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2.0 FLOOD AFFECTED LAND

2.1 PURPOSE

This chapter is intended to provide supplementary information to expand on some of the elements specified in the Filling and Excavation Code and the Stormwater Management Code of the *Brisbane City Plan*. Therefore **the user must read this chapter in conjunction with the *Brisbane City Plan* to ensure that the development proposal complies in its entirety with the relevant codes, provisions and planning scheme policies**.

The primary objectives of this chapter are:

- To supplement the Stormwater Management Code of the *Brisbane City Plan*. Performance Criteria P12 states "Development levels must be set above the relevant design flood level or storm surge level to reduce property damage and, where applicable, ensure public safety". The corresponding Acceptable Solution A12 states "The development levels are set in accordance with Council's current Subdivision and Development Guidelines". Section 2.2 outlines the flood immunity standards.
- To supplement the Subdivision Code of the *Brisbane City Plan*, in particular with respect to road access during flooding. An extract from the Code states "The purpose of the general design elements in this Code is to create road networks where the function of each road is clearly identified, providing acceptable levels of access, safety, amenity and convenience for all users". Section 2.3 specifies the flood immunity standards required to satisfy this design element.
- To supplement the Filling and Excavation Code of the *Brisbane City Plan*. Performance Criteria P3 states " Filling or excavation must not cause any increase in flooding or drainage problems". Section 2.4 provides some guidance in respect of earthworks adjacent to waterways and overland flow paths.

2.2 FLOOD IMMUNITY

Floodable land is any land that is affected by river, creek or localised flooding. The three types of flooding are described as follows:

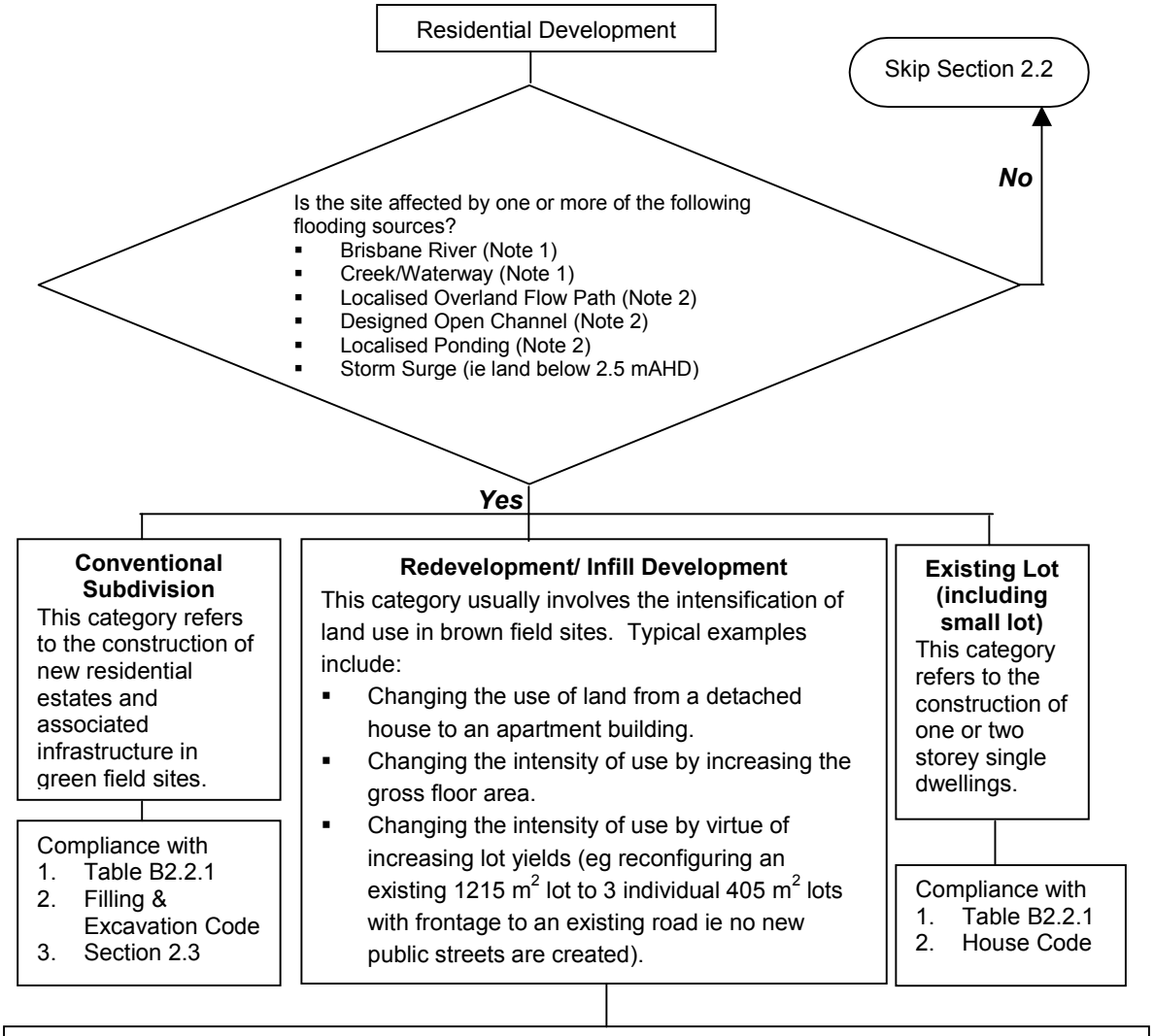
- River flooding occurs when there is widespread prolonged rain over the catchment of the Brisbane River.
- Creek flooding occurs when bankfull capacities are exceeded. On average Brisbane's natural creeks have a 50-100% chance of exceeding their bankfull capacities in any one year.
- Local flooding occurs when components of the stormwater drainage system such as pipes and gully inlets are blocked and/or design capacity is exceeded and/or when the overland flow path is blocked by a building or fence.

