

# Guidelines for the construction or modification of category 1 levees

This publication has been compiled by Water Policy, Department of Natural Resources and Mines.

© State of Queensland, 2014

The Queensland Government supports and encourages the dissemination and exchange of its information. The copyright in this publication is licensed under a Creative Commons Attribution 3.0 Australia (CC BY) licence.



Under this licence you are free, without having to seek our permission, to use this publication in accordance with the licence terms.

You must keep intact the copyright notice and attribute the State of Queensland as the source of the publication.

For more information on this licence, visit <http://creativecommons.org/licenses/by/3.0/au/deed.en>

The information contained herein is subject to change without notice. The Queensland Government shall not be liable for technical or other errors or omissions contained herein. The reader/user accepts all risks and responsibility for losses, damages, costs and other consequences resulting directly or indirectly from using this information.

To be read in conjunction with the IDAS code for development applications for construction or modification of particular levees.

## Table of contents

1. Purpose .....	4
2. Definition of a levee .....	6
2.1 Inclusions .....	6
2.2 Exclusions.....	6
3. Construction or modification of levees.....	7
4. Levee category .....	8
4.1. Calculating off-property impacts.....	8
4.2. Calculating the number of impacted people.....	8
4.2 Engagement of a suitably qualified person .....	9
5. Roles and responsibilities.....	9
6. Assessing Category 1 self-assessable levees .....	12
6.1 Required performance outcomes for self-assessable levees .....	12
6.1.1 PO1 - The levee is located in a rural area and is designed to protect part of an individual's property.....	12
6.1.2 PO2—The levee does not alter the flow of overland flow water or floodwaters in a way that results in off-property impacts.....	13
6.1.3 Determining off-property impacts—floodplain parameters .....	15
6.1.4 Determining off-property impacts—hydraulic assessments .....	16
6.2 Rationale behind self-assessment outcomes.....	20
7. Consultation .....	21
8. Liability for impacts .....	22
9. Further information .....	22
Appendix A: Glossary .....	23
Appendix B: References .....	26
Appendix C: Activities excluded from the definition of levees.....	28
Appendix D: Checklist for self-assessable levees.....	33
Appendix E: Example of a self-assessable levee .....	35
Appendix F: Default populations for occupied buildings.....	38

## 1. Purpose

This document provides information to help levee proponents meet the requirements under the *Sustainable Planning Regulation 2009* for the construction of new levees and modification of existing levees.

These guidelines provide information relating to the *Self-assessable code for the construction or modification of levees*.

Guidelines in relation to the following codes are provided in the *Guidelines for the construction or modification of category 2 and 3 levees*:

- IDAS Code for development applications for the construction or modification of particular levees (Schedule 15B of the *Water Regulation 2002* available at [www.legislation.qld.gov.au](http://www.legislation.qld.gov.au).)
- Construction and modification of levees state code as part of the State Development Assessment Provisions available at [www.dsdiqld.gov.au](http://www.dsdiqld.gov.au).

The regulation will not apply to levee that are under construction at the commencement date of the regulation. Physical construction on building or modifying the levee must have started for it to be considered 'under construction'. A levee is not considered to be under construction unless all applicable permissions have been received, land acquisitions completed and work begun.

These guidelines are designed to be used by:

- landholders interested in constructing a new levee or modifying an existing levee
- suitably qualified persons engaged by the levee proponent to design and construct a levee
- assessment managers from the local government authorities
- consultants engaged by either levee proponents or local government authorities.

Note: These guidelines do not provide a technical standards or detailed methodologies for the design, construction, modification or maintenance of levees. The detailed design and construction or modification of levees is recommended to be undertaken by suitably qualified person with relevant professional experience and knowledge.

These guidelines will be reviewed and updated periodically by the Queensland Government. They may be changed over time and are not designed to apply to every type of proposal.

### Use of the guidelines

It is important to note that these are guidelines only and therefore have no statutory authority. They are designed to assist in the interpretation of the relevant codes.

Any application to construct or modify a levee is required to comply with the codes listed above which override any information that is contained in these guidelines.

The following appendixes are provided in these guidelines:

- **Appendix A** contains a glossary of terms used in the guidelines.

- **Appendix B** provides a list of references for further information that may be of use to the levee proponent, levee designer or the assessment manager.
- **Appendix C** details the activities excluded from the definition of levees and how those activities are currently managed.
- **Appendix D** contains a checklist for self-assessable levees.
- **Appendix E** is an example of a self-assessable levee and how the methods detailed in the guidelines may be applied to an example levee.
- **Appendix F** details the default populations for occupied buildings which are used to determine the population impacted by a levee.

## 2. Definition of a levee

### 2.1 Inclusions

The *Water Act 2000* defines a levee as:

*A levee is an artificial embankment or structure which prevents or reduces the flow of overland flow water onto or from land.*

A levee includes levee-related infrastructure, which is defined as infrastructure that is:

- a. connected with the construction or modification of the levee; or
- b. used in the operation of the levee to prevent or reduce the flow of overland flow water onto or from land.

Levees can be constructed in a number of ways, for example earthen levees, crib walls or concrete walls. Earthen or earthfill levees are the most commonly constructed levees. They are constructed only of soil material, which can include clay, silt, gravel, sand and rocks. Earthen levees can include fill material that is pushed up or deposited for the purposes of diverting overland flow water. Other types of levees, such as crib walls or concrete retaining walls, are often used in more restrictive or difficult sites.

### 2.2 Exclusions

The *Water Act 2000* also includes a number of activities that are excluded from the definition of a levee, as follows:

- a. prescribed farming activities
- b. fill that is—
  - i. deposited at a place for gardens or landscaping, including, for example, landscaping for the purposes of visual amenity or acoustic screening and
  - ii. less than the volume of material prescribed under a regulation (prescribed as 50m<sup>3</sup> in Section 62B of the *Water Regulation 2002*)
- c. infrastructure used to safeguard life and property from the threat of coastal hazards
- d. a structure regulated under another Act including, for example, the following—
  - i. a levee constructed as emergency work under the Planning Act, section 584 or 585
  - ii. a structure constructed under an approved plan under the *Soil Conservation Act 1986*
  - iii. a structure whose design takes into account the impacts of flooding or flood mitigation but which is not primarily designed for flood mitigation;  
*Example - a public road within the meaning of the Transport Infrastructure Act 1994*
  - iv. a structure constructed within the bed, or across a bank, of a watercourse, including, for example, a weir or barrage, the construction of which was carried out under this Act and for which a development permit under the Planning Act was given
  - v. an embankment or other structure constructed for long-term storage of water under the Water Supply Act  
*Examples - a ring tank or dam*

- e. irrigation infrastructure that is not levee-related infrastructure.

**irrigation infrastructure** means water infrastructure or other infrastructure constructed, erected or installed for the supply of water or the storage and distribution of water for the irrigation of crops or pastures.

*Examples of irrigation infrastructure* - a supply channel, head ditch or tailwater drain

**levee-related infrastructure** means infrastructure, including irrigation infrastructure, that is—

- a. connected with the construction or modification of the levee or
- b. used in the operation of the levee to prevent or reduce the flow of overland water onto or from land.

*Examples of infrastructure for paragraph (b)* - a channel, drain, outfall or pipe

**prescribed farming activities** means—

- a. cultivating soil; or  
*Examples* - clearing, replanting and broadacre ploughing
- b. disturbing soil to establish non-indigenous grasses, legumes or forage cultivars or
- c. using land for horticulture or viticulture or
- d. laser levelling or contouring soil.

**Appendix C** provides more information on the activities that are excluded from the definition of levees and where these activities may be captured by other legislation or regulations. Where there is uncertainty around whether an activity or structure is defined as a levee, the levee proponent should contact the assessment manager.

### 3. Construction or modification of levees

These steps apply to the construction of new levees or the modification of existing levees. A new levee is a structure that is built where no pre-existing levees are in place for flood mitigation or other purposes.

An existing levee means a levee:

- a) that
  - was under construction when section 967 of the *Water Act 2000* commenced and
  - has not been modified since the construction of the levee was completed or otherwise came to an end or
- b) that was existing on the commencement and has not been modified since.

Modify, for an existing levee, means any or all of the following:

- to raise or lower the height of the levee
- to extend or reduce the length of the levee
- to make another change to the levee that affects the flow of water.

## 4. Levee category

For the purposes of regulation, levees in Queensland are classified into three categories based on their potential level of impact. The categorisation ensures that the level of assessment that a levee application will need to go through is proportionate to the level of risk that the levee poses to people, property and the catchment.

The three categories and their respective assessment level are as follows:

Category	Definition	Level of assessment	Assessor
Category 1	A levee that has no off-property impact	Self-assessment	Applicant
Category 2	A levee that has an off-property impact and for which the affected population is less than 3	Code assessment	Local government
Category 3	A levee that has an off-property impact and for which the affected population is at least 3	Impact assessment	Local government with Queensland Government as referral agency

### 4.1. Calculating off-property impacts

Off-property impacts determine whether a proposed levee is subject to self-assessment or code/impact assessment. Self-assessment only applies to levees that have no off-property impacts. If a levee does not meet this requirement of no off-property impacts, it is subject to code and impact assessment (category 2 and 3 levees)

Self-assessable levees will typically be structures built or modified on a large rural property far enough from other properties to cause no impact. The smaller property size in other zones, such as urban zones, means that any sized levee in these zones will almost certainly result in some type of impact beyond the property boundary.

An off-property impact means an impact the levee has on people, property or the environment outside the levee property. Off-property impacts are measured in terms of the hydraulic effects of the levee. If the construction or modification of a levee results in no changes to the flow path, flow velocity, flooded area or flood height of floodwaters or overland flow waters beyond the boundary of the property on which it is located, this levee is considered to have no off-property impacts and is subject to self-assessment.

Refer to section 6 of these guidelines for more information on how to calculate off-property impacts.

### 4.2. Calculating the number of impacted people

For levees that have off-property impacts, a risk assessment is required to determine the impacts of the proposed levee on people, property and the environment. As part of this risk assessment, the affected population will need to be calculated in order to classify the levee



as category 2 or 3. Affected population, for a levee, means the total number of persons occupying the building or buildings on which the levee has a significant impact.

A significant impact for a levee on a building means each of the following:

- an increase, caused by the levee, of more than 5cm in the flow height of water over the floorboards of the building
- an increase, caused by the levee, of more than 0.2m/s in the flow velocity of water over the height of the floorboards of the building.

Refer to the *Guidelines for the construction and modification of category 2 and 3 levees* for more information on calculating the number of impacted people.

