

GUIDELINES FOR FLOODPLAIN CUT AND FILL WITHIN THE GLENELG HOPKINS CMA REGION



Cover photographs: Psaltis Parade (courtesy of Goulburn Broken CMA) and Diamond Creek (courtesy of Melbourne Water).

November 2012

Glenelg Hopkins



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1. Purpose of the guidelines

The guidelines have been prepared to assist property owners, developers, designers and builders to:

- Understand the broad issues and constraints that apply to raising ground levels in flood affected areas ^[1]
- Minimise the time and effort involved in reaching an acceptable development proposal and gaining the necessary approvals
- Understand the procedures used by Glenelg Hopkins CMA for determining planning permit applications and development proposals involving filling in flood affected areas.

The guidelines outline a consistent approach to the assessment of development proposals that involve cutting and filling in flood affected areas. The employment of these guidelines may result in varying outcomes dependant on individual site conditions, design proposals and their impacts on neighbouring properties.

These guidelines are not intended to justify wholesale production of development lots in flood prone areas or to completely eliminate flooding from proposed development sites. It is not intended that application of the guidelines will enable subdivision of land to create lots, or sole access to lots, that are entirely within an identified flood extent. It is also not the intention of the guidelines to increase the area of land outside the flood extent considered suitable for development within a flood affected lot.

The purpose of the guidelines is to assist developers to recognise the small scale landscaping works that may be undertaken without causing harm to others or the environment. The guidelines have been developed for two specific applications:

to enable development on lots created and zoned residential before completion of a flood study, where the flood hazard identified during the study precludes development and the site topography offers the opportunity to manipulate the location or shape of an existing flood free area to increase development potential;

to facilitate smoothing of small irregularities in the flood extent to improve subdivision design layout.

Filling land will in many instances be inappropriate and it will only be permitted if there are no practical alternatives and when there are no adverse affects created. A planning permit will be required and the applicant will need to demonstrate through an engineering assessment that there will be no adverse impacts to the environment or to other people or property. Where uncertainties exist as to the level of flood risk consequent on a development proposal, a cautious approach will be employed.

¹ The term 'flood affected areas' refers to an area determined to be liable to flooding within the Authority's Flood Information Database or as otherwise determined by the Authority and is the area contained within the 1% probability flood extent.

2. Background

These guidelines outline the principles and practices applied by Glenelg Hopkins CMA to the design and assessment of development proposals involving filling in flood affected areas. They are not intended to apply to canal or marina developments for which additional specific criteria apply.

Development of residential properties adjacent to waterways has long been preferred by the community for the aesthetic values our waterways provide. Likewise industrial land has often been developed adjacent to waterways because of the general flatness of the land and the need for water supply and waste disposal. However this must be balanced against the hazard posed by flooding at these locations.

As the authority responsible for floodplain management in the south-west region, Glenelg Hopkins Catchment Management Authority assesses flood risks and provides advice about flooding and controls on development to property owners, developers, councils and government agencies.

Filling of floodplain areas to raise ground levels and reduce the severity of flooding has historically been widely used within the region. If designed and constructed correctly, raising of ground levels within the floodplain can be accomplished without negatively impacting on nearby properties. Conversely, allowing fill without understanding and mitigating the potential impacts can increase flood levels and detrimentally affect others.

3. Guiding Principles

Development involving fill within flood affected areas needs to be appropriately designed. In order to minimise the flood risk to people and property and to ensure that any potential impacts on adjacent, upstream or downstream areas are identified and prevented the following principles apply:

- There shall be no significant increase or re-direction in flood flow as a result of loss of conveyance
- There shall be no decrease in floodplain storage
- The amount of fill shall not be excessive.

Floods occur on a huge range of scales from minor annual events to extremely rare events which can be very severe. When considering the impacts of fill on flooding it is important to examine a range of floods, from minor “inconvenience flooding” to at least the one 1 in 100 year event².

² The one in one hundred year flood is referenced in flood overlays in municipal planning schemes. It has a probability of 1% of being equalled or exceeded in any year. It is the design standard flood in Victoria.

