Flood Proofing Code

component	order of preference suitable	mild effects	marked effects	severe effects
flooring and sub-floor structure	• concrete slab-on-ground monolith construction note: clay filing is not permitted beneath slab-on-ground construction, which could be inundated • suspension reinforced concrete slab	• timber floor (T & G boarding, marine plywood) full epoxy sealed joints	• timber floor (T & G Boarding, marine plywood) with ends only epoxy sealed on joints and provision of side clearance for board swelling	• timber close to ground with surrounding base • timber flooring with ceilings or soffit linings • timber flooring with seal on top only
floor covering	• clay tiles • concrete, precast or in situ • concrete tiles • epoxy, formed-in-place • mastic flooring, formed-in-place • rubber streets or tiles with chemical-set adhesives • silicone floors formed-in-place • vinyl sheets or tiles with chemical-set adhesive • ceramic tiles, fixed with mortar or chemical-set adhesive • asphalt tiles, fixed with water resistant adhesive	• cement/bituminous formed-in-place • cement/latex formed-in-place • rubber tiles, with chemical-set adhesive • terrazzo • vinyl tile with chemical-set adhesive • vinyl –asbestos tiles asphaltic adhesives • loose rugs • ceramic tiles with acid and alkali-resistant grout	• asphalt tiles with asphaltic adhesive • loose fit nylon or acrylic carpet with closed cell rubber underlay	• carpeting, glue-down type or fixed with smooth edge on jute felts • chipboard (particle board) • cork • linoleum • PVA emulsion cements • vinyl sheets or tiles coated on cork or wood backing • fibre matting (sea-grass matting)
wall structure (up to the DFL)	• solid brickwork, blockwork, reinforced, concrete or mass concrete	• two skins of brickwork or blockwork with inspection openings	• brick or blockveneer construction with inspection openings	• inaccessible cavities • large window openings
roofing structure (for situations where DFL is above the ceiling)	• reinforced concrete construction • galvanised metal construction	• timber trusses with galvanised fittings	• traditional timber roof construction	• inaccessible flat roof construction • ungalvanised steel work eg. lintels, arch bars, tie rods, beams etc. • unsecured roof tiles

component	order of preference suitable	mild effects	marked effects	severe effects
doors	• solid panel with water proof adhesives • flush door with marine ply filled with closed cell foam • painted metal construction • aluminium or galvanised steel frame	• flush panel or single panel with marine plywood and water proof adhesive • T & G lined door, framed ledged and braced • painted steel • timber frame fully epoxy sealed before assembly •	• fly-wire doors • standard timber frame	• hollow core ply with PVA adhesives and honeycomb paper core
wall and ceiling linings	• asbestos-cement board • brick, face or glazed • clay tile glazed in waterproof mortar • concrete • concrete block • steel with waterproof applications • stone, natural solid or veneer, waterproof grout • glass blocks • glass • plastic sheeting or wall with waterproof adhesive	• brick, common • plastic wall tiles • metals, non ferrous • rubber mouldings and trim • wood, solid or exterior grade plywood fully sealed	• chipboard exterior grade • hardboard exterior grade • wood, solid (boards or trim) with allowance for swelling • wood, plywood exterior grade • fibrous plaster board	• chipboard • fibreboard panels • mineral fibreboard • paperboard • plaster-board, gypsum plaster • wall coverings (paper, burlap cloth types) • wood, standard plywood • strawboard
insulation	• foam or closed cell types	• reflective insulation	• bat or blanket types	• open cell fibre types
windows	• aluminium frame with stainless steel or brass rollers	• epoxy sealed timber waterproof glues with stainless steel or brass fittings • galvanised or painted steel	•	• timber with PVA glues mild steel fittings



MAP 1

COOKS RIVER CATCHMENT