Retrofitting Your Home for Flood Resilience

James Davidson | JDA Co | 19 May 2021

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What is flood resilience?

Flood resilience is the ability to prepare for, live through and then return to normal household routines with the least amount of disruption and anxiety possible. Flood resilience will not stop flood waters. However, it aims to equip residents to make their properties more resilient, ensuring they recover quickly from flood events.

What is flood-resilient design?

Flood-resilient design is the use of materials, construction systems and design types that can withstand substantial and multiple inundations by actively mitigating the effects of, and minimising the cost of flooding. Flood-resilient design enables homeowners to safely store belongings prior to a flood event, easily clean and quickly move back in after such an event with minimal long-term disruption. By implementing flood-resilient design measures, home owners can actively mitigate or minimise the effects of flooding.

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TYPE OF DAMAGE SEEN DURING EAA ASSESSMENTS

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BUILDING ASSESSMENT REPORT 2011 No: 0024

Emergency Architects Australia architects are assisting homeowners to assess the building damage caused to their houses by the flood, in order to help them organise affordable and functional repairs.

The volunteer architects will look over the house with the owners, help the owners get a good understanding of the full extent of damage (both apparent and perhaps hidden), and discuss options and opportunities for the repair work. They will also indicate any areas of concern which might need further assessment by other tradespeople or professionals before repairs are undertaken.

Report of Apparent Damage

Date of Visit: **26/02/2011**
Building address: **Unit 6, 5 Spalding Court, Goodna**
Local Authority: **Ipswich council**
Owner's Name **Wayne McIntosh** Occupant's Name: **Wayne McIntosh**

Phone Contact: **0407 017 123** Email Contact: wmcintosh@hotmail.com
Occupancy Description: **3** Bedrooms # **1** Bathrooms # **1** Living Areas #
Insurance Details: **Body corporate covers structure - but this only covers bricks**
GPS Co-ordinates: **S 27° 36' 45.5'' E 152° 54' 02.4''**

1.0 TYPE OF BUILDING/CONSTRUCTION

1.1 Type: [ ] Housing [ ] Office [ ] Shop
[ ] Detached [x] Townhouse [ ] Apartment
1.2 Construction: [ ] Timber Clad [x] Brick Veneer [ ] Cavity Brick
[ ] Elevated Frame [x] Slab on ground [ ] Other
1.3 Number of storeys: **1**
1.4 Height of floors above ground:
1.5 Date/s of construction: **approx. 1995**
1.6 Heritage Status: [ ] Heritage Listed [ ] Character [x] None [ ] Unkown

2.0 FLOOD DAMAGE DATA

2.1 Height of flood above floor level: **3.6m**
2.2 Length of inundation: **4 days**
2.3 Date of initial inundation: **Very late 11/01/11**
2.4 Number of people displaced/evacuated during flood: age 0 to 5: ,age 6-17: , age 18 to 70: 2 ,age 70+:

	Yes	No	N/A	?
3.0 Building Clean-out Status				
3.1 Is the building clean of mud, silt and water?	x			
If No: We recommend a full secondary clean of all mud, silt and water. Make sure to check on tops of the building frame if possible (beams, trusses, posts, etc.)				
3.2 Has the building finished drying out?		x		
See **Summary of Recommendations** at end of document - subheading "internal linings/external cladding"				
3.3 Have possessions, furnishings, linings, joinery, etc. been removed?	x			
If No: All affected materials need to be removed. This includes: all kitchen and bathroom cabinetry. All plasterboard. All carpets,vinyl,etc. Underneath all linings needs to be thoroughly cleaned and then dried. This is to decrease the chance of mould once linings have been removed.				
4.0 Asbestos and lead paint				
4.1 Is the house built prior to 1990? If yes, it may have asbestos.		x		
4.2 Are there any potential signs of asbestos? If evident, advise owner to seek appropriate advice.		x		
If Yes: If you suspect asbestos is present do not cut, sand or displace any material sheeting. Contact an asbestos expert. 1300 QH INFO.				
4.3 Is there potential encapsulated non-visible asbestos lining (eg. under floor tiles)?		x		
If Yes: If you suspect asbestos is present do not cut, sand or displace any material sheeting. Contact an asbestos expert 1300 QH INFO.				
4.4 Recommend testing for lead paint?		x		
If Yes: Be aware there health risks related with lead paint. Avoid sanding and wear protective clothing and masks during clean up. Seek further advice if need be.				
Note: A person removing > 10m2 of asbestos must have an 'A' or 'B' class WHS license				
5.0 Structure				
5.1 Has the water visibly shifted the house structure?		x		
If Yes: A structural engineer will determine the extent of structural damage and advise as to the necessary initial step of securing the structure. Do not proceed in any renovation work until the engineer has cleared the building.				
5.2 Has there been visible subsidence or cracking in the sub-structure?		x		
If Yes: A structural engineer will determine the extent of sub-structural damage and advise as to the necessary initial step of securing the structure. Do not proceed in any renovation work until the engineer has cleared the building.				
5.3 Have floodwaters scoured out soil around footings/foundations (remove silt to see)?		x		
If Yes: An engineer will advise as to the necessary steps to secure the foundations.				
5.4 Are there any cracked or broken structural members?		x		
If Yes: An engineer will advise as to the necessary steps to repair the affected structure.				
5.5 Are there any affected laminated beams, or other composite members in the structure?	x			
LVL lintel above sliding glass door to patio. We recommend structural engineer look at the LVL in one or two townhouses in the development and advise whether all the LVLs are ok (see summary of recommendations) - since all townhouses have the same lintel and were inundated for the same amount of time				
5.6 Are all flooring members adequately seated and beared? Including sub-structure?	x			
If No: An engineer will advise as to the necessary steps to secure floor framing				
5.7 Did water inundate areas of steel posts?		x		
If Yes: Posts may have filled with water from holes in the top. If necessary drill a very small hole at base of the post to allow water to escape.				
5.8 Did water inundate areas of steel framing?			x	
If Yes: Make sure that all steel is clean and dry from water and silt.				
5.9 Are there any structural brick walls affected?	x			
If Yes: Brick cavities and cores may have filled with water. If possible check if water has flowed into cavities through gaps in the top or vents in the side. Take note to advise future builder and engineer.				