Property developers and consulting engineers can often save valuable time by discussing the flood protection aspects of development proposals with Glenelg Hopkins CMA prior to lodging a fully developed planning application with the relevant Council.

In some cases detailed hydraulic modelling will be required to assess the impacts of earthworks on flood flow and flood storage. Any required computer modelling must demonstrate to the satisfaction of Glenelg Hopkins Catchment Management Authority that there are no adverse impacts on adjacent, upstream or downstream areas.

3.1 Flood Flow

There shall be no significant increase or re-direction in flood flow as a result of loss of conveyance.

This requirement is designed to ensure that existing flood risks are not made worse by alterations to the flow characteristics of a floodplain. Flow rates can be affected by changes to the cross-section, gradient or alignment of a flood flow path. In general, a decrease in the available flow area will cause a restriction that increases flood levels upstream and increases the velocity past the restriction. This increase in velocity can introduce safety issues and cause erosion of the downstream waterway.

Fill pads that significantly impede flood flows will not be approved.

It is important that any potential environmental impacts are considered if flow paths are altered. Altering the shape of a flow path may result in increased erosion and divert floodwater from natural floodplain storages.

Generally any proposal to increase the flow capacity of a waterway by excavating an additional area contained within its normal banks will be prohibited.

3.2 Flood Storage

There shall be no decrease in floodplain storage

This requirement is designed to prevent higher flood levels from occurring due to reductions in flood storage volume and loss of flood attenuation (described in Appendix 1). The impacts of individual developments and the long-term cumulative impacts arising from similar developments have the potential to cause higher flood levels.

Typically, site flood storage capacity is reduced by importation of fill to the floodplain to raise land above flood levels.

The flood storage capacity can also be impacted by excavating a lower portion of the site to fill a higher portion of the site, even if the cut and fill volumes are equal. Merely balancing fill volume with excavation volume may not be adequate if the filled area reduces storage capacity or if the excavated area floods more readily.

Generally:

- The excavated areas must be fully active, readily flooding and draining for a range of flood events
- The net flood storage for any cross section perpendicular to the prevailing direction of flood flow must not be reduced, irrespective of the size of the flood (see Section 4).

A detailed technical explanation of the effect of floodplain storage on flood behaviour is described in Appendix 1.

3.3 Fill Limitations

The amount of fill shall not be excessive

Wholesale filling of allotments will not be supported. Generally:

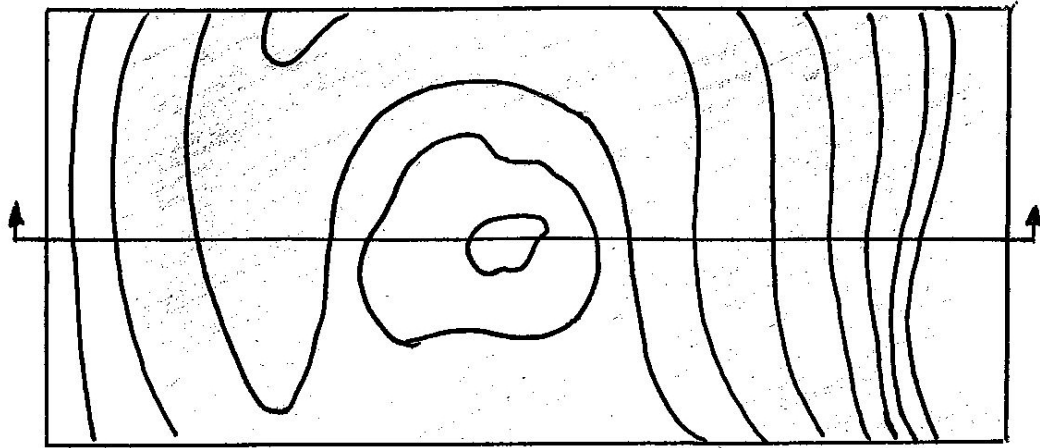
- fill in areas proposed for dwellings should only be provided to the extent required to improve site safety, e.g. to provide a platform for a dwelling or safe access to a dwelling
- fill may be assessed on merit for other purposes, e.g. stock refuges
- fill will not be supported in areas of high flood hazard (i.e. where the depth of flooding in a 1% probability flood event is greater than 500 mm or where the corresponding flood velocity is estimated to be more than 1 m/s).
- Subdivision proposals that rely on introduction of fill to justify the subdivision layout will not be accepted by the Authority.