## **4.2 Engagement of a suitably qualified person**

It is recommended that for all levees the levee proponent engage a suitably qualified person to assist in meeting the requirements of the codes. This is particularly the case for levees subject to development approvals (category 2 and 3). This person should be engaged as early as possible in the process.

A suitably qualified person is a person with the necessary qualifications and experience to undertake risk assessments, hydraulic studies or the design and construction of a levee.

An example of this person is a Registered Professional Engineer of Queensland (RPEQ) under the provisions of the *Professional Engineers Act 2002*, such as a civil engineer who has demonstrated competency and relevant experience in the design and construction of levee banks or other flood infrastructure.

A suitably qualified person engaged in the design and construction of the levee will have access to relevant Australian and international standards and expertise necessary to meet the IDAS code requirements.

## **5. Roles and responsibilities**

There are typically many participants (individuals and organisations) involved in flood risk and levee management who need to interact together and communicate information in order to perform their relevant roles and responsibilities efficiently and effectively.

These roles may be filled by the same person (in the case of simple levees where the levee proponent, designer and constructor may be the same person) or in the case of larger, more complex levees, many different people or companies.

In this section, the focus is on roles and responsibilities rather than organisations because many variants are possible within individual organisations. For example:

- the organisation which owns the levee may also employ the designers and project managers
- the construction company may take responsibility for the design and the project management as well as for the construction itself.

Clearly defined roles and responsibilities are fundamental for efficient delivery of levee design and construction. The levee proponent or project manager should evaluate project needs, clarify roles and responsibilities and establish effective lines of communication.

It is recognised that these roles and responsibilities will not be applicable to assessments and applications for all levee categories.

The following roles have been defined:

### **Levee proponent**

The levee proponent, landholder or levee owner has the responsibility of funding the design, construction and operation and maintenance of the levee up to the design life. Should the levee asset be required to be maintained beyond the design life, then it is the responsibility of the levee proponent to repeat the cycle of design and construction of the levee in perpetuity. Adequate records of design, construction and maintenance records should form part of any levee asset management plan, and these records should be handed over when there is a change of ownership.

### **Applicant**

For the purposes of these guidelines, it is assumed that the applicant is the levee proponent, landholder or levee owner. In some cases the applicant can be both the levee proponent and the designer. Also, the levee owner can delegate the application role to another party, but the responsibility of the application rests with the levee proponent.

### **Designer**

A suitably qualified person may be needed to certify the levee design. Under Queensland law, penalties apply if a professional engineer certifies a design or flood impact assessment that contains information that the engineer knows is false or misleading and does not disclose this (refer to the *Professional Engineers Act 2002*).

The designer will be responsible for the technical elements of the project, and will work closely with the levee proponent to ensure the relevant code requirements are properly addressed. The designer may also have responsibilities for checking that the constructor is complying with the contractual requirements including adherence to the design drawings and the specifications.

### **Project manager**

The project manager must have sufficient knowledge and experience to manage a wide variety of disciplines. Good overall project management is crucial to the timely delivery of projects, but all team members must understand their roles and contribute accordingly to achieve success. Project managers should have an understanding of levee construction, risk identification, analysis and management and may have to manage conflicting requirements.

### **Constructor**

The constructor is responsible for adhering to the design and specifications provided by the project team. The constructor must provide sufficient quality assurance documentation to the levee proponent to satisfy the levee proponent and the assessment manager that the levee has been constructed to the technical requirements of the design and specifications. Employment of the levee designer or an independent certifying authority is often a means of achieving construction certification to ensure that the design intent is expressed in the construction methodology, and that the construction complies with the certified design.

**Assessment manager**

There is no assessment manager for category 1 self-assessable levees.

**Referral agency**

There is no referral agency for category 1 self-assessable levees.

## 6. Assessing Category 1 self-assessable levees

This section provides additional guidance for the proponent to determine whether the self-assessable levee has no off-property impacts and how the self-assessment performance outcomes can be met.

If as a consequence of this further assessment the proponent determines that the levee will have off-property impacts please go to the *IDAS code for development applications for construction or modification of particular levees* for category 2 and 3 levees. The *Self-assessable code for the construction of new levees or the modification of existing levees* can be found on the Department of Natural Resources and Mines website at [www.dnrm.qld.gov.au](http://www.dnrm.qld.gov.au).

Where there is uncertainty about the impacts of the levee on neighbouring properties, it is advised that the proponent apply for a category 2 or 3 levee where more detailed assessments will indicate the extent of the levee impacts. If the detailed studies show that the levee will not lead to off-property impacts, the proponent can revert to self-assessment.

### 6.1 Required performance outcomes for self-assessable levees

This should be read in conjunction with the *Self-assessable code for the construction or modification of levees* which can be found on the Department of Natural Resources and Mines website at [www.dnrm.qld.gov.au](http://www.dnrm.qld.gov.au).

Performance outcome	Acceptable outcome
<b>PO1</b> The levee is located in a rural area and is designed to protect part of an individual's property	<b>AO1</b> The levee is located in a rural zone  Editor's note: rural zone refers to a zone in a local government planning scheme that is equivalent to the 'rural zone' of the Queensland Planning Provisions
<b>PO2</b> The levee does not alter the flow of overland flow water or floodwaters in a way that results in off-property impacts	<b>AO2</b> There must be no change in the hydraulic effects beyond the boundaries of the property as a result of levee construction or modification. Hydraulic effects that must not change are: <ul style="list-style-type: none"> <li>• the flow path of overland flow water or floodwater where it enters or exits the property and</li> <li>• the flow velocity off-property and</li> <li>• the flooded area off-property and</li> <li>• the flood height off-property</li> </ul>

#### 6.1.1 ***PO1 - The levee is located in a rural area and is designed to protect part of an individual's property***

The self-assessment code is only applicable to levees located in a rural zone (refer to AO1). A 'rural zone' for the purposes of this code refers to a zone in a local government planning

scheme that is equivalent to the 'rural zone' defined in the Queensland Planning Provisions. Refer to the Department of State Development, Infrastructure and Planning website at [www.dsdiq.qld.gov.au](http://www.dsdiq.qld.gov.au) for more information. Levees in zones other than rural will be category 2 or 3 levees and cannot be self-assessed and will therefore require code or impact assessment.

### **6.1.2 PO2—The levee does not alter the flow of overland flow water or floodwaters in a way that results in off-property impacts**

In order to meet the requirements of PO2 of the self-assessment code, the proponent needs to assess the potential of the levee to cause off-property impacts.

Off-property impacts are defined in terms of the hydraulic effects of the levee. If the construction or modification of a levee results in no changes to the flow path, flow velocity, flooded area or flood height of floodwaters or overland flow waters beyond the boundary of the property on which it is located, this levee is considered to have no off-property impacts and is subject to self-assessment.

#### **Hydraulic effect**

The term hydraulic effect is used frequently in these guidelines. In simple terms, hydraulics refers to the study of the flow of water in waterways, in particular, the evaluation of flow parameters such as water level, extent and velocity.

A hydrologic assessment is the study of water and its constituents as they move through the natural processes that constitute the hydrological cycle (i.e. rainfall, runoff, evaporation, infiltration).

Hydraulic effects in relation to self-assessable levees are measured by examining:

- the flow path of overland flow water or floodwater where it enters or exits the property
- the flow velocity off-property
- the flooded area off-property
- the flood height off-property.

It is expected that in the decision to embark on the construction or modification of a levee, the proponent has a general sense of the levee size, location and configuration, as well as an estimation of the flood height that the levee will protect against and the area that is to be protected by the levee. This information, in combination with the considerations listed below, will provide an indication of the potential impacts of the levee. Using the information gathered, the proponent must be able to reasonably determine if there are potential off-property impacts that will cause damage to people, property or the environment. It is recommended that the basis of this assumption should be documented and records kept by the levee proponent in case of any future concerns being raised by third parties with regards to the impact of the levee.

It is recommended that, to the extent possible, proponents consider the following issues and use the checklist in Appendix D to ensure that the appropriate issues are taken into account:

- Property size
- Levee design details, including:
  - total length

- maximum height
- width at top of levee
- width at base of levee
- estimated volume of fill in cubic metres
- Fill material that is used to construct the levee
- Soil on which the levee is built on and other in-situ conditions
- Type of levee (earthen, concrete, crib wall, other)
- Proximity of the levee to:
  - property boundary
  - watercourses, including rivers, lakes, wetlands and dams
  - occupied buildings on-property
  - occupied buildings off-property
  - urban or residential areas
  - community infrastructure
  - other levees and ringtanks
  - roads and other access infrastructure
- Known flood heights (can be based on local knowledge of historical levels, flood levels at nearby gauging stations, or design flood heights where available, such as Q100 or the 2011 flood)
- The flood protection height of the levee in relation to the known flood heights, i.e. the maximum flood height that the levee is designed to protect against
- The size of the property area to be protected by the levee
- Volume of water that is being displaced during flood events
- Predicted flow path of floodwaters or overland flow when the flood height reaches the flood protection height of the levee
- Predicted flow path of floodwaters or overland flow when the levee is overtopped
- Estimated life of the levee
- Maintenance requirements
- Applicable design standards to which the levee is constructed or modified
- Levee location and configuration in relation to:
  - floodplain
  - overland flow paths
- The proportion of the floodplain that will be blocked by the levee structure
- Set-back distance of the levee from the watercourse

It is the responsibility of the proponent to ensure that the acceptable outcomes of the self-assessment code are achieved. As indicated in section 6.2, it is recognised that the acceptable outcome in the code does not allow for a clear definitive way for the proponent to determine whether or not the proposed works will meet the outcome and that it is virtually impossible to provide prescriptive parameters that will apply to all the geographic regions in Queensland. Further investigation by the Queensland Government into this issue is ongoing to test if there is an easier way to allow for a levee proponent to determine if any proposed levee will have no off-property impacts.

Guidance that will assist the proponent to determine whether or not the levee has off-property impacts are outlined in sections 6.1.3 and 6.1.4. Which methods should be used is at the discretion of the proponent, but sufficient analysis should be undertaken to allow the

proponent to be confident that no off-property impacts will result from the proposed levee and that this could be justified, if necessary, to a third party.

### **6.1.3 Determining off-property impacts—floodplain parameters**

There is no single factor that can be applied across the state that will determine whether a levee will have off-property impacts. Due to the unique and interrelated characteristics of each and every floodplain in Queensland, the assessment of whether a levee will cause off-property impacts can only be undertaken through sound application of established hydrological/hydraulic principles. This is a complex task that is typically only undertaken by a suitably qualified person. If the proponent can obtain the advice of a suitably qualified person in the construction or modification of a levee, it is strongly recommended.