The 'Flood Search Flag' theme in Council's BIMAP database generally refers to indicative areas of potential creek/river flooding problems based on historical flood records. The currently mapped areas under this theme do not extend to any areas with potential localised overland flow problems.

For the purpose of assigning flood immunity levels in this chapter, residential developments are classified in the 3 categories of conventional subdivision, redevelopment/ infill development, and existing lot. These definitions and the assessment flowchart to determine the flood immunity standards for residential developments are outlined in Figure B2.2.1.

Similarly the industrial/ commercial developments are classified in the 2 categories of conventional subdivision and redevelopment/ infill development. These definitions and the assessment flowchart to determine the flood immunity standards for industrial/ commercial developments are outlined in Figure B2.2.2.

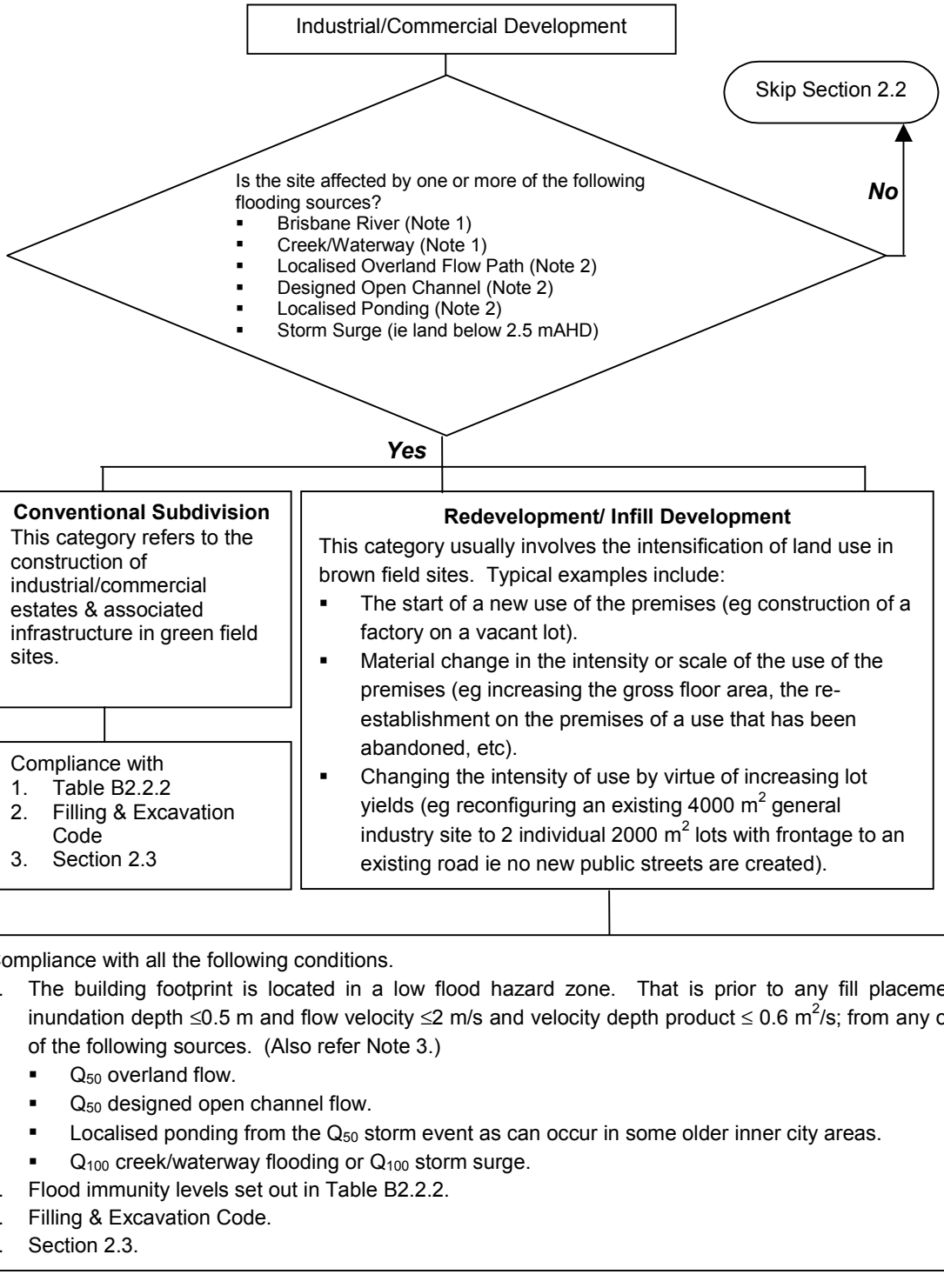
FIGURE B2.2.1 ASSESSMENT FLOWCHART TO DETERMINE FLOOD IMMUNITY STANDARDS FOR RESIDENTIAL DEVELOPMENTS