4. Level-for-level Flood Storage Compensation

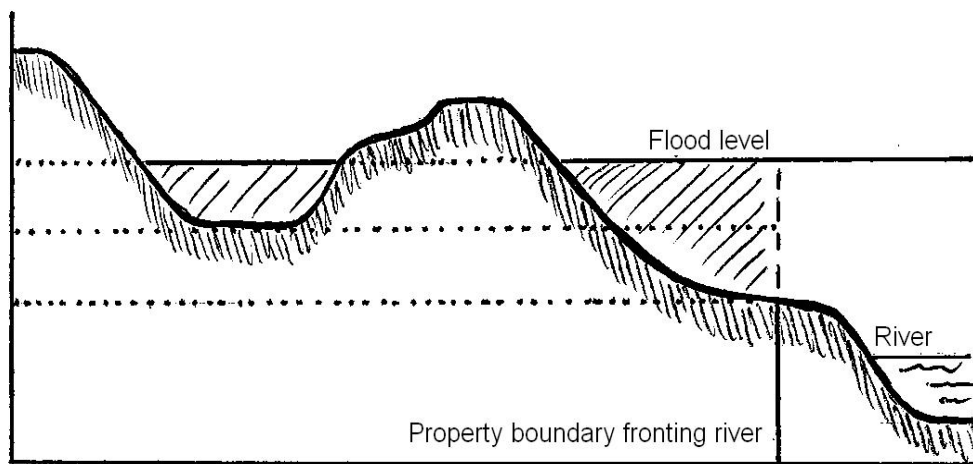
Level-for-level flood storage compensation refers to manipulation of ground levels within a site to provide the required development area^[3] while maintaining existing floodplain storage at every level within the site. This is achieved by undertaking detailed site survey to determine the existing contour levels, calculating the existing flood storage volume at all flood stages, and then designing a cut and fill strategy that maintains available flood storage volumes at each flood stage. These steps are outlined below:

1. Calculation of available flood storage is accomplished by splitting the existing site into horizontal layers through the full range of elevations across the site. Layer depth should be in the range of 100-200 millimetres. The volume of available flood storage within each layer is then calculated for all layers up to the applicable flood level.

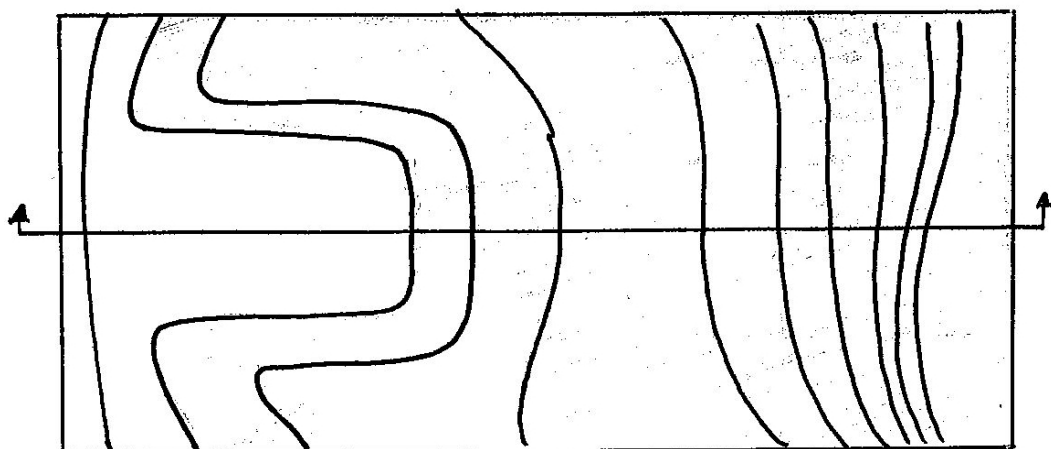
³ The term 'development area' refers to building pads, access routes and other critical areas.