In the absence of a suitably qualified person to verify the hydraulic effects of a levee, various prescriptive requirements have been investigated to give proponents guidance in determining whether the levee is a category 1 levee. It should be noted that these should not be considered as rules when determining whether a levee has off-property impacts or not, but can be used to provide guidance.

Three simple geometric parameters were identified as being the most representative of the distinction between category 1 (no off-property impacts) and category 2 (off-property impacts) levees. These are explained below and a case study of how the impact of a levee could be assessed using these parameters is provided in appendix E. The example in appendix E is included for indicative purposes only, and provides some context that may be useful for proponents to see the characteristics of a typical category 1 levee.

#### **Floodplain blocked**

This is the percentage of the entire floodplain that is blocked by a levee for the given levee protection height. The greater this value, the more the flow is restricted and so the greater the impact will be. This is evaluated as:

$$\text{Floodplain blocked (\%)} = \frac{\text{Levee width}}{\text{Floodplain width}} \times 100\%$$

The levee width required by this equation is the projected width of the levee in the direction of flow. Similarly the floodplain width is the width of a cross section that passes through the levee, perpendicular to flow.

A percentage is required to ensure this value is standardised between floodplains of all different sizes; the impact of a 500m wide levee in a 2km floodplain is invariably different to the same size levee in a 5km wide floodplain. For a given levee size, the proportion of floodplain blocked is a constant, regardless of its location in the floodplain. By extension this means the impact is the same regardless of levee location in the floodplain. This is an oversimplification, however it is a useful guide.

Appendix E provides an example of a levee that was deemed to be category 1 levee. In this example, the proportion of floodplain blocked by the levee was estimated to be 5 per cent.

#### **Floodplain behind levee**

This parameter addresses part of the issue identified as a shortcoming of floodplain blocked—levee position on floodplain. It is assumed here that the closer to the main river channel a

levee is, the bigger its impact will be. Unfortunately this is only the case for very specific geometric arrangements, however it serves as a useful approximation in most cases. It is evaluated as:

$$\text{Floodplain behind levee(\%)} = \frac{\text{Overbank width} - \text{Levee setback}}{\text{Overbank width}} \times 100\%$$

The overbank width is the floodplain width, perpendicular to flow, on the side of the river the levee is located. Levee setback is the distance, perpendicular to flow, from the main river bank to the levee. A percentage is again used to standardise between floodplains of differing sizes.

In the example in appendix E, the floodplain behind the levee was estimated to be 55 per cent.

### **Flood volume displaced**

A functioning levee protects an area by displacing water. The greater the volume of this water, the more restricted floodwaters are, and so the greater the impact. Unfortunately this does not consider the location of the levee, and in doing so, how critical this displaced volume is to flow. If a levee was built in an area where, during flood flows, the water conveyance is negligible, there would be little impact. Yet if a levee is built in an area where, during flood, conveyance is high, the impact would be significant.

Flood volume displaced is difficult to determine accurately without elevation data. It can however, be approximated using several assumptions. First the levee height is assumed to be a constant for the length of its perimeter. Secondly it is assumed the levee height is equal to the flood inundation depth for the area protected by the levee, before the levee was built. It is then calculated as:

$$\text{Flood volume displaced} = (\text{Levee plan area}) \times (\text{Levee height})$$

In the example in appendix E, the flood volume displaced was estimated to be 3000m<sup>3</sup>.

#### **6.1.4 Determining off-property impacts—hydraulic assessments**

Conducting a formal hydraulic assessment is the most effective way to identify the hydraulic effects of the levee and off-property impacts under a set of flood events. The types of hydraulic assessments that may be undertaken include, from simplest to most complex:

- Mannings formula, which estimates the average velocity of water flowing in an open channel.
- One-dimensional steady state hydraulic modelling, such as HEC-RAS, models water flows in an open channel.
- Two-dimensional fully hydrodynamic modelling, such as MIKE-21, TUFLOW and RMA-2.

The proponent may engage a suitably qualified person, such as a relevant Registered Professional Engineer of Queensland trained in hydrology, to assist in undertaking the hydraulic assessment and demonstrating achievement of the outcomes. While this is not a mandatory requirement for self-assessment, the engagement of a suitably qualified person is recommended as it will provide an expert opinion on the likely impacts of the levee. The



suitably qualified person can be engaged to undertake and/or certify a hydraulic assessment and also help with design of the levee.

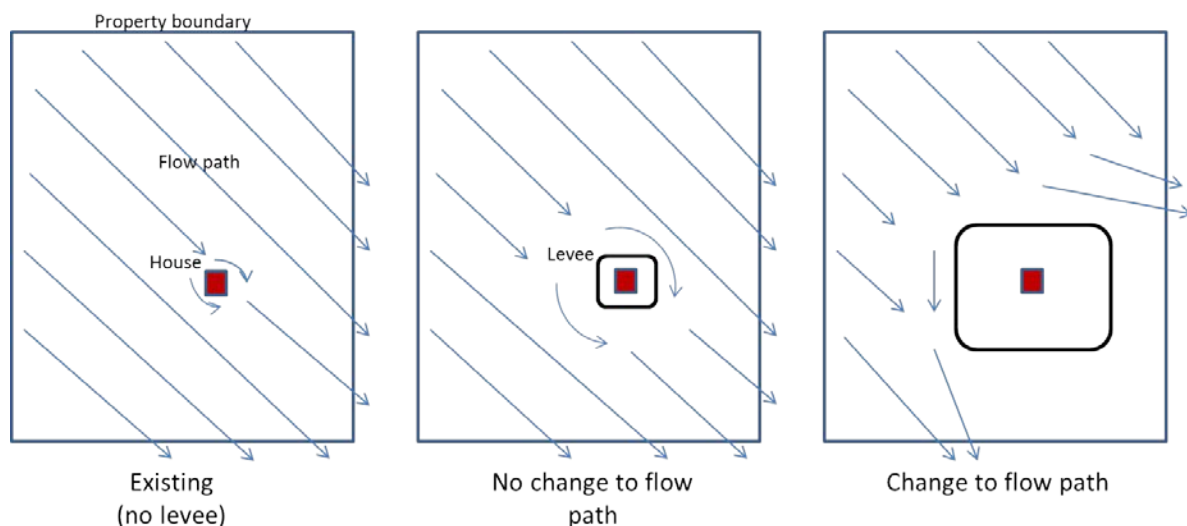
Off-property impacts of self-assessable levees are based on whether or not there are hydraulic effects from the levee that extend beyond the property boundary on which the levee is located. This is based on the assumption that if the hydraulic effects off-property do not change as a result of the levee construction or modification, then there will be no impacts on people, property or the catchment.

The off-property impacts of a levee can vary depending on the type of flood event. To ensure performance outcome 2 of the code is met, the proponent should consider a set of flood events, which includes events up to the design height of the levee as well as events that overtop the levee. The proponent should also consider the impacts if the levee fails structurally. Flood events can be selected on historical flood levels or in line with design floods, such as Q100 or the 2011 flood, where available.

The four types of hydraulic effects that will need to be measured in a hydraulic assessment by the proponent are explained below. Each hydraulic effect is illustrated in a simplistic manner to help explain how the building or modification of a levee can lead to off-property impacts.

### Flow path alteration

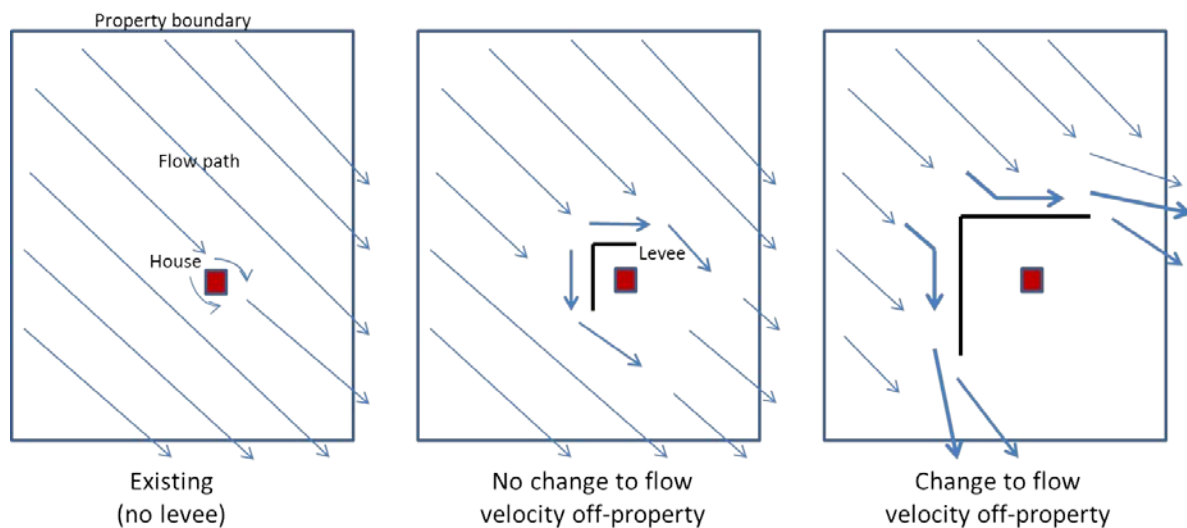
Prior to the construction or modification of the levee, proponents should have a reasonable knowledge of how water flows across their property during rain or flood events. The construction or modification of the levee should not change the flow path of overland flow water or floodwaters where it enters or exits the property. Levees have the potential to influence the flow of water upstream or downstream from where it is located. The extent of flow alteration will depend on a number of factors, including, but not limited to, levee length and height, proximity to the property boundary or watercourse and proportion of the floodplain blocked.