Hmmm... traditions developed here in Queensland versus those which evolved elsewhere.

I know which I prefer...

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Recommendation: Bracing & Tie-down

emergency architects australia

Units at 5 Spalding Crescent – Summary of Recommendations:

Note – this section begins with a compiled summary of recommendations relevant to **all** the townhouses inspected at 5 Spalding Crescent. Notes of additional concerns specific to your unit (if any) are at the end.

Cleaning:
- Give the stripped-out interior a further clean: concentrating especially on the structural members above ceiling level. Use a cloth with water and some kind of disinfectant (e.g. chlorine)
- Treat with a mouldicide product afterwards.
- Clean out under and on top of the edge of the damp-proof coursing at the bottom of the exterior walls (see photo on page 8).

Additional (Optional) Suggestion:
- Remove soffits at eaves and clean out.

Structural:
- All home-owners in complex could get together and seek an engineer to inspect one of each type of townhouse (end, middle) for the same 3 issues: 1) checking the LVL lintel above the sliding glass door onto the back patio; 2) all bracing ply and tie-downs (or lack of); 3) any cracks in the concrete blockwork party walls between units.
- All bracing ply to be replaced (unless otherwise stated by engineer).Remove existing ply where possible and clean behind.

Potential Option for Replacement: fix metal straps with triple grips to the top and bottom of studs around doors and windows; AND fix new bracing ply sheets to studs on the interior face of stud wall where the existing bracing ply sits (see photo on page 9). Removal of existing ply sheets before doing so optional: preferable as it allows cleaning out of any muck behind. Consult engineer also.

Roof:
- On visual inspection from the ground, roof seems to be in a reasonable condition.
- Roof structure seems to be intact and has not shifted which is positive.
- Clear all gutters of mud and debris.
- Fix/replace all damaged downpipes. Reseal downpipes at the top where they meet the gutter.
- Replace roof insulation: Install batt insulation above ceiling. Run Sarking (foil lined waterproofing membrane) between trusses and drain to eaves where possible.
-Have roof inspected by licenced roofing contractor. Replace broken tiles/repoint where necessary

Additional (Optional) Suggestion:
In the cleaning section, we have recommended the removal of all eaves soffits for cleaning. When these are replaced/re-instated, place some perforated panels/grilles in the eaves to help ventilate the cavity and prevent growth of mould etc. Also,replacing some of the bricks in the external walls (non-structural) with air bricks will assist in ventilating the wall cavity. This will help prevent growth of mould etc in the cavity and help in preventing odours produced by any mud in the cavity.

Party wall (structural concrete block wall between units):
-Have any cracks in this wall checked by a structural engineer
- Party walls should be fireproof, but currently are not. Seal any penetrations in the wall (i.e. hole where a power socket to both units either side of the wall existed). One option is to fill the penetrations with a fire-retardant, expanding foam product. Another option, if the power points are to be kept, is to seek advice from a licensed electrician.
- Where it had been inundated by water, replace the layer of fire-insulation ('Firestop' or a similar product)located where the party wall meets the roof

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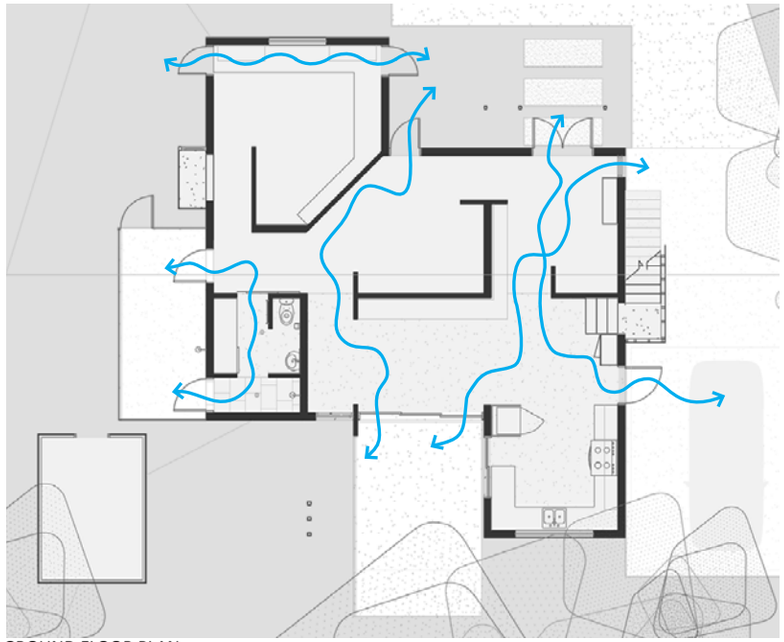