NOTES:

1. The 'Flood Search Flag' theme in Council's BIMAP database generally refers to areas with potential creek/river flooding problems based on historical flood records. For flood level information contact Council's Flood Enquiry Hotline. Where the flood level information is unavailable, refer Note 2.
2. The applicant must engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake this assessment.
3. Flooding from these sources can peak in a matter of a few hours whereas the Brisbane River flood can take days to peak, thus allowing adequate time to disseminate flood warnings.

FIGURE B2.2.2 ASSESSMENT FLOWCHART TO DETERMINE FLOOD IMMUNITY STANDARDS FOR INDUSTRIAL/COMMERCIAL DEVELOPMENTS



NOTES:
1. The 'Flood Search Flag' theme in Council's BIMAP database generally refers to areas with potential creek/river flooding problems based on historical flood records. For flood level information contact Council's Flood Enquiry Hotline. Where the flood level information is unavailable, refer Note 2.
2. The applicant must engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake this assessment.
3. Flooding from these sources can peak in a matter of a few hours whereas the Brisbane River flood can take days to peak, thus allowing adequate time to disseminate flood warnings.

TABLE B2.2.1
MINIMUM FLOOD IMMUNITY LEVELS FOR
RESIDENTIAL DEVELOPMENTS

Flooding Type (Note 1)	**Minimum Design Levels (mAHD)**			
	Conventional Subdivision	**Existing Lot & Redevelopment/ Infill Development**		
	Allotment Fill	**Habitable Floor**	**Non-Habitable Areas (Note 2)**	**Carparking (Note 3)**
Brisbane River	100y ARI+0.3m	100y ARI+0.5m	100y ARI+0.3m	20y ARI
Creek or Waterway	100y ARI+0.3m	100y ARI+0.5m	100y ARI+0.3m	100y ARI
Localised Overland Flow Path	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Designed Open Channel	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Storm Surge (Note 4)	100y ARI+0.3m	100y ARI+0.5m	100y ARI+0.3m	100y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie localised overland flow paths and/or designed open channels and/or creek flooding and/or river flooding and/or storm surge), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older inner city areas is often controlled by localised ponding.
2. Examples of non-habitable areas include utility area, garage, laundry room, and storage room.
3. Basement carparks can be constructed to below the specified levels provided that suitably waterproofed perimeter walls, air vents, and entry/exit ramps at the carpark entrance are above the 100 year ARI flood levels for all flooding sources including the Brisbane River.
4. The 100 year ARI storm surge is 2.5 mAHD. This value incorporates greenhouse effects.
5. If no hydraulic modelling data is available, assume the Q_{100} flood levels to be 700 mm above the highest recorded flood levels (where adequate historic flood levels are available to enable reliable interpretation and the Engineering Officer Development & Regulatory Services deem this assumption appropriate). Otherwise the applicant must engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessment.
6. Child Care Centres, Nursing Homes, Hospitals, etc must satisfy the same requirements as residential properties with respect to flood immunity and trafficability.