### Flow velocity

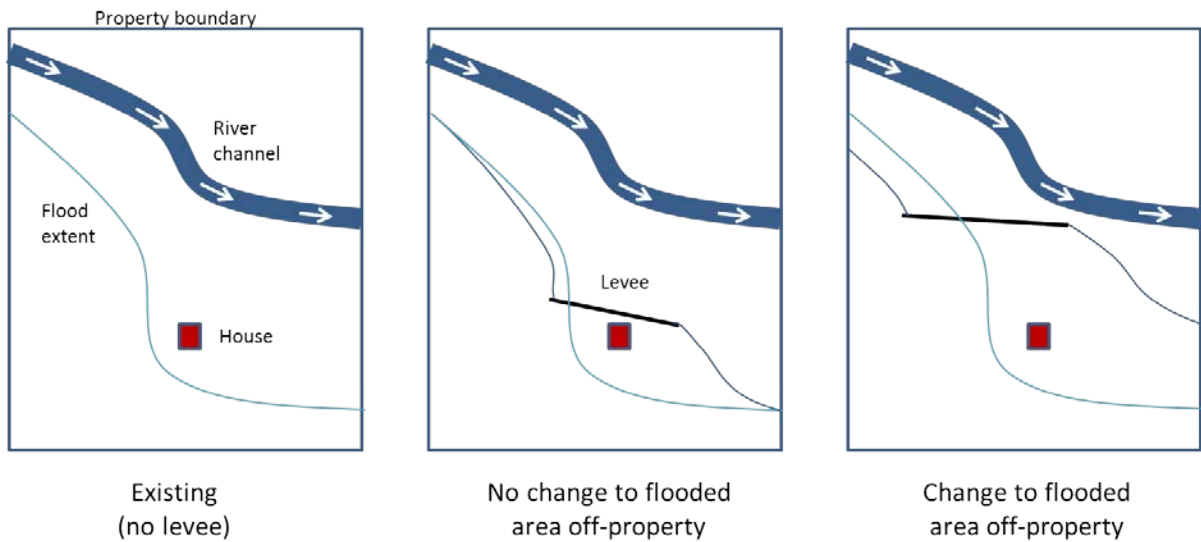
Flow velocity can be qualitatively estimated using key indicators such as observable erosion, vegetation and soil conditions. For a given soil type, the greater the erosion, it is reasonable

to assume the greater the flow velocity; the less vegetation, the less resistance there is to flow, and so the greater its velocity. The construction or modification of the levee should not change overland flow water velocity where it enters or exits the property. A levee restricts flood water flow which causes an associated change in velocity. The magnitude of these changes depends on the new flow area, reduced in width by the imposed levee, however also increased in height, and the amount of water passing through the floodplain. Velocity also has a direction component, and this should be considered in determining flow path alteration.



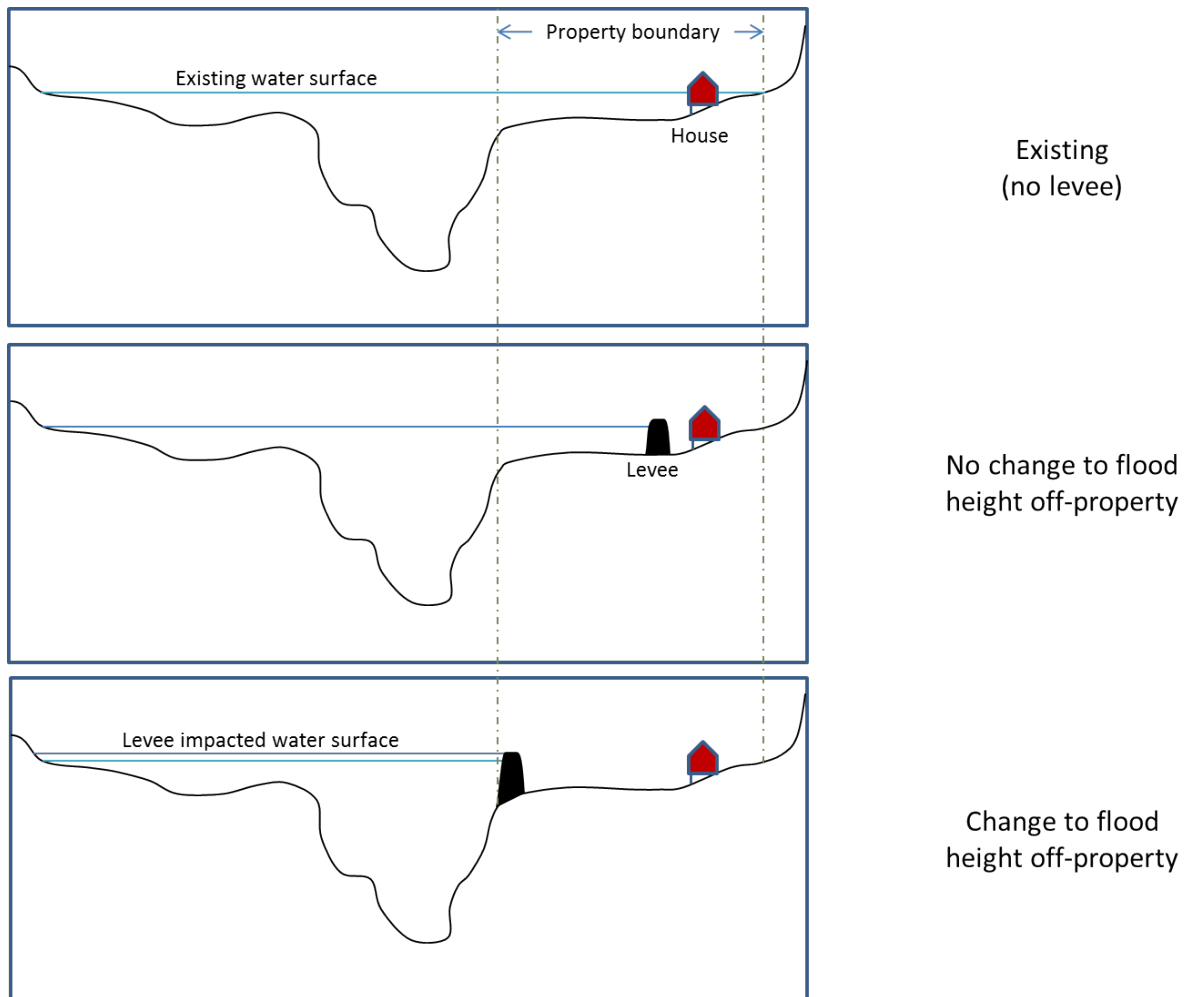
### Flooded area

Topographical maps may be useful as a guideline to determine floodwater extent for a given flood height. The construction or modification of the levee should not change floodwater extent on external properties. A levee restricts flood water flow which causes, with variation due to unique floodplain parameters, water to backup upstream. Downstream of a restriction caused by a levee, floodwaters spread out. These changes protrude away from a levee for a distance which is influenced by floodplain characteristics such as slope and flow resistance, and how these are changed by construction or modification of the levee. The more the levee imposes on the natural floodplain, the further floodwater changes will result. It is useful to consider floodplain extent at the same time as flood height as they are inextricably linked.



## Flood height

Construction or modification of the levee should not change floodwater height off-property. A levee restricts flow, yet the amount of water going through a floodplain does not change. For this to occur, a change must occur to flow velocity, flow height, or a combination of both. The latter almost always happens in practice. If the restriction is in a region of relatively high flow rate, as is the case closer to the main channel, the change to flow height will be greater. By identifying flow paths and velocities, the region of low flow rate can be determined and the flood height impact of a levee minimised. Large vegetation and areas protected by topography from high velocity flows are indications of this minimised impact region. Reducing the levee size will further reduce flood height impacts.



## 6.2 Rationale behind self-assessment outcomes

Throughout the development of the self-assessable code a numbers of parameters were investigated to determine if it was possible to develop a simple, prescriptive measure to determine of a levee had off-property impacts that would be applicable across the state. This section provides some background to the formulation of the performance outcomes and the challenges in developing a prescriptive measure. Further work on this issue is ongoing and the approach will be refined as the challenges with regards to self-assessment are identified.

Whether or not a levee poses off-property impacts is site specific. Each catchment in Queensland is unique and the likelihood of a levee having off-property impacts is dependent on a range of factors, including levee size, catchment type and location, proximity to watercourses and flood characteristics. As an example, the potential impacts of a one metre high levee in a broad floodplain in South West Queensland will differ considerably from the same sized levee in a smaller, higher gradient floodplain in coastal areas of Queensland.

There is currently limited state-wide information available in Queensland on levee locations and their impacts. While some areas have reliable information and data, there are many areas that do not.

Due to the site-specific nature of levee impacts and the limited data and information available, it is difficult to set prescriptive outcomes based on levee size or other parameters that will meet the requirement of no off-property impacts. Looking solely at geometric

parameters, while easy to establish, is a simplification of levee impacts and neglects important governing hydrodynamic principles. To set a trigger for self-assessable levees based on an individual parameter or set of parameters would mandate limits being set so low to ensure a levee with offsite impacts is not incorrectly allowed category 1 status, that true category 1 levee designs would be needlessly limited.

Investigations and preliminary modelling have been undertaken by the Queensland Government to test parameters and assess their applicability across the state. To date, these investigations have not been able to identify any definitive measures to allow for a prescriptive outcome, although work in this area will continue as more information is gathered.

A number of options regarding self-assessment were considered during the development of the regulatory framework. The first option was to remove the self-assessable category altogether, which meant that all levees, no matter the size or location, would be code assessable and require a hydraulic assessment. This was not considered appropriate as it would not allow for a proportionate level of assessment based on risk.

The second option explored was to prescribe a certain levee size, such as one metre in height and 100m<sup>3</sup> of fill that could be used as a trigger below which the levee would be self-assessable and above which would be code assessable. This approach would provide a consistent and objective measure with no ability to exercise discretion by the levee proponent. Preliminary modelling and the results of consultation did not allow for a measurable parameter-based threshold to be set that would apply to all levee types and contexts across the state. In other words, there was a risk that levees that fell below the size threshold could potentially have significant off-property impacts in some locations.

While prescriptive approaches are not useful for gauging levee impacts, there is still need for a mechanism to define the trigger between category 1 and 2 levees. The Queensland Government is aware of stakeholder concerns in this regard, and is pursuing more rigorous solutions that better encompass site uniqueness.

It may be an option in the future to prescribe more measurable and objective requirements that allow the proponent to more easily determine off-property impacts. In the meantime, however, the proponent will need to follow these guidelines to ensure that they can reasonably assume that the proposed levee will not lead to off-property impacts.

## **7. Consultation**

It is recommended that the proponent consult with neighbours about the intention to build a levee. Although not mandatory for self-assessable levees, the consultation can be used to provide details of the levee to neighbours and assurance that off-property impacts have been considered.

The proponent can also contact their local government with details of the proposed works and to discuss the assumptions on which the impact assessment of the levee are based.

It should be noted, however, that any agreement with the neighbours or local government does not reduce potential liability of the proponent if off-property impacts are caused by the levee.

## 8. Liability for impacts

The proponent bears full responsibility for any impacts that the levee may cause under any flood event scenario including possible overtopping or failure. It is recommended that any records or information created as part of the self-assessment be maintained by the proponent.

In the case where a self-assessed levee is located on a property that is subsequently sold, the liability for any impacts is transferred to the new owners.