GROUND FLOOR PLAN

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SECTION

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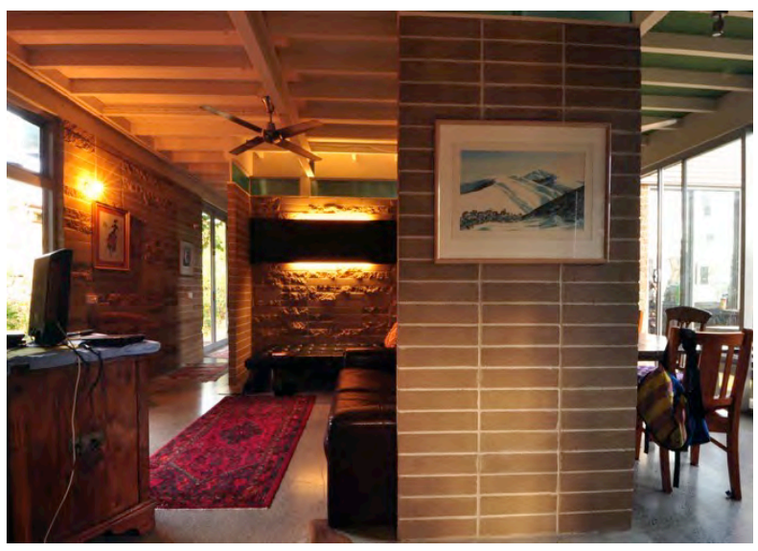

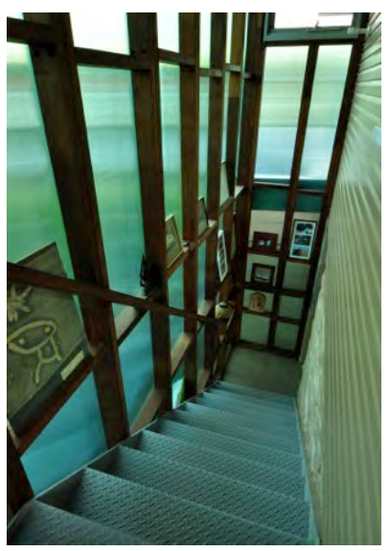

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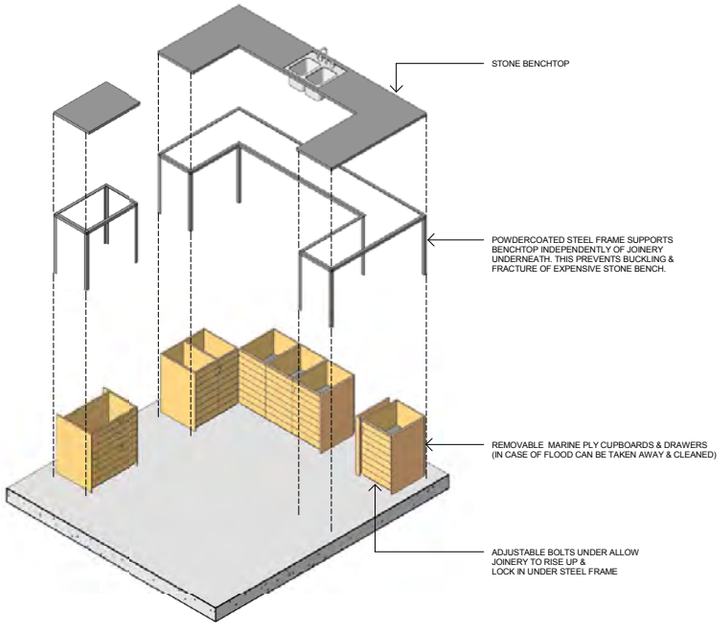

KITCHEN DETAIL

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COMPLETED KITCHEN

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BEFORE RAISE

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AFTER RAISE

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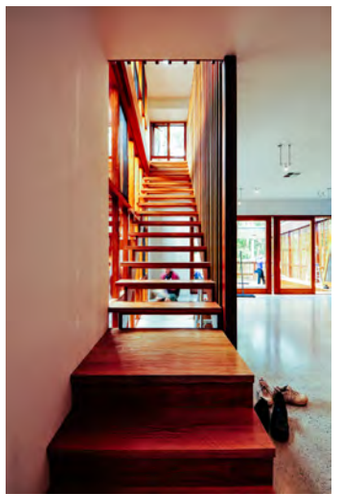