TABLE B2.2.2
MINIMUM FLOOD IMMUNITY LEVELS FOR
INDUSTRIAL/COMMERCIAL DEVELOPMENTS

Flooding Type (Note 1)	**Minimum Design Levels (mAHD)**			
	Conventional Subdivision	**Existing Lot & Redevelopment/ Infill Development**		
	Allotment Fill	**Habitable Floor (if applicable)**	**Non-Habitable Areas (Note 2)**	**Carparking (Note 3)**
Brisbane River	100y ARI	100y ARI + 0.5m	100y ARI	20y ARI
Creek or Waterway	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI
Localised Overland Flow Path	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Designed Open Channel	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Storm Surge (Note 4)	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie localised overland flow paths and/or designed open channels and/or creek flooding and/or river flooding and/or storm surge), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older inner city areas is often controlled by localised ponding.
2. Examples of non-habitable areas include utility area, garage, laundry room, and storage room.

3. Basement carparks can be constructed to below the specified levels provided that suitably waterproofed perimeter walls, air vents, and entry/exit ramps at the carpark entrance are above the 100 year ARI flood levels for all flooding sources including the Brisbane River.
4. The 100 year ARI storm surge is 2.5 mAHD. This value incorporates greenhouse effects.
5. If no hydraulic modelling data is available, assume the Q_{100} flood levels to be 700 mm above the highest recorded flood levels (where adequate historic flood levels are available to enable reliable interpretation and the Engineering Officer Development & Regulatory Services deem this assumption appropriate). Otherwise the applicant must engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessment.
6. This condition will only apply where the creek or waterway is also subject to the backwater influence from Brisbane River (eg Oxley Creek, Norman Creek, Bulimba Creek, etc). In exceptional circumstances Council may consider development proposals (at existing lots and infill sites) that do not meet the flood immunity level set for the regional Brisbane River flooding, provided that the applicant can satisfactorily demonstrate compliance with all the following conditions.
   - The development proposal is above the specified immunity levels from all the other flooding sources (ie creek/waterway and localised overland flow path/designed open channel and storm surge). Flooding from these sources can peak in a matter of a few hours. On the other hand the Brisbane River flood can take days to peak, thus allowing adequate time to disseminate flood warnings.
   - The landform is not amenable to providing a commercially viable development if the regional flood level from Brisbane River is substantially higher than creek flood level. Not only would the development proposal incur excessive infrastructure costs (eg elevated carpark) but also compliance with the planning scheme codes (eg building height restrictions) may be unattainable.
   - Risks (safety and economic losses) associated with the proposed use are compatible with the level of flood immunity. The risk evaluation must be undertaken in accordance with the framework outlined in *AS 4360 Risk Management*. For example a warehouse for the purpose of storing perishable goods such as fruits and vegetables will incur less flood damage losses when compared to a warehouse used to store electrical appliances. The storage of hazardous chemicals may not be an appropriate use.

The Gateway Ports generally refer to industrial precincts in the low-lying areas adjacent to the lower reaches of Brisbane River. These precincts are located in parts of Colmslie, Eagle Farm, Hemmant, Lytton, Murarrie and Pinkenba. The minimum fill levels are identified in the Gateway Ports Local Plan.

2.3 ROAD TRAFFICABILITY

The level of serviceability to be provided to traffic at a creek crossing will depend upon the ARI of the flood for which the creek crossing will be passable to traffic and the duration of road closure during times of flooding. Trafficability will depend upon the combination of depth and velocity of flow over a floodway, when the frictional resistance between a vehicle's tyres and the floodway surface is overcome and the vehicle loses stability.

All new dedicated roads within any subdivision or development must comply with the minimum levels specified in Table B2.3.1.

Access to the subdivision/development from existing dedicated roads (including the portion of dedicated road fronting the subdivision/development) must comply with the flood immunity levels specified in Table B2.3.2. The road classification is in accordance with the Transport and Traffic Facilities Planning Scheme Policy of the *Brisbane City Plan*. For example the local access road serves up to 100 lots whereas the neighbourhood access road serves up to 300 lots.