## 9. Further information

Further information that may assist self-assessment includes:

- *Guidelines for the construction and modification of category 2 and 3 levees*
- Applicable standards and manuals, such as:
  - *Floodplain Management in Australia. Best Practice Principles and Guidelines* (SCARM, 2000)
  - *Levee Design, Construction and Maintenance Manual* (Victoria State Government, 2002)
  - *International Levees Handbook* (CIRIA, 2013)
  - *Floodplain Development Manual* (NSW State Government, 2005)
  - *Queensland Urban Drainage Manual* (Queensland State Government Department of Natural Resources and Water, 2007)
  - *Planning for stronger, more resilience floodplains* (Queensland State Government Queensland Reconstruction Authority, 2011)
  - *Emergency Management Practice Guide 3: Managing the Floodplain* (Emergency Management Australia, 1999).
- Available reports and historical information on floods for the local area and catchment
- Queensland Reconstruction Authority mapping, aerial photography, satellite imagery and other applicable local knowledge at [www.qldreconstruction.org.au](http://www.qldreconstruction.org.au).
- Consultation with Bureau of Meteorology, Department of Transport and Main Roads, Department of Natural Resources and Mines, Department of Environment and Heritage Protection, Department of State Development, Infrastructure and Planning,
- Consultation with local government as well as local residents who have experienced flood events
- Interim floodplain assessment overlay by Queensland Government (Queensland Globe)
- Relevant Australian and international standards
- Topographic information from aerial imagery or field survey.

Levee proponents should contact their local council for additional guidance in relation to this code.

## Appendix A: Glossary

**Affected population:** for a levee means the total number of persons occupying all buildings on which the levee has a significant impact.

**Annual Exceedance Probability (AEP):** probability of exceeding a specified flow or level in any one year (CIRIA, 2013).

**Average Recurrence Interval (ARI):** the average period in years between the occurrence of a flood of a given size or larger (SCARM, 2000).

**Category 1 levee:** a levee that has no off-property impact.

**Category 2 levee:** a levee—

- a) that has an off-property impact; and
- b) for which the affected population is less than 3.

**Category 3 levee:** a levee—

- a) that has an off-property impact; and
- b) for which the affected population is at least 3.

**Defined Flood Event (DFE):** the flood event selected for the management of flood hazard to new development. This is generally determined in floodplain management studies and incorporated in floodplain management plans. Selection of DFEs should be based on an understanding of flood behaviour, and the associated likelihood and consequences of flooding. It should also take into account the social, economic, environmental and cultural consequences associated with floods of different severities (Draft SPP Guideline: State interest—natural hazards).

**Existing levee:** means a levee—

- a) that
  - i. was under construction when section 967 of the *Water Act 2000* commenced; and
  - ii. has not been modified since the construction of the levee was completed or otherwise came to an end or
- b) that was existing on the commencement and has not been modified since.

**Flood:** relatively high water levels caused by excessive rainfall, storm surge, dam break or a tsunami that overtop the natural or artificial banks of a stream, creek, river, estuary, lake or dam (SCARM, 2000).

**Flood hazard area:** refer to *State Planning Policy* (Queensland State Government Department of State Development, Infrastructure and Planning, 2013a).

**Flood protection height:** the height of the maximum flood that the levee is designed to protect against. The flood protection height should not include the freeboard.

**Floodways:** areas where a significant volume of water flows during floods and are often aligned with obvious natural channels. They are areas that, 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, areas with deeper flow or areas where higher velocities occur (adopted from NSW Floodplain Management Manual, 2001).

**Flood storage areas:** those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. If the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. Substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flood flows (adopted from NSW Floodplain Management Manual, 2001).

**Flood fringe:** the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels (adopted from NSW Floodplain Management Manual, 2001).

**Freeboard:** the height above a defined flood level, typically used to provide a factor of safety. Freeboard compensates for effects such as wave action, localised hydraulic behaviour and settlement of levees, which increase flood levels or reduce the level of protection provided by levees. Freeboard should not be relied upon to provide protection for flood events larger than the DFE (SCARM, 2000).

**Hydraulic assessment:** the study of the flow of water in waterways, in particular, the evaluation of flow parameters such as water level, extent and velocity (SCARM, 2000).

**Hydrologic assessment:** the study of water and its constituents as they move through the natural processes that constitute the hydrological cycle (i.e. rainfall, runoff, evaporation, infiltration) (SCARM, 2000).

**Irrigation infrastructure:** water infrastructure or other infrastructure constructed, erected or installed for the supply of water or the storage and distribution of water for the irrigation of crops or pastures.

*Examples of irrigation infrastructure - a supply channel, head ditch or tailwater drain*

**Landholder:** includes owners or lessees of the land on which the levee is proposed to be constructed or modified. Also referred to as levee proponent.

**Levee:** an artificial embankment or structure which prevents or reduces the flow of overland flow water onto or from land. A levee includes levee-related infrastructure. Refer to Attachment 1 for the list of exclusions as defined in the *Water Act 2000*.

**Levee property:** (a) means the lot or parcel of land on which a levee is situated; and (b) includes another lot or parcel of land that is contiguous with the lot or parcel mentioned in paragraph (a) and owned by the same entity.

**Levee-related infrastructure:** for a levee, means infrastructure, including irrigation infrastructure, that is—

- a. connected with the construction or modification of the levee; or
- b. used in the operation of the levee to prevent or reduce the flow of overland water onto or from land.

*Examples of infrastructure for paragraph (b) - a channel, drain, outfall or pipe*

**Modify,** for an existing levee, means any or all of the following:



- to raise or lower the height of the levee
- to extend or reduce the length of the levee
- to make another change to the levee that affects the flow of water.

**Off-property impact:** for a levee, means an impact the levee has on a people, property or the environment outside the levee property.

**Overland flow water:** – Refer to Schedule 4 of the *Water Act 2000*.

**Overtopping:** passing of water over the top of a structure as a result of a water level higher than the crest of the structure (CIRIA, 2013).

**Prescribed farming activities** means—

- cultivating soil or  
*Examples* - clearing, replanting and broadacre ploughing
- disturbing soil to establish non-indigenous grasses, legumes or forage cultivars or
- using land for horticulture or viticulture or
- laser levelling or contouring soil.

**Probable Maximum Flood (PMF):** the largest flood that could conceivably occur at a particular location. The PMF defines the extent of flood-prone land.

**Property:** refer to levee property definition

**Registered Professional Engineer Queensland (RPEQ):** means a person registered as a registered professional engineer under the *Professional Engineers Act 2002*.

**Resilience:** the ability to adapt to changing conditions and prepare for, withstand and rapidly recover from disruption.

**Rural zone:** refers to a zone in a local government planning scheme that is equivalent to the 'rural zone' of the Queensland Planning.

**Significant impact,** of a levee on a building, means each of the following:

- disturbing soil to establish non-indigenous grasses, legumes or forage cultivars or
- using land for horticulture or viticulture

**Suitably qualified person:** a person with the necessary qualifications and experience to undertake risk assessments, hydraulic studies or the design and construction of a levee.

**Watercourse:** refer to the *Water Act 2000* section 5.

**Vulnerability:** the degree of susceptibility of individual persons, the community and the environment to natural hazards, such as floods.

## Appendix B: References

- Australian Government, 2012. *Natural disasters and community resilience: A framework for support*.
- CIGB-ICOLD, 2012. *Internal erosion of existing dams, levees, and dikes, and their foundations -International Glossary*. CIGB-ICOLD Bulletin, (1), p.2–8
- CIRIA, 2013. *International Levee Handbook (ILH)*
- CIRIA/CUR/CETMEF, 2007. *The Rock Manual - The use of rock in hydraulic engineering* (2nd edition) Report C683, London: CIRIA
- DEFRA & Environment Agency, 2011. *Understanding the risks, empowering communities, building resilience - National flood and coastal erosion risk management strategy for England*
- Environment Agency, 1999. *Flood and Coastal Defence Project Appraisal Guidance – Economic Appraisal*.  
[archive.defra.gov.uk/environment/flooding/documents/policy/guidance/fcdpag/fcdpag3.pdf](http://archive.defra.gov.uk/environment/flooding/documents/policy/guidance/fcdpag/fcdpag3.pdf)
- Emergency Management Australia, 1999. *Emergency Management Practice Guide 3: Managing the Floodplain*
- Emergency Management Queensland (EMQ), 2012. *Queensland Local Disaster Management Guidelines – Disaster Management Act 2003*
- EurOtop, 2008. *Wave Overtopping of Sea Defences and Related Structures: Assessment Manual*. Environmental Agency (UK), Expertise Netwerk Waterkeren (NL), Kuratorium für Forschung im Küsteningenieurwesen (DE)
- Federal Emergency Management Agency (FEMA), USA, 2006. *National Flood Insurance Program (NFIP), Floodplain Management Requirements: A Study Guide and Desk Reference for Local Officials*
- Federal Emergency Management Agency FEMA, April 2004. *Federal Guidelines for Dam Safety Glossary of Terms*
- McCue, 1999. *Australian Seismological Report – 1999*
- McCue, year unknown. *Historical earthquakes in Queensland*
- McLuckie, et al, 2013. *Monitoring the conditions of levees to inform decision making*
- NEMC, 2009. *National Strategy for Disaster Resilience*
- NSW State Government, 2001. *Floodplain Management Manual*
- NSW State Government, 2005. *Floodplain Development Manual*
- Queensland Flood Commission of Inquiry (QFCoI) *Final Report*, March 2012
- Queensland State Government Department of Energy and Water Supply (DEWS), 2012. *Guidelines for Failure Impact Assessment of Water Dams*
- Queensland State Government Department of Natural Resources and Water, 2007. *Queensland Urban Drainage Manual*

Queensland State Government Department of State Development, Infrastructure and Planning, 2013a. *State Planning Policy*

Queensland State Government Department of State Development, Infrastructure and Planning, 2013b. *State Planning Policy: State interest—natural hazards: Guidance on flood, bushfire and landslide hazards*

Queensland State Government Queensland Reconstruction Authority, 2011. *Planning for stronger, more resilient floodplains*

SCARM, 2000. *Floodplain Management in Australia. Best Practice Principles and Guidelines* Report No 73, CSIRO Publishing, Collingwood, Victoria.