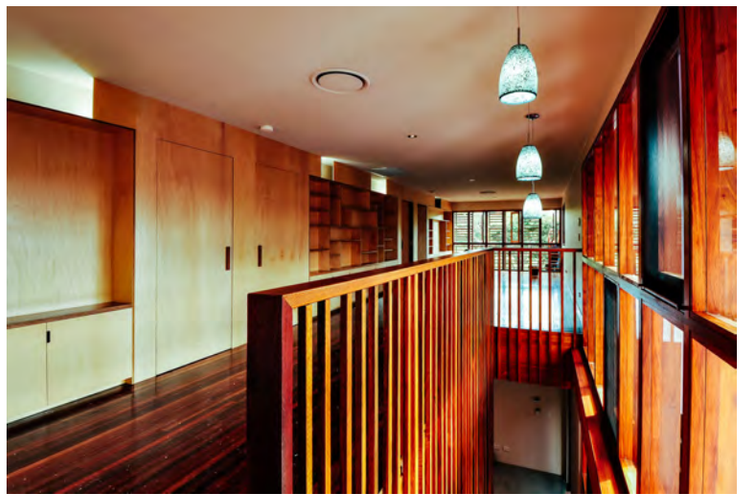

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Brisbane City Council

FloodWise Property Report

Report Reference
1500171
15/02/2011 13:08:14

Dedicated to a better Brisbane

The FloodWise Property Report is a free report to inform Brisbane residents and professionals about flood risks for a specified lot or property so they may better prepare for flooding and to plan and build in accordance with Council requirements.

To find out more about how the contents of this report may affect your ability to build or renovate, as well as Council advice on how to protect your property and family by being FloodWise, visit www.brisbane.qld.gov.au, a Customer Service Centre or call (07) 3403 8888.

PROPERTY DETAILS:

Address: 203 GRACEVILLE AVE GRACEVILLE QLD 4075
Lot Details: L.106/RP.29418

FLOOD LEVEL INFORMATION

Flood Levels
The blue bars in the graph above show the height of flooding estimated to occur on average once every 5, 20, 50 and 100 years at this address or lot.

Ground Levels (Min - Max)
The line above shows this property's lowest and highest ground levels. Confirm with a surveyor.

Minimum Habitable Floor Level
The dotted line in the graph above depicts the minimum height above sea level that habitable areas of development must be constructed to, i.e. lounge, kitchen or bedroom.

For a detailed summary of anticipated flood levels and flags see technical summary over page.

HIGHEST SOURCE OF FLOODING

RIVER The highest source of flooding affecting this property originates from a river. For more information about flooding in your area you can view and download Council's Flood Flag Maps by visiting www.brisbane.qld.gov.au/floodmap

Reactionary Reponses – Local Government Temporary Local Planning Instruments

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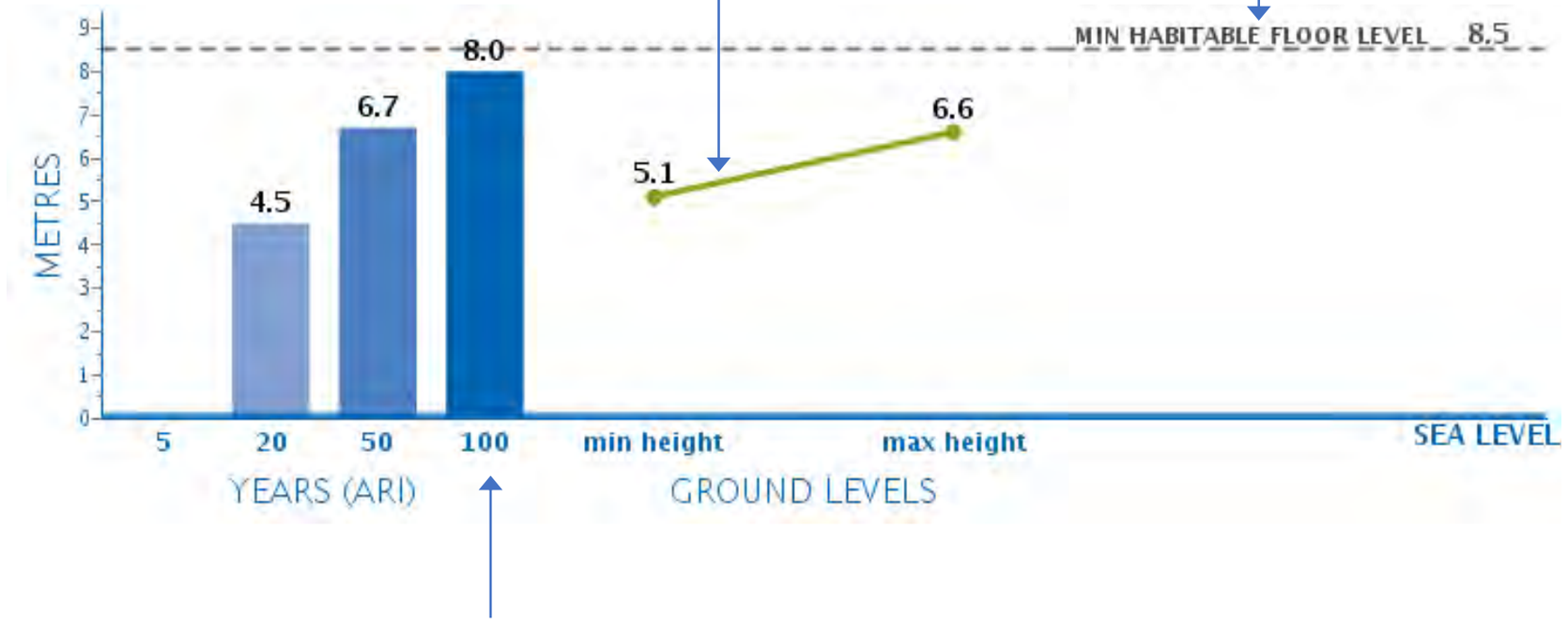
Ground levels on site