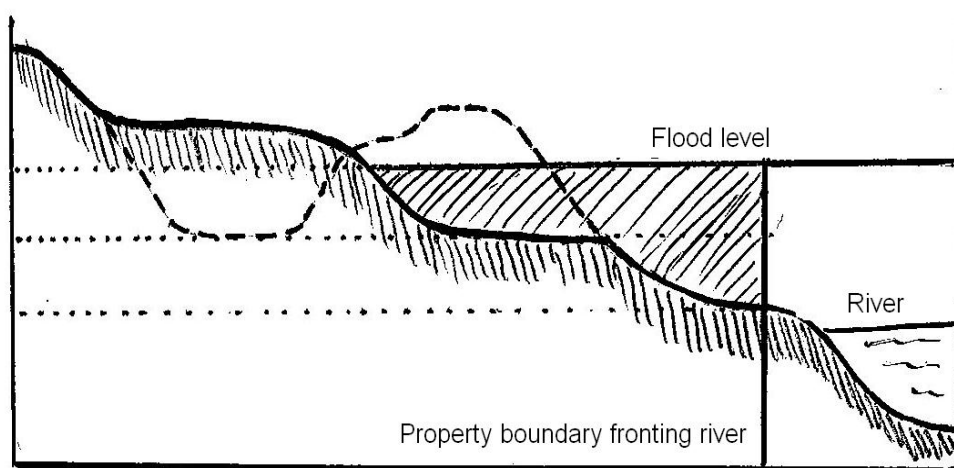
Plan view of existing ground surface contours (above), and cross-section showing horizontal layers (below). Available flood storage is shown as diagonal shading.



2. A cut and fill proposal that produces the desired building pad at the required finished surface level is designed.



Proposed plan view of final ground surface contours (above), and cross section showing available flood storage as diagonal shading (below).



3. The available flood storage for each layer is calculated for the cut and fill design in a similar manner to Step 1 above
4. The available flood storage for the existing site conditions is compared to the available flood storage for the cut and fill proposal. Only cut and fill proposals that maintain available flood storage within each horizontal layer will be considered by the Authority.

5. Planning Scheme Requirements

In order to ensure that all fill activities are consistent with good floodplain management practice and that natural flow path and/or drainage lines are not obstructed, a formal planning permit application will need to be submitted to Council for consideration. This should include a “cut and fill” proposal that includes details of all fill and borrow areas as well as volumes involved. generally:

- fill areas (and also any areas of cut) will need to be carefully planned with respect to long-term management, maintenance and safety.
- batter slopes should be designed and constructed with reference to structural integrity and public safety.

The applicant is responsible for ensuring planning permit applications for floodplain cut and fill are in accordance with the latest version of the guidelines. Applicants should consult with Glenelg Hopkins CMA prior to lodging an application. Works should not commence prior to a planning permit being issued.

6. Summary of decision criteria for Cut and Fill applications

In deciding whether or not an application can be supported, the Glenelg Hopkins CMA assesses cut and fill applications against the following criteria.

- Fill will not be supported in areas of high flood hazard. ie where the depth of flooding in a 1% probability flood event is greater than 500mm or where the corresponding flood velocity is estimated to be more than 1 metre per second.
- Subdivision proposals that rely on importation of fill to justify the subdivision layout will not be supported by the CMA
- Fill pads that significantly impede flow will not be approved.
- Potential environmental impacts such as erosion and diversion of water from wetland systems must be considered if alteration of natural flow paths is a likely outcome of the works.
- Flood storage volume within the floodplain must be maintained. Excavated areas must be fully active areas within the floodplain. ie the area excavated must be subject to flooding for the full range of flood levels expected to impact on the site being filled.
- Fill in areas proposed for dwellings should only be provided to the extent required to provide an adequately sized building envelope (as per the requirements of the local planning scheme) and safe access to the dwelling.

Appendix 1. Effect of floodplain storage on flood behaviour

When it rains, water finds its way off roof areas and roads, into open and piped drains, before discharging into watercourses. Water also runs off the land but at a slower rate.