NFRAG, not yet available. *Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*

RWS (Office of Public Works), 2012. *Flood Risk and Water Management in the Netherlands* (A2012 update)

RWS (Office of Public Works), 2006. *Dutch Directive for Safety Assessment of flood defences (Voorschrift Veiligheid Toetsen (VTV))*

SEPA (Scottish Environment Protection Agency), 2010. *Technical Flood Risk Guidance for Stakeholders*, Version 6, 30 August 2012

Victoria State Government, Department of Natural Resources and Environment, 2002. *Levee Design, Construction & Maintenance*

## Appendix C: Activities excluded from the definition of levees

Activity	Definition	How activity is currently managed
1. Prescribed farming activities	<p>a. cultivating soil; or</p> <p style="text-align: center;"><i>Examples—</i></p> <p style="padding-left: 40px;">clearing, replanting and broadacre ploughing</p> <p>b. disturbing soil to establish non-indigenous grasses, legumes or forage cultivars; or</p> <p>c. using land for horticulture or viticulture; or</p> <p>d. laser levelling or contouring soil.</p> <p>Reference: Agricultural activities (including a, b and c but excluding d above) are defined in section 5 Dictionary of the <i>Wild Rivers Act 2005</i>.  <a href="https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WildRivA05.pdf">https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WildRivA05.pdf</a></p> <p>Common or dictionary definition applies to laser levelling.</p> <p>Ref: Agricultural use definitions in the Queensland Planning Provisions Version 3.0, Schedule 1 under the <i>Sustainable Planning Act 2009</i>.  <a href="http://www.dsdip.qld.gov.au/resources/policy/state-planning/qpp-3.pdf">http://www.dsdip.qld.gov.au/resources/policy/state-planning/qpp-3.pdf</a></p>	<ul style="list-style-type: none"> <li>Prescribed farming activities are managed as in accordance with best practice guidelines. For example- Strip cropping – see link <a href="http://www.regional.org.au/au/asa/1980/contributed/land-use/s4-06.htm">http://www.regional.org.au/au/asa/1980/contributed/land-use/s4-06.htm</a> and <a href="http://www.grazingbestprac.com.au/bestpractice/farmers/property-planning.html">http://www.grazingbestprac.com.au/bestpractice/farmers/property-planning.html</a><a href="http://www.dsdip.qld.gov.au/resources/policy/state-planning/qpp-3.pdf">http://www.dsdip.qld.gov.au/resources/policy/state-planning/qpp-3.pdf</a> Table 9.2.2.1</li> <li>Check with the relevant codes and best practices applicable in your Local Government area. Refer to the Planning Scheme of your Council for further details.</li> </ul>
2. Fill that is used in landscaping /visual amenity / acoustic screening.	<p>Fill is not considered as a levee, if it uses less than a volume of 50m<sup>3</sup> of fill material. Reference - Definition of a levee (<i>Water Act 2000</i>)</p>	<p>Cut and fill is often used to improve access, to provide useable outdoor spaces, to improve visual amenity and provide acoustic screening as in accordance with the best practice guidelines. For example' Landscape Design requirements for Education Queensland School grounds'.</p> <p><a href="http://deta.qld.gov.au/corporate/pdf/landscape-design-requirements-school-facilities-school-grounds.pdf">http://deta.qld.gov.au/corporate/pdf/landscape-design-requirements-school-facilities-school-grounds.pdf</a></p> <ul style="list-style-type: none"> <li>Check with the relevant codes and best practices applicable in your Local Government area. Refer to the Planning Scheme of your Council for further details.</li> </ul>
3. Infrastructure used to safeguard life and property from the threat of coastal hazards.	<p>The infrastructure used to safeguard life and property from the threat of coastal hazards within coastal management district, includes coastal protection structures like seawalls and groynes. Reference- Sections 54, 56 and Schedule (page 124) in <i>Coastal Protection and Management Act 1995</i>. Dictionary definition applies for seawalls and groynes.</p> <p><a href="https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/C/CoastalProtA95.pdf">https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/C/CoastalProtA95.pdf</a></p>	<p>The primary purpose of such infrastructure is to prevent bank or beach erosion.</p> <p>Such infrastructure is assessed under Prescribed Tidal Works Code for development applications as assessable development.</p> <p><a href="http://www.austlii.edu.au/au/legis/qld/consol_reg/cpamr2003400/sch4a.html">http://www.austlii.edu.au/au/legis/qld/consol_reg/cpamr2003400/sch4a.html</a></p> <p>State development assessment provisions Module 10.1-Tidal works, or development in a coastal management district code also applies here for the assessment of applications on such infrastructure construction.</p> <p><a href="http://www.dsdip.qld.gov.au/resources/template/sdap/module-10-1">www.dsdip.qld.gov.au/resources/template/sdap/module-10-1</a>.</p>
4. Structures	(1) Levees or levee like structures could be	The primary purpose of the constructed structures

Activity	Definition	How activity is currently managed
constructed for emergency work.	<p>constructed as emergency work by an applicant because of an emergency endangering:</p> <p>(i) the life or health of a person; or</p> <p>(ii) the structural safety of a building; or</p> <p>(iii) the operation or safety of community infrastructure that is not a building; and notify (written) the assessing authority as soon as practicable after starting the construction.</p> <p>Reference-Exemption for emergency development or use is defined in the section 584 of the <i>Sustainable Planning Act (SPA) 2009</i>.</p> <p>(2) However, above provisions do not apply if the applicant is required by an enforcement notice or order to stop carrying out the development or use.  <a href="https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/S/SustPlanA09.pdf">https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/S/SustPlanA09.pdf</a></p>	<p>(levees or levee-like) as emergency work is to protect life and property under emergency situations. Levees or levee like structures may be constructed as emergency work as in accordance with the best available engineering standards.</p> <p>An applicant undertaking an emergency development or use, would only be required to give written notice to the assessing authority as soon as practicable after starting the development or use (refer s.584(1)(b) of the SPA). An enforcement notice or order to stop carrying out the levee construction could be applied by the assessing authority, if a levee constructed under an emergency is not up to the engineering standards or non-complying with the code provisions.  <a href="https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/S/SustPlanA09.pdf">https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/S/SustPlanA09.pdf</a></p>
5. A structure constructed under <i>Soil Conservation Act 1986</i> (SC Act).	<p>Structures under the SC Act are designed for the purpose of controlling erosion. Structures include contour banks, diversion banks and waterways. Reference- Sections 10,11,14,15 and 17 of the <i>Soil Conservation Act 1986</i>.  <a href="https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/S/SoilConservA86.pdf">https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/S/SoilConservA86.pdf</a></p>	<p>A Property Plan details soil conservation works/measures required for an individual landholding. A Property Plan may be approved by delegated officers. A Project Plan consists of several properties within a defined catchment and co-ordinates runoff control works across land within a catchment including road/rail infrastructure. Chief Executive advertises a proposed project plan, review objections and make recommendations to the Governor-in-Council who then may approve the Plan. Appeal provisions are available for both Project and Property Plans.</p>
6. A structure whose design takes into account the impacts of flooding or flood mitigation but which is not primarily designed for flood mitigation such as public roads	<p>Roads and associated engineering structures designed and constructed under <i>Transport Infrastructure Act 1994</i> and Planning schemes of the local government.  <a href="https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/T/TranstInfA94.pdf">https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/T/TranstInfA94.pdf</a></p>	<p>The roads designed and constructed under <i>Transport Infrastructure Act 1994</i>, are being assessed under chapter 1 of the Department of Main Roads and Transport's Road Drainage Manual (RDM) for flood impacts.</p> <p>Council roads are assessed under the relevant codes (for example 'Stormwater Management Code', 'Waterway Code' and 'Filling and Excavation Code' in the City Plan 2000 of Brisbane City Council) of the Planning schemes, for flood impacts.</p> <p>The provisions of the Queensland Urban Drainage Manual (QUDM) are also being applied to assess the flood impacts of these roads.</p> <p>1. <a href="http://www.tmr.qld.gov.au/business-industry/Technical-standards-anpublications/Road-drainage-manual.aspx">http://www.tmr.qld.gov.au/business-industry/Technical-standards-anpublications/Road-drainage-manual.aspx</a></p> <p>2. <a href="http://www.dews.qld.gov.au/water-supply-regulations/urban-drainage">http://www.dews.qld.gov.au/water-supply-regulations/urban-drainage</a></p> <p>3. <a href="http://www.brisbane.qld.gov.au/planning-building/planning-guidelines-and-tools/city-plan-zones-codes/city-plan-2000-document/chapter-5-codes-and-related-provisions/index.htm">http://www.brisbane.qld.gov.au/planning-building/planning-guidelines-and-tools/city-plan-zones-codes/city-plan-2000-document/chapter-5-codes-and-related-provisions/index.htm</a></p>
7. Structure regulated under	Dams or levees relating to resources operations are regulated structures constructed as part of	A environmental impact statement (EIS) is required for a environmentally relevant activity. Generic Terms of