TABLE B2.3.1
FLOOD IMMUNITY LEVELS FOR NEW ROADS WITHIN
A SUBDIVISION OR DEVELOPMENT

Flooding Type (Note 1)	**Minimum Design Levels at Crown of Road (mAHD)**	
	Residential Development	**Industrial/Commercial Development**
Brisbane River	100y ARI	50y ARI
Creek or Waterway	100y ARI	50y ARI
Localised Overland Flow Path	50y ARI	50y ARI
Designed Open Channel	50y ARI	50y ARI
Storm Surge (Note 2)	100y ARI	100y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie localised overland flow paths and/or designed open channels and/or creek flooding and/or river flooding and/or storm surge), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older inner city areas is often controlled by localised ponding.
2. The 100 year ARI storm surge is 2.5 mAHD. This value incorporates greenhouse effects.

TABLE B2.3.2
FLOOD IMMUNITY LEVELS FOR EXISTING DEDICATED ROAD PROVIDING
ACCESS TO OR FRONTING A SUBDIVISION OR DEVELOPMENT

Flooding Type (Note 1)	**Minimum Design Levels at Crown of Road (mAHD)**			
	Local Access	**Neighbourhood Access**	**Industrial Access**	**District Access/ Suburban Route/ Arterial Route**
Brisbane River	20y ARI	50y ARI	20y ARI	50y ARI
Creek or Waterway	20y ARI	50y ARI	20y ARI	50y ARI
Localised Overland Flow Path	50y ARI	50y ARI	50y ARI	50y ARI
Designed Open Channel	50y ARI	50y ARI	50y ARI	50y ARI
Storm Surge (Note 2)	100y ARI	100y ARI	100y ARI	100y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie localised overland flow paths and/or designed open channels and/or creek flooding and/or river flooding and/or storm surge), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older inner city areas is often controlled by localised ponding.
2. The 100 year ARI storm surge is 2.5 mAHD. This value incorporates greenhouse effects.

In exceptional circumstances Council may consider development proposals that do not meet the specified requirements of Table B2.3.2. In this instance the applicant must satisfactorily demonstrate compliance with items 1-4. In the decision making process, Council would also consider additional issues listed in items 5-9 below.

1. Alternative access routes are available.
2. The time of closure for the 50 year ARI flood event from all the nominated flooding sources with the exception of Brisbane River, does not exceed 6 hours. The time of closure is calculated by drawing a horizontal line on the hydrograph at the trafficable discharge level and measuring the time for which the flow is above this level. (Note: The time of closure for each ARI event is not necessarily the design hydrograph that produces the highest peak flood level but rather the critical duration envelope is usually derived from a series different duration flood hydrographs. For example for a given trafficable capacity, the 24 hour storm may generate the longest time of closure at the crossing rather than the 6 hour critical duration storm that produces the highest peak flood level at the crossing.) Road closure is normally assumed when the total head (static plus velocity) on a carriageway with a two-way crossfall or across the highest edge of a carriageway with a one-way crossfall exceeds 300 mm. For any detail assessment or explanations of terminologies, the applicant must make reference to the publication *Waterway Design. A Guideline to the Hydraulic Design of Bridges, Culverts and Floodways* (AustRoads, 1994).
3. The Average Annual Time of Closure (AATC) from all the nominated flooding sources with the exception of Brisbane River, does not exceed 2 hours. Reference must be made to the publication *Waterway Design. A Guideline to the Hydraulic Design of Bridges, Culverts and Floodways* (AustRoads, 1994) for the procedure to estimate AATC.
4. The depth by velocity product does not exceed 0.4 m^2/s for all floods up to and including the 100 year ARI event. The value of 0.6 m^2/s can be used if safety downstream is not an issue.
5. Where the existing dedicated road fronting the subdivision/development does not comply with the specified flood immunity standards, Council may require that the access frontage be upgraded as part of the development works. This may be particularly relevant to developments in green field sites typically applicable to the Emerging Community Areas.
6. Where considerable upgrading is required to the existing dedicated road providing access to the subdivision/development in order to achieve the specified flood immunity standards, Council may seek the Developer's contribution towards the road upgrade costs through the Infrastructure Charges Plan. This may be particularly relevant to developments in brown field sites typically in the older suburbs.
7. The number of affected properties.
8. The number of allotments proposed.
9. The proposed use of the development or subdivision.