If one considers a fixed point in a watercourse, runoff from rain falling just upstream of that point will arrive before that falling further away from the watercourse, and so on, until the rain falling furthest away arrives last. When this occurs runoff is reaching this fixed point from the whole area drained and the flow has reached its maximum. This is why following rain, a watercourse can take some time to respond, and in some cases the flood will peak after the rain has stopped.

Over time the rain will diminish and the amount of runoff passing through this fixed point will likewise reduce. This rise and fall in flow is called a flood wave or, more technically, **a flood hydrograph**.

It is at this **peak flow**, i.e. when levels are highest, that properties are most likely to be affected; but it is also at this stage that nature takes a hand to reduce the problem. The process is called flood attenuation.

Consider a plot of rate of flow against time (or flood hydrograph, fig.1), and assume that the channel banks are very high (fig.1a). The flow will rise to a peak and fall, and provided there is no overflow onto the adjoining floodplain; it will leave the site as it arrives, being contained throughout within the channel.

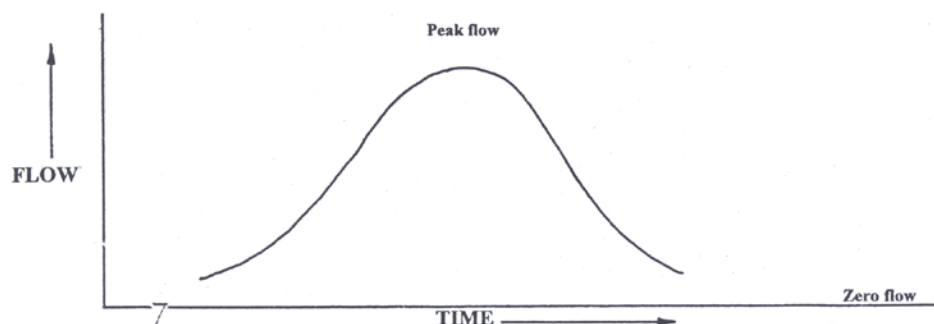


Fig. 1 Flood Hydrograph



Fig.1a Channel without flood plain

If a floodplain exists and the banks are not too high (fig.2a), the hydrograph (fig.2) is rather different. Once the flow rises to a rate which exceeds the channel capacity (the horizontal dashed line) it starts to overflow into the floodplain. Immediately the rate of increase in flow passing down stream levels off as a certain proportion of the flow passes into storage in the floodplain and stays there until the flow rate reaches it's maximum and begins to drop, allowing water in the floodplain to flow back into the channel. Fig.2 demonstrates the resulting, altered, hydrograph. The onward flow is modified along the blue line, the peak reached being lower; the volume stored on site is shown vertically hatched. This volume is discharged after the peak as the diagonally hatched area and both are equal.