Activity	Definition	How activity is currently managed
<p><i>Environmental Protection Act 1994</i>(EP Act).</p>	<p>environmentally relevant activities. Protecting human life and the environment requires that the standards used for the design, construction, operation, modification and decommissioning of regulated structures mitigate the consequences arising from potential failure or collapse of those structures.</p> <p>Reference- s24 Schedule 3 of EP Act and Schedule 3A in the EP Regulations 2008.</p> <p><a href="https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/E/EnvProtR08.pdf">https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/E/EnvProtR08.pdf</a></p> <p>Notes: The term regulated structures includes land-based containment structures, levees, bunds and voids, but not a tank or container designed and constructed to an Australian Standard that deals with strength and structural integrity.</p> <p><a href="https://www.legislation.qld.gov.au/LEGISLTN/ACTS/1994/94AC062.pdf">https://www.legislation.qld.gov.au/LEGISLTN/ACTS/1994/94AC062.pdf</a></p>	<p>Reference for EIS provides for the description of current flood risk for a range of annual exceedance probabilities up to the probable maximum flood, for potentially affected waterways, and the assessment of (through flood modelling) how the project may potentially change flooding characteristics. The assessment should consider all infrastructure associated with the project including levees, roads and linear infrastructure and all proposed measures to avoid or minimise impacts. (Ref-section 8.6 of ToR).</p> <p>EIS lists and describe all dams or levees proposed on the project site and undertake an assessment to determine the hazard category of each dam or levee (low, significant, or high), according to the criteria in the EHP 'Manual for Assessing Hazard Categories and Hydraulic Performance of Dams'.</p> <p>Further, the potential risks to people and property that may be associated with the project in the form of a preliminary risk assessment for all components of the project under section 8.13 – 'Hazard and Safety' in the ToR of EIS.</p> <ol style="list-style-type: none"> <li><a href="http://www.ehp.qld.gov.au/land/mining/pdf/mn-mi-assess-haz-cat-hyd-perf-dams-em635.pdf">http://www.ehp.qld.gov.au/land/mining/pdf/mn-mi-assess-haz-cat-hyd-perf-dams-em635.pdf</a></li> <li><a href="http://www.ehp.qld.gov.au/licences-permits/compliance-codes/pdf/code-high-hazard-dams-with-hazardous-waste-em1698.pdf">http://www.ehp.qld.gov.au/licences-permits/compliance-codes/pdf/code-high-hazard-dams-with-hazardous-waste-em1698.pdf</a></li> <li><a href="http://www.ehp.qld.gov.au/land/mining/pdf/guide-structures-dams-levees-mining-em634.pdf">http://www.ehp.qld.gov.au/land/mining/pdf/guide-structures-dams-levees-mining-em634.pdf</a></li> <li><a href="http://www.ehp.qld.gov.au/management/impact-assessment/eis-processes/">http://www.ehp.qld.gov.au/management/impact-assessment/eis-processes/</a></li> </ol>
<p>8. Structures constructed within the bed, or across a bank of a water course under <i>Water Act 2000</i></p>	<p>Construction of weirs, barrages and dams across a water course that hinder or obstruct the flow of water in the watercourse.</p> <p>Reference - Section 204 of the <i>Water Act 2000</i>. <a href="https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WaterA00">https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WaterA00</a></p> <p>Notes: A watercourse is a river, creek or other stream, including a stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events (Ref: Chapter 1 Part 2). The bed and banks of the watercourse typically consist of bedrock and very coarse material, including boulders, cobbles and gravel (Water Regulation 2002 Schedule 1AA page 107). Dam is defined in the Schedule 4. Weir means a barrier constructed across a watercourse below the outer banks of the watercourse that hinders or obstructs the flow of water in the watercourse weir means a barrier constructed across a watercourse below the outer banks of the watercourse that hinders or obstructs the flow of water in the watercourse (Schedule 4).</p>	<p>The construction of weirs, barrages and dams are code assessed (Ref: State Development Assessment Provisions-Module 7-Water Resources , Table 7.1.2) under the provisions in the Schedule 3 Part 1 Table 4-Operational works item 3 of Sustainable Planning Regulations 2009 (SPA Reg) unless operations are mentioned as self-assessable development in a water resource plan or a wild river declaration. (Ref: Schedule 3, Part 2, Table 4-Operational work -item 1 in SPA Reg). For example -Code for self-assessable development of operational works that interfere with water in a watercourse, lake or spring - WAM/2008/3500.</p> <p><a href="http://www.dsdp.qld.gov.au/resources/policy/sdap/sdap-module-7.pdf">www.dsdp.qld.gov.au/resources/policy/sdap/sdap-module-7.pdf</a></p> <p><a href="https://www.legislation.qld.gov.au/LEGISLTN/.../S/SustPlanR09.pdf">https://www.legislation.qld.gov.au/LEGISLTN/.../S/SustPlanR09.pdf</a></p> <p><a href="http://www.nrm.qld.gov.au/about/policy/documents/.../wam_2008_3500.pdf">www.nrm.qld.gov.au/about/policy/documents/.../wam_2008_3500.pdf</a></p>
<p>9. Waterway</p>	<p>Waterway includes a river, creek, stream,</p>	<p>Operational work that is the construction or raising of</p>

Activity	Definition	How activity is currently managed
barrier works	<p>watercourse (as defined under Water Act 2000, schedule 4) or inlet of the sea. Waterway barrier works means a dam, weir or other barrier across a waterway if the barrier limits fish stock access and movement along a waterway .(Ref-<i>Fisheries Act 1994</i>)</p> <p><a href="https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/.../FisherA94">https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/.../FisherA94</a></p>	<p>waterway barrier works, other than operational work that is self-assessable development under part 2 Schedule 3 of SPA Reg or carried out on premises to which structure plan arrangements apply (SPA Reg schedule 3 Part1 table 4 –Operational work item 6) Codes for operational work for constructing or raising a waterway barrier works:</p> <p>Each of the following documents, prepared and held by the chief executive, is a code for IDAS for self-assessable development mentioned in the Planning Regulation, schedule 3, part 2, table 4, item 2—</p> <p>(a) the document called ‘Code for self-assessable development—Minor waterway barrier works’;</p> <p>(b) the document called ‘Code for self-assessable development—Temporary waterway barrier works’;</p> <p>(c) the document called ‘Code for self-assessable development—Regularly constructed temporary waterway barrier works’. (Ref :section 704-Fisheries Regulation 2008 Chapter 15 Other matters relating to fisheries management Part 3 Codes for IDAS)</p> <p><a href="https://www.legislation.qld.gov.au/LEGISLTN/.../S/SustPlanR09.pdf">https://www.legislation.qld.gov.au/LEGISLTN/.../S/SustPlanR09.pdf</a></p> <p><a href="https://www.legislation.qld.gov.au/.../F/FisherR08_03F_120921.pdf">https://www.legislation.qld.gov.au/.../F/FisherR08_03F_120921.pdf</a></p>
10. A structure constructed for long term storage of water	<p><i>Water Supply (Safety and Reliability) Act 2008</i> (WSA) provides for the regulation of referable dams constructed and maintained for the safety and reliability of water supply. Under section 341 of this Act:</p> <p>A dam is, or a proposed dam after its construction will be, a referable dam (dam is considered referable if it would threaten life if it failed.) if—</p> <p>(a) a failure impact assessment of the dam, or the proposed dam, is required to be carried out under this part; and</p> <p>(b) the assessment states the dam has, or the proposed dam after its construction will have, a category 1 or category2 failure impact rating; and</p> <p>(c) the chief executive has, under section 349, accepted the assessment</p> <p><a href="https://www.legislation.qld.gov.au/LEGISLTN/.../WaterSupSRA08.pdf">https://www.legislation.qld.gov.au/LEGISLTN/.../WaterSupSRA08.pdf</a></p>	<p>The failure assessment must be undertaken by a Registered Professional Engineer and is required for all dams exceeding the following criteria:</p> <ul style="list-style-type: none"> <li>• more than eight metres high, and</li> <li>• a storage capacity exceeding 500 megalitres</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• more than eight metres high, and</li> <li>• a storage capacity exceeding 250 megalitres, and</li> <li>• a catchment area which is more than three times the reservoir surface area at full supply level.</li> </ul> <p><a href="https://www.legislation.qld.gov.au/LEGISLTN/.../WaterSupSRA08.pdf">https://www.legislation.qld.gov.au/LEGISLTN/.../WaterSupSRA08.pdf</a></p>
11.Irrigation Infrastructure that is not levee-related infrastructure	<p>Irrigation infrastructure means water infrastructure or other infrastructure constructed, erected or installed for the supply of water or the storage, distribution and application of water for the irrigation of crops or pastures. Examples of irrigation infrastructure—</p> <p>a supply channel, head ditch or tail water drain</p>	<p>Irrigation infrastructure is managed at property level and the responsibility being on a landholder to carry out works and measures for flood mitigation.</p> <p>Guidelines for Ring Tank Storages- <a href="http://www.cottoncrc.org.au/files/33d5c040.../Ring_Tank_Guidelines.pdf">www.cottoncrc.org.au/files/33d5c040.../Ring_Tank_Guidelines.pdf</a></p> <p>In Queensland, licensing for the installation of irrigation</p>

Activity	Definition	How activity is currently managed
	<p><a href="https://www.legislation.qld.gov.au/Bills/54PDF/2013/LandWaterOLAB13.pdf">https://www.legislation.qld.gov.au/Bills/54PDF/2013/LandWaterOLAB13.pdf</a></p> <p>Irrigation channel means an artificial channel in which there is only water that is intended to be used for irrigation (Ref: Chemical Usage (Agricultural and Veterinary) Control Regulation 1999- Div 3 Sub Div 1 –Interpretation)</p> <p><a href="https://www.legislation.qld.gov.au/LEGISLTN/.../ChemUsAgVetR99.pdf">https://www.legislation.qld.gov.au/LEGISLTN/.../ChemUsAgVetR99.pdf</a><a href="https://www.legislation.qld.gov.au/LEGISLTN/.../ChemUsAgVetR99.pdf">https://www.legislation.qld.gov.au/LEGISLTN/.../ChemUsAgVetR99.pdf</a></p>	<p>is two-step process. The license is issued by the Builders Services Authority. Information on the licence can be found here.</p> <p><a href="http://www.qbcc.qld.gov.au/SiteCollectionDocuments/Builders_Contractors/Fact%20Sheets/Scopes%20of%20Work/Irrigation.pdf">http://www.qbcc.qld.gov.au/SiteCollectionDocuments/Builders_Contractors/Fact%20Sheets/Scopes%20of%20Work/Irrigation.pdf</a></p>



## Appendix D: Checklist for self-assessable levees

### D.1 Levee design

Design element	Details
Property size	
Total length	
Maximum height	
Width at top of levee	
Width at base of levee	
Estimated volume of fill (in m <sup>3</sup> )	
Fill material that is used to construct the levee	
Soil type on which the levee is constructed	
Type of levee (earthen, concrete, crib wall, other)	

### D.2 Levee location and configuration

D.2.1 Site map showing location and alignment of levee and identifiers (property boundary, watercourses, roads, other landmarks, address) and map series number and coordinates

D.2.2 The proximity of the levee to the following (distances should be measured from the point of the levee that is closest to the object or landmark):

Object or landmark	Distance (in metres)
Property boundary	
Watercourses, including rivers, lakes, wetlands and dams	
Occupied buildings on-property	
Occupied buildings off-property	
Urban or residential areas	
Community infrastructure	
Other levees and ringtanks	
Roads and other access infrastructure	
Other	

### **D.3 Details on levee design and potential impacts**

D.3.1 What are the known flood heights that are being used to set the levee height?

D.3.2 What is the flood protection height of the levee in relation to the known flood heights?

D.3.3 What is the size of the area to be protected by the levee?

D.3.4 What is the average slope of the property on which the levee is located?

D.3.5 What is the estimated volume of water that is being displaced during flood events?

D.3.6 What is the predicted flow path of floodwaters or overland flow when the flood height reaches the flood protection height of the levee?

D.3.7 What is the predicted flow path of floodwaters or overland flow when the levee is overtopped?

D.3.8 What is the estimated life of the levee and what are the maintenance requirements over the life of the levee?

## Appendix E: Example of a self-assessable levee

This example is provided as an illustration of a potential category 1 levee that is subject to self-assessment.