2.4 EARTHWORKS ADJACENT TO WATERWAYS AND FLOW PATHS

Any earthworks activities must comply with all the performance criteria and acceptable solutions specified in the Filling and Excavation Code of the *Brisbane City Plan* (refer to illustration on Figure B2.4.1).

Some of the typical acceptable solutions with respect to flooding or drainage problems include:

- Filling or excavation is not located within the flood regulation lines.
- If there are no flood regulation lines, filling or excavation is not located within the 100 year ARI inundation extent.
- Filling or excavation is not located in any waterway corridor as shown on the Planning Scheme Maps.
- Filling or excavation is not located in any wetland as shown on the Planning Scheme Maps.

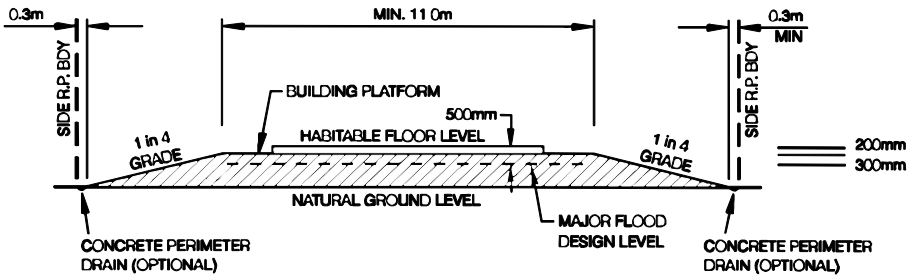
The applicant must ensure that the development proposal does not adversely impact on either the hydraulic conveyance and/or flood storage.

Hydraulic conveyance is a measure of the flow carrying capacity of a watercourse and is a function of the geometry and surface impedance of that watercourse. The loss of conveyance from obstruction or filling is usually characterised by increases in flood levels upstream. Mathematical models that are appropriate to assess the impacts of flood flow conveyance include HEC-RAS steady state hydraulic model and MIKE-11 hydrodynamic model.

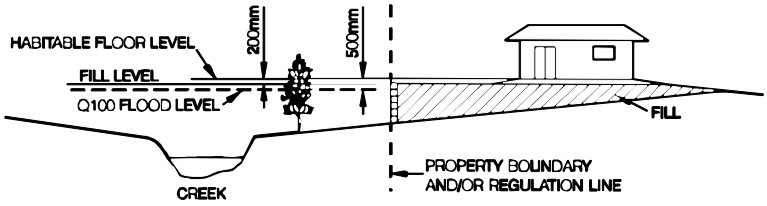
As floodwaters flowing in a watercourse rise during a flood event and overtop the banks, a portion of floodwaters are transferred into storage areas of the floodplain where the flow velocities are small in comparison with the main channel. The loss of critical **flood storage** from obstruction or filling is usually characterised by increases in flow velocities and/or flood levels downstream. Mathematical models that are appropriate to assess the impacts of flood storage include RAFTS runoff routing model and MIKE-11 hydrodynamic model.

For overland flow paths that are not designated channels or waterways, the overland flow path may be altered to suit the development provided that the Q_{50} velocity depth product is $\leq 0.6\ m^2/s$. Compensatory earthworks must not cause the velocity depth product to exceed $0.6\ m^2/s$ nor concentrate flows onto adjacent properties. Flood storage capacity areas below the Q_{50} flood levels must be preserved by matching any filled area with an excavated area of equal volume at the same levels.

FIGURE B2.4.1
TYPICAL FILLING EXAMPLE



FILLING OF LAND (BATTERS)



FILLING OF LAND (RETAINING WALLS)

NOTES:

1. Where the neighbouring property is low lying with existing drainage problems Council may require a concrete perimeter drain at the toe of the embankment or retaining wall.
2. The toe of all embankments adjoining public space (eg park, road reserve, etc) must be at least 0.3 m clear of the property alignment. All embankments to neighbouring properties are to be maintainable. In most cases, a batter of 1V in 4H is desirable but steeper landscaped embankments may be considered. Where the property adjoins parkland the batters are to be no steeper than 1V in 6H to allow easy access.
3. Retaining walls instead of the earth batter may be accepted with approval of Development & Regulatory Services subject to appropriate landscaping to soften the visual impact of the retaining wall.
4. Retaining wall structures must conform to the requirements set out in the Standard Building Regulation 1993. In general any retaining walls greater than 1.0 m in height will require a building application and structural certification. Where the combined height of a fence and a wall exceeds 2.0 m, the aforementioned requirements plus the written authorisation from the neighbour will need to be provided with the engineering drawings.