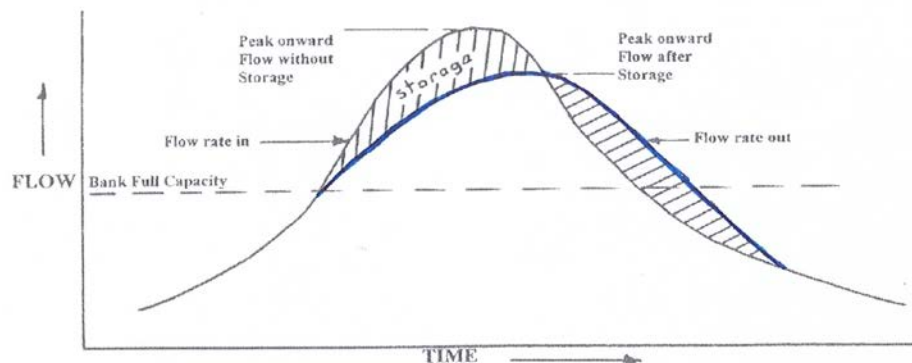


Fig. 2 Hydrograph altered by flood plain storage

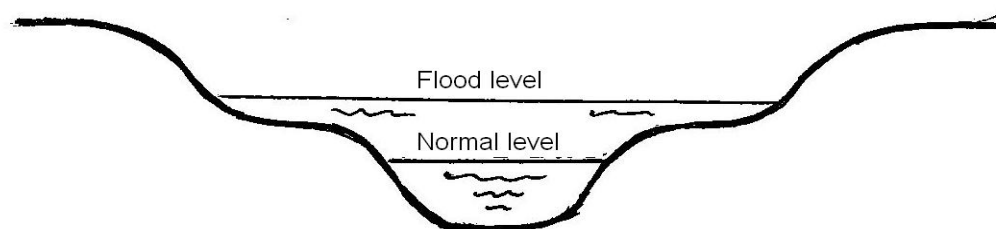


Fig 2a Channel with floodplain

In summary floodplain storage reduces the peak of the flow passed on downstream by lowering the top off the hydrograph. Without the storage, as shown in Figs 1 & 1a, the peak flow to be dealt with downstream would be higher and the flood risk greater.

It is important that compensation for floodplain fill is designed on a **level for level basis**. The following example (fig.3a) shows compensation provided at a lower level than the fill in the floodplain; one side of the floodplain is excavated below existing ground level to 'provide compensation' for the filling above ground level elsewhere in the floodplain, the argument being that the storage volume is still the same.

Looking at the hydrograph (fig.3), the black line represents the hydrograph if there was no provision for flood storage (that is if all the flow could be contained within the waterway and there was no spillage into the adjacent floodplain). The blue line shows the hydrograph with provision for flood storage prior to cut and fill. The effect of the natural flood storage in attenuating flood flows can be clearly seen in that the flow has peaked at a lower rate and at a later time compared to the black line.

Now consider the effect of cut and fill at different levels. Now storage can take place earlier, as on one side the bank is lower. The rate of increased flow follows the red line. At first it is flatter because at the lower flows there is more flood storage. However as the flow rate gets higher the hydrograph steepens because the volume of remaining storage becomes progressively less. Put simply there is more storage available for the lower flows and less storage available for the higher flows. The net result is an increase in peak flow rate compared to the flow rate that occurred with the floodplain in its natural shape (blue line).

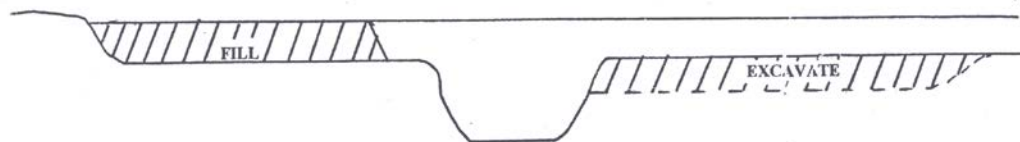


Fig 3a Channel with fill above and 'compensation' excavation below ground

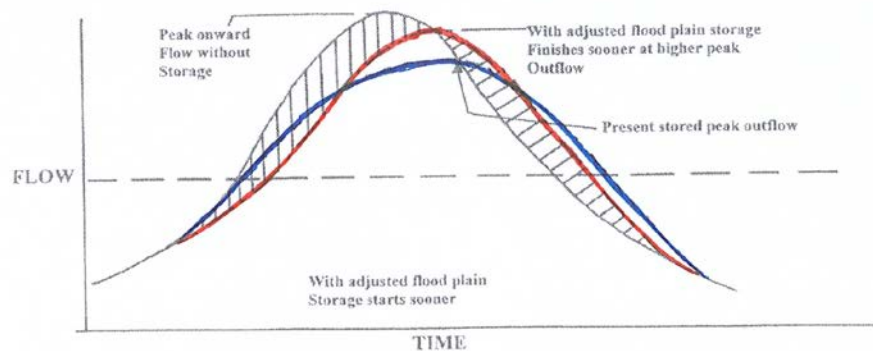


Fig. 3 Hydrograph altered by below ground flood plain compensation

In summary, the effect of providing storage at the wrong level, too early in the flood, is to allow a higher peak flow to pass on downstream, whereas the provision of storage commencing at the natural level will ensure that the performance of the floodplain and the flood hydrograph will remain unaltered and flood risk will not be worsened.