In this example the proponent has decided to look at protecting a small 2,000m<sup>2</sup> area of their 100 acre property using a levee. The height of the levee is to be an average of 1.5m, determined from historical flood events. In order to better understand how flood waters flow through the floodplain, the proponent downloaded Queensland Globe for Google Earth available at the Department of Natural Resources and Mines website [www.dnrm.qld.gov.au/mapping-data/queensland-globe](http://www.dnrm.qld.gov.au/mapping-data/queensland-globe) and turned on the Queensland Topographic Map layer. After navigating to their private rural lot, the proponent was then able to measure:

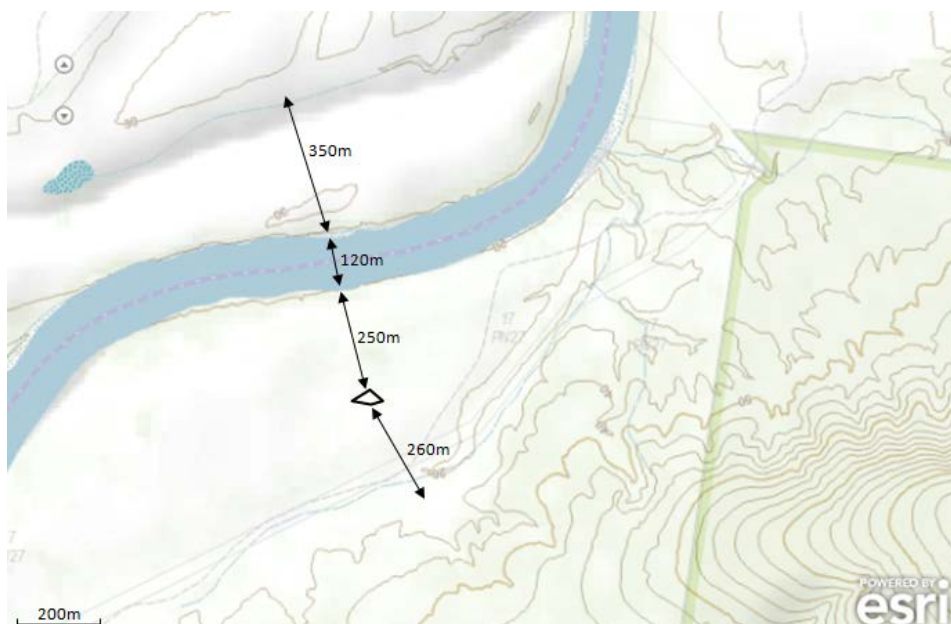
- The levee width *perpendicular to flow* of 50m and length in the *direction of flow* of 75m

As well as key floodplain widths (perpendicular to flow), including:

- The ground elevation where the levee is to be located is approximately 25m AHD
- The flood protection height of the levee is 26.5m AHD
- Distance of the main channel to the levee is 250m
- Distance from the levee to the floodplain boundary is 260m
- Main channel width is 120m
- Total floodplain width is  $350 + 120 + 250 + 260 + 50 = 1030\text{m}$

Note that for some of the above information, some intermediate contour lines had to be estimated/linearly interpolated. The proponent is also able to determine lengths from a physical survey of their property.

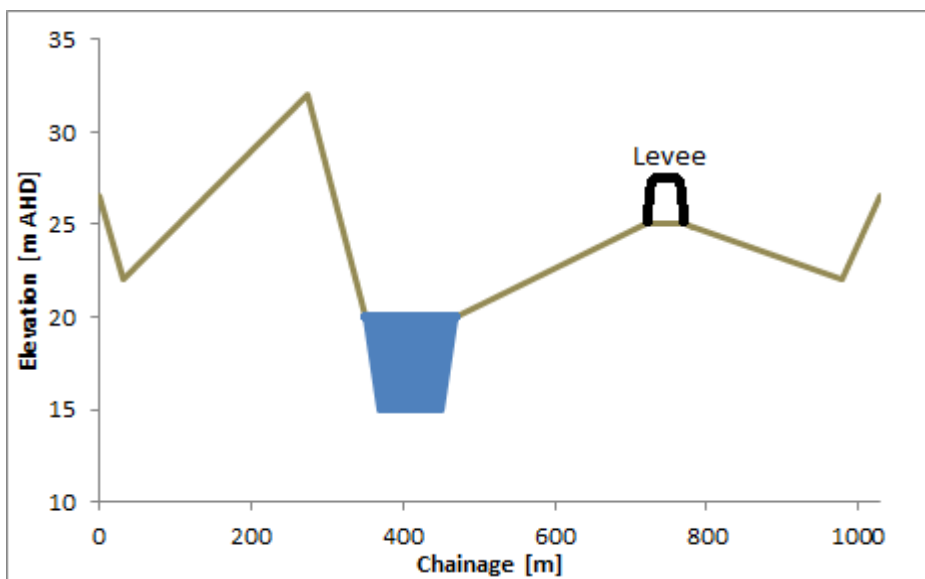
The following figure illustrates this information, where the river flows from left to right. The levee is located on the right overbank (looking downstream as is standard convention).



The proponent then calculates the percentage of the floodplain the levee design blocks as

$$\text{Floodplain blocked (\%)} = \frac{\text{Levee width}}{\text{Floodplain width}} \times 100\% = \frac{50}{1030} \times 100 \cong 5\%$$

This value is low, indicating that the levee does not significantly restrict flood waters. However this alone does not guarantee that the proposed design is category 1. The right overbank is relatively flat and wide, and so it may convey a large amount of flood flow. Ideally the levee should be located in a position where flow conveyance is minimal. The contours provide a rough guide in this respect—if they indicate a trench where water can flow, it is prudent to avoid this area. To look at this, the applicant plotted an approximate cross section using the topographic information above. This is done by measuring elevation information along the black dimension lines.



Note that the channel is shown for illustrative purposes only—it is not known from the input data.

Since the proponent is constructing the levee to protect their main dwellings, moving the levee to minimise impacts may not be an option.

The percentage of the floodplain behind the levee can be useful in this example because, generally, the further the levee is set back into the floodplain, the lesser its impact. This is especially true for floodplains that have elevation profiles that gradually rise from the channel to the edge of the floodplain, as approximately shown in this example. This is calculated as

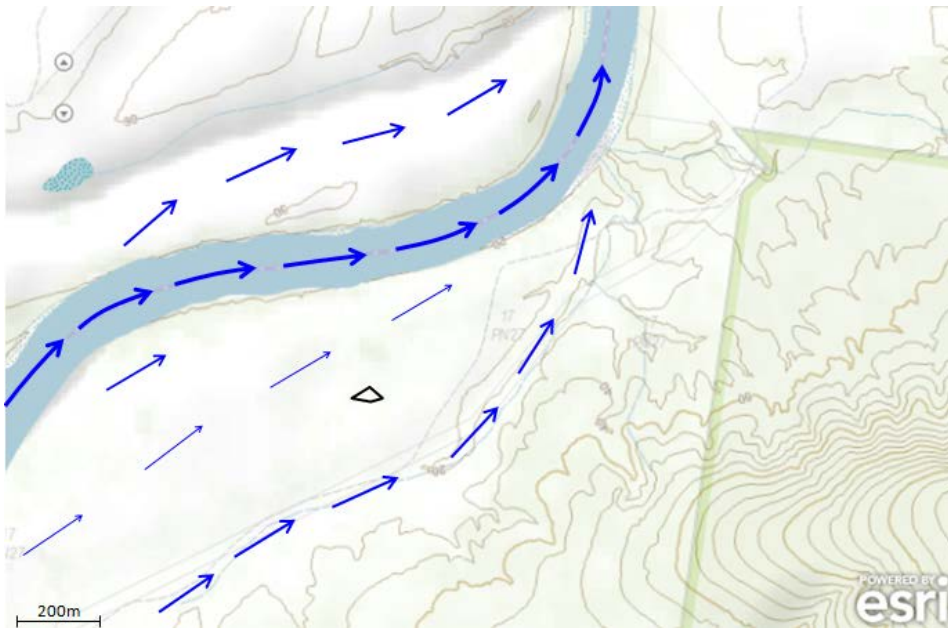
$$\text{Floodplain behind levee (\%)} = \frac{\text{Overbank width} - \text{Levee setback}}{\text{Overbank width}} \times 100\% = \frac{(250 + 50 + 260) - (250)}{(250 + 50 + 260)} \times 100$$

The lower the value for the above calculation, the better. While 55 per cent is high, coupled with the consideration of a low floodplain blocked, this design is likely to have no impact.

A further consideration is to look at the flood volume displaced. This is calculated as

$$\text{Flood volume displaced} = (\text{Levee plan area}) \times (\text{Levee height}) = (2000) \times (26.5 - 25) = 3000\text{m}^3$$

Theoretically the more volume displaced, the more water is forced through the remainder of the cross section, and so the greater the levee impact. A more sophisticated approach is to also consider how critical the protected area was to flow. If the levee was built in a channel, this is very important to flow, whereas if it was at a high water mark level, it may not be so important. Again with reference to the cross section, the levee is located on a small trough, and so it likely is not in a region of particular importance to flow conveyance. This is confirmed using the flow path diagram below, which indicated flow paths do not flow around the levee with a high velocity.



This example illustrates a design that will likely have no off-property impacts, especially considering the large 100 acre property size. Using the information above and considering other factors in line with section 4.2 of the guidelines, the proponent can reasonably assume that given the large size of the property and the relatively small size of the levee, the levee will not have any off-property impacts.

In this example, it can be reasonably assumed that the building of the level would not impact on:

- the flow of water where it enters and exits the property
- the velocity of flood flow beyond the boundaries of the property
- ponding beyond the boundaries of the property
- flood heights beyond the boundaries of the property.

## Appendix F: Default populations for occupied buildings<sup>1</sup>

Nature of buildings or other places of occupation	Equivalent population
Detached housing	2.9 per house
Semi-detached, row or terrace housing	2.0 per house
Multi-unit buildings	1.7 per unit
Blocks of flats	1.7 per flat
House or flat attached to a shop, office, etc.	2.5 per house or flat
Approved caravan parks	1.8 per caravan site
Approved camping grounds	0.45 per camping site
Hotel/motel accommodation	1.0 per bedroom
Child care centres	0.4 per child and staff member
Kindergartens, pre-schools	0.25 per student and staff member
Primary schools (day)	0.25 per student and staff member
High schools (day)	0.3 per student and staff member
Tertiary education centres	
Lectures—day	0.35 per student and staff member attending during the day
Lectures—evening	0.15 per student and staff member attending during the night
Offices	0.4 per employee
Restaurants	0.3 per member of staff and diners' places
Medical centres	1.7 per member of staff
Mines	Total of all personnel working in inundated area where the path to escape the inundation will be cutoff by the incoming flows.
Tavern/hotel bars	0.15 per m <sup>2</sup> of patrons' area
Shops, shopping centres	2.0 per 100 m <sup>2</sup> of gross area

<sup>1</sup> This is modified from the **Guidelines for Failure Impact Assessment of Water Dams**, Queensland Government Department of Energy and Water Supply, 2012

Hospitals	1.0 per bed plus 0.33 times the total number of staff
Institutional accommodation	1.0 per bed plus 0.33 times the total number of staff
Service stations	0.4 times the total number of staff
Industrial buildings and other non-residential sites	0.4 times the total number of staff