Prescribed flood datum by Council

FLOOD LEVEL INFORMATION



Q100 line, which indicates a 1in100 chance of annual flooding

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Graceville Ave – 2011 inundation levels including neighbouring houses

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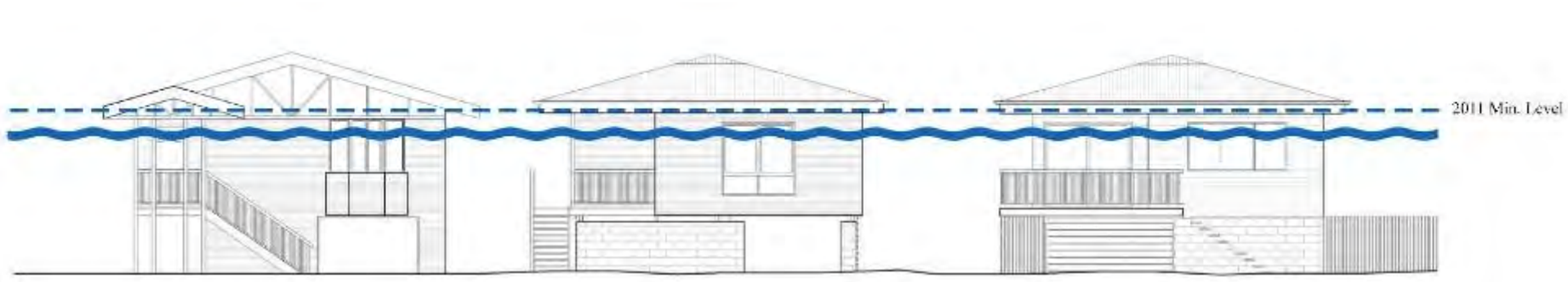

Post-flood Local Government established datums for minimum habitable floor levels

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Elevation as protection against inundation - Graceville Avenue case study after raise

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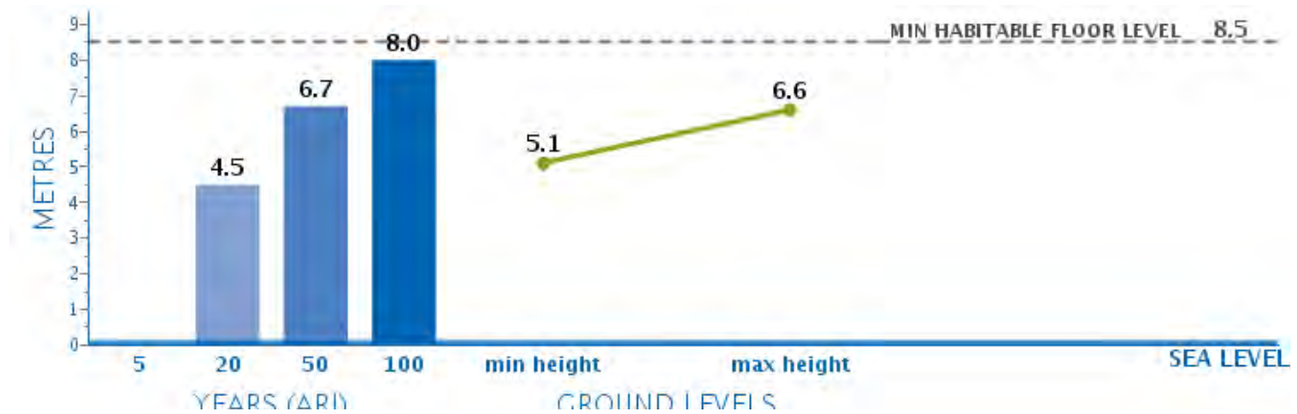
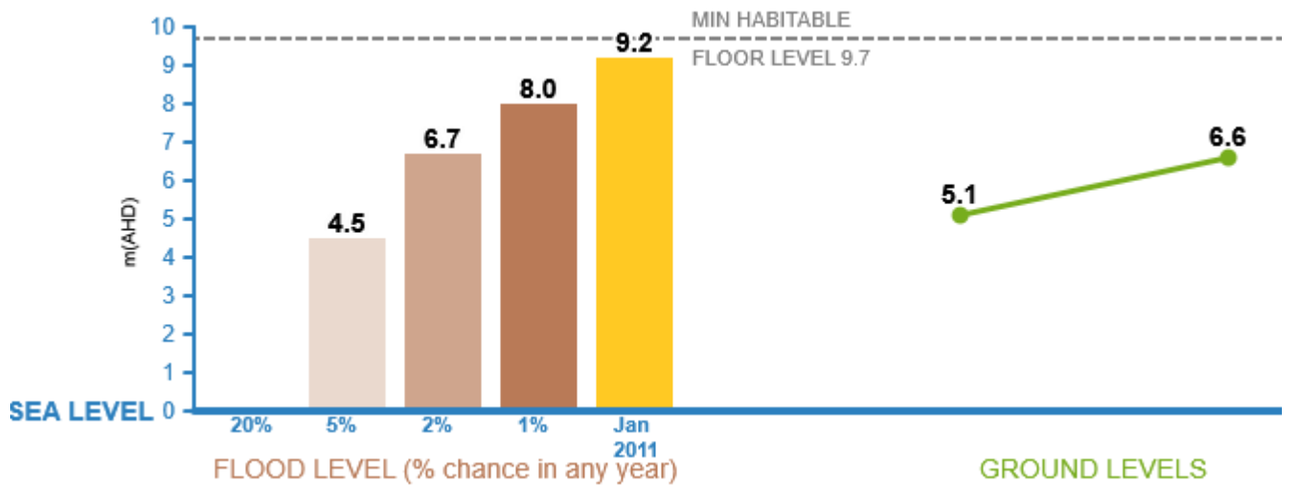
2011

FLOOD LEVEL INFORMATION



2015

FLOOD LEVEL INFORMATION



Reactionary planning at its finest – Shifting Datum Levels
What are homeowners to do?

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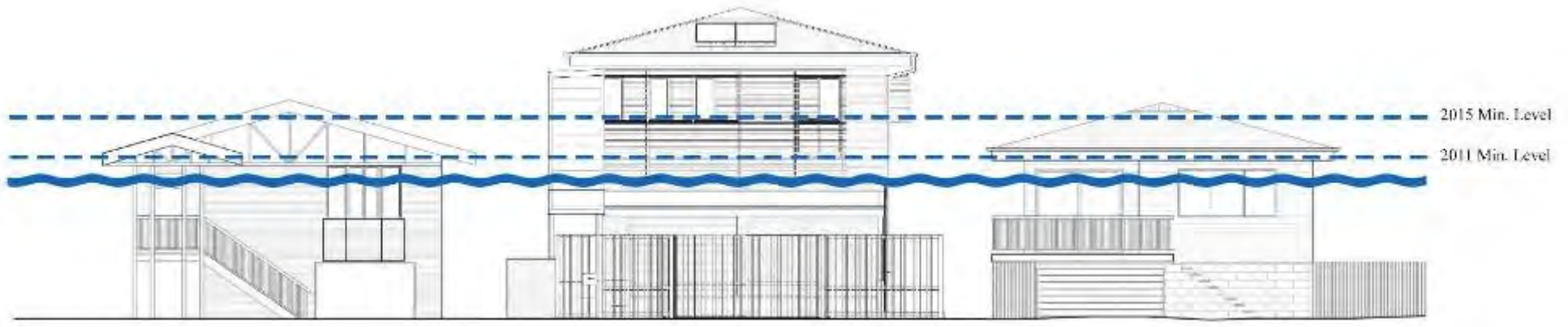

Shifting datum levels – what was the point of the line in the first place?

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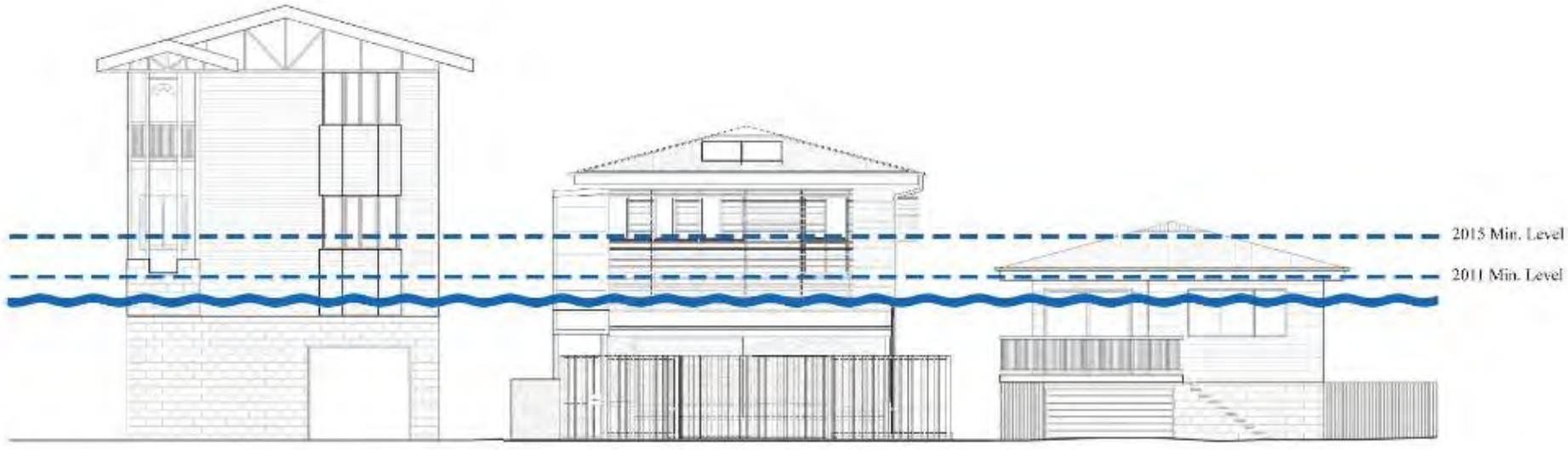

How high do we go???

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SEQ Water Futures Design Charrette

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INTERNATIONAL WATERCENTRE

PIB
Rijksdienst voor Ondernemend Nederland

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seqwater
WATER FOR LIFE

Deltares
Enabling Delta Life

bosch slabbers
LANDSCAPE + URBAN DESIGN

FLOOD community of practice

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

school of architecture

CRC for
Water Sensitive Cities

SUNCORP
Insurance

Washington University in St. Louis

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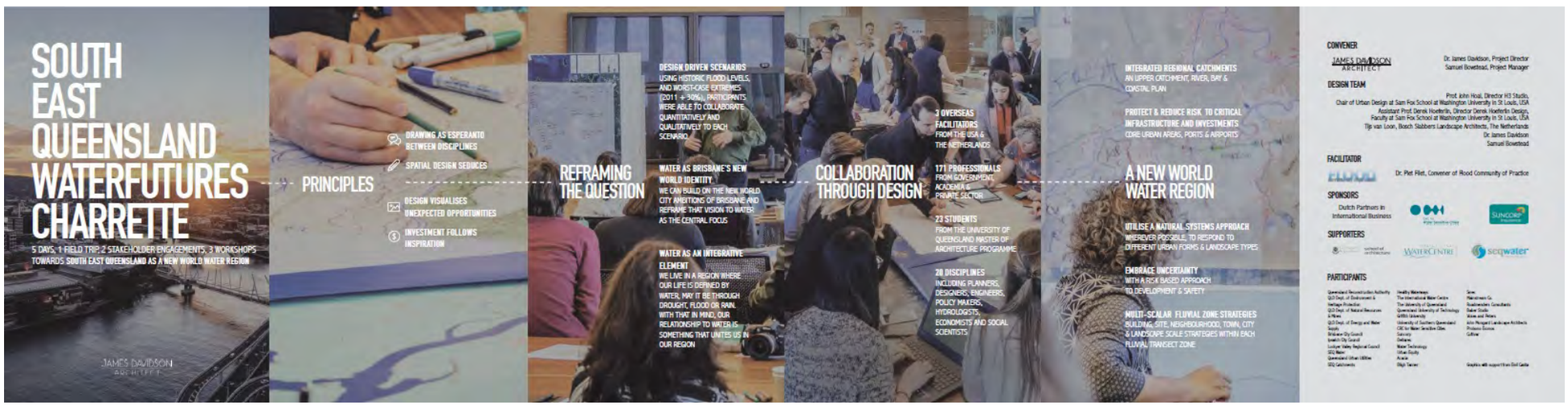
SOUTH EAST QUEENSLAND WATERFUTURES CHARRETTE
5 DAYS, 1 FIELD TRIP, 2 STAKEHOLDER ENGAGEMENTS, 3 WORKSHOPS TOWARDS SOUTH EAST QUEENSLAND AS A NEW WORLD WATER REGION
JAMES DAVIDSON ARCHITECT
PRINCIPLES
DRAWING AS ESPERANTO BETWEEN DISCIPLINES
SPATIAL DESIGN SEDUCES
DESIGN VISUALISES UNEXPECTED OPPORTUNITIES
INVESTMENT FOLLOWS INSPIRATION
REFRAMING THE QUESTION
DESIGN DRIVEN SCENARIOS
USING HISTORIC FLOOD LEVELS, AND WORST-CASE EXTREMES (2011 +30%), PARTICIPANTS WERE ABLE TO COLLABORATE QUANTITATIVELY AND QUALITITIVELY TO EACH SCENARIO
WATER AS BRISBANE'S NEW WORLD IDENTITY
WE CAN BUILD ON THE NEW WORLD CITY AMBITIONS OF BRISBANE AND REFRAME THAT VISION TO WATER AS THE CENTRAL FOCUS
WATER AS AN INTEGRATIVE ELEMENT
WE LIVE IN A REGION WHERE OUR LIFE IS DEFINED BY WATER, MAY IT BE THROUGH DROUGHT, FLOOD OR RAIN. WITH THAT IN MIND, OUR RELATIONSHIP TO WATER IS SOMETHING THAT UNITES US IN OUR REGION
COLLABORATION THROUGH DESIGN
3 OVERSEAS FACILITATORS FROM THE USA & THE NETHERLANDS
171 PROFESSIONALS FROM GOVERNMENT, ACADEMIA & PRIVATE SECTOR
23 STUDENTS FROM THE UNIVERSITY OF QUEENSLAND MASTER OF ARCHITECTURE PROGRAMME
28 DISCIPLINES INCLUDING PLANNERS, DESIGNERS, ENGINEERS, POLICY MAKERS, HYDROLOGISTS, ECONOMISTS AND SOCIAL SCIENTISTS
A NEW WORLD WATER REGION
INTEGRATED REGIONAL CATCHMENTS
AN UPPER CATCHMENT, RIVER, BAY & COASTAL PLAN
PROTECT & REDUCE RISK TO CRITICAL INFRASTRUCTURE AND INVESTMENTS
CORE URBAN AREAS, PORTS & AIRPORTS
UTILISE A NATURAL SYSTEMS APPROACH
WHEREVER POSSIBLE, TO RESPOND TO DIFFERENT URBAN FORMS & LANDSCAPE TYPES
EMBRACE UNCERTAINTY
WITH A RISK BASED APPROACH TO DEVELOPMENT & SAFETY
MULTI-SCALAR FLUVIAL ZONE STRATEGIES
BUILDING, SITE, NEIGHBOURHOOD, TOWN, CITY & LANDSCAPE SCALE STRATEGIES WITHIN EACH FLUVIAL TRANSECT ZONE
CONVENER
JAMES DAVIDSON ARCHITECT
Dr. James Davidson, Project Director
Samuel Bowstead, Project Manager
DESIGN TEAM
Prof. John Hoal, Director H3 Studio,
Chair of Urban Design at Sam Fox School at Washington University in St Louis, USA
Assistant Prof. Derek Hoeferlin, Director Derek Hoeferlin Design,
Faculty at Sam Fox School at Washington University in St Louis, USA
Tije van Loon, Boach Stabbers Landscape Architects, The Netherlands
Dr. James Davidson
Samuel Bowstead
FACILITATOR
Dr. Piet Filet, Convener of Rood Community of Practice
SPONSORS
Dutch Partners in International Business
SUNCORP
SUPPORTERS
WATERCENTRE
seqwater
PARTICIPANTS

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WATER FUTURES
INTEGRATED WATER AND FLOOD MANAGEMENT STRATEGIES FOR ENHANCING LIVEABILITY IN SOUTH EAST QUEENSLAND
JAMES DAVIDSON ARCHITECT

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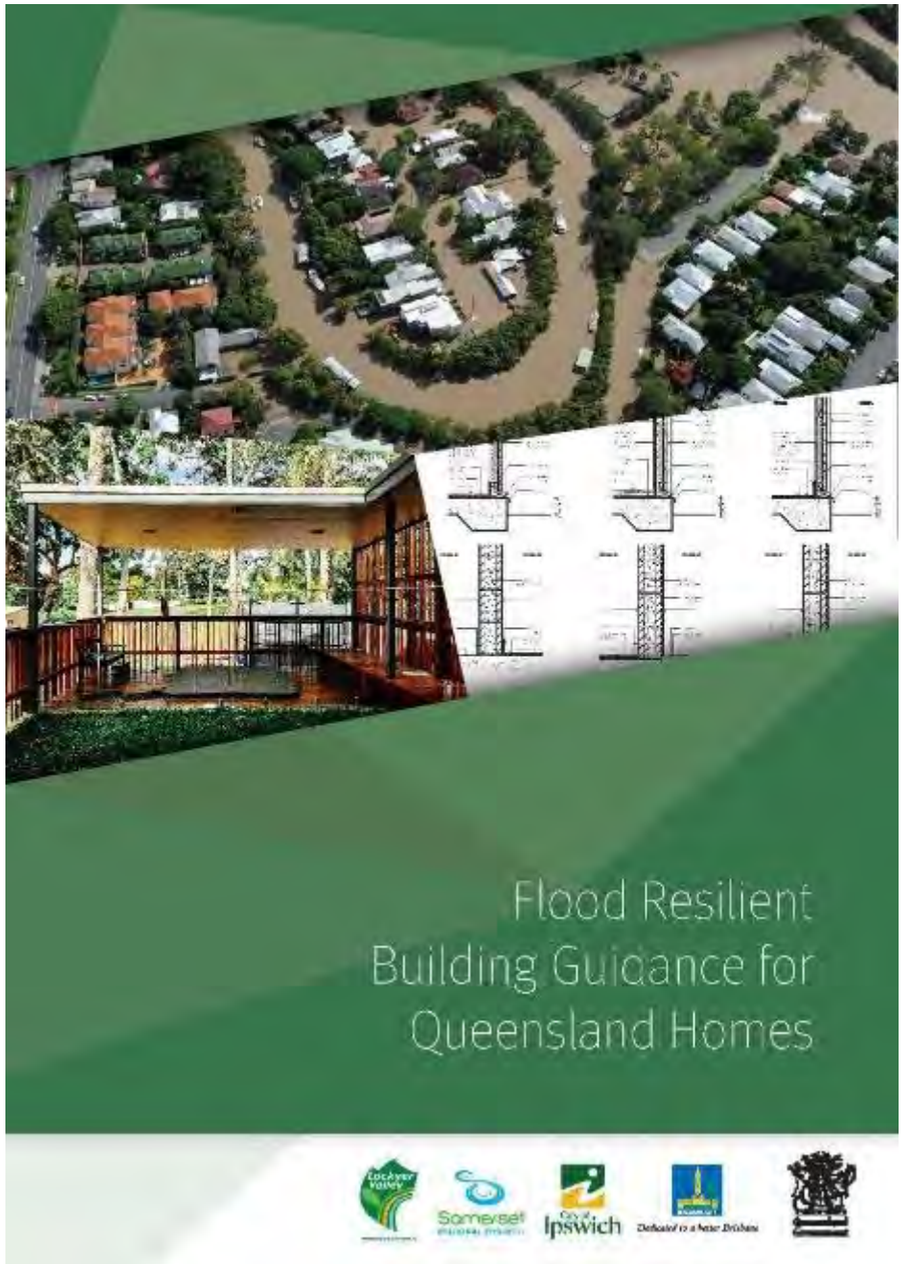
Flood Resilient
Building Guidance for
Queensland Homes
Somerset
Ipswich

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Part 2 - Flood resilient strategies

Sectional perspectives

The following sectional perspectives illustrate a variety of different resilience strategies applicable to common building typologies in Queensland, both historic and contemporary. The typologies are classified into New and Retrofit categories. The water levels shown in these diagrams indicate a hypothetical flood event.[5]

Sectional perspective 1
New home
Lightweight | VJ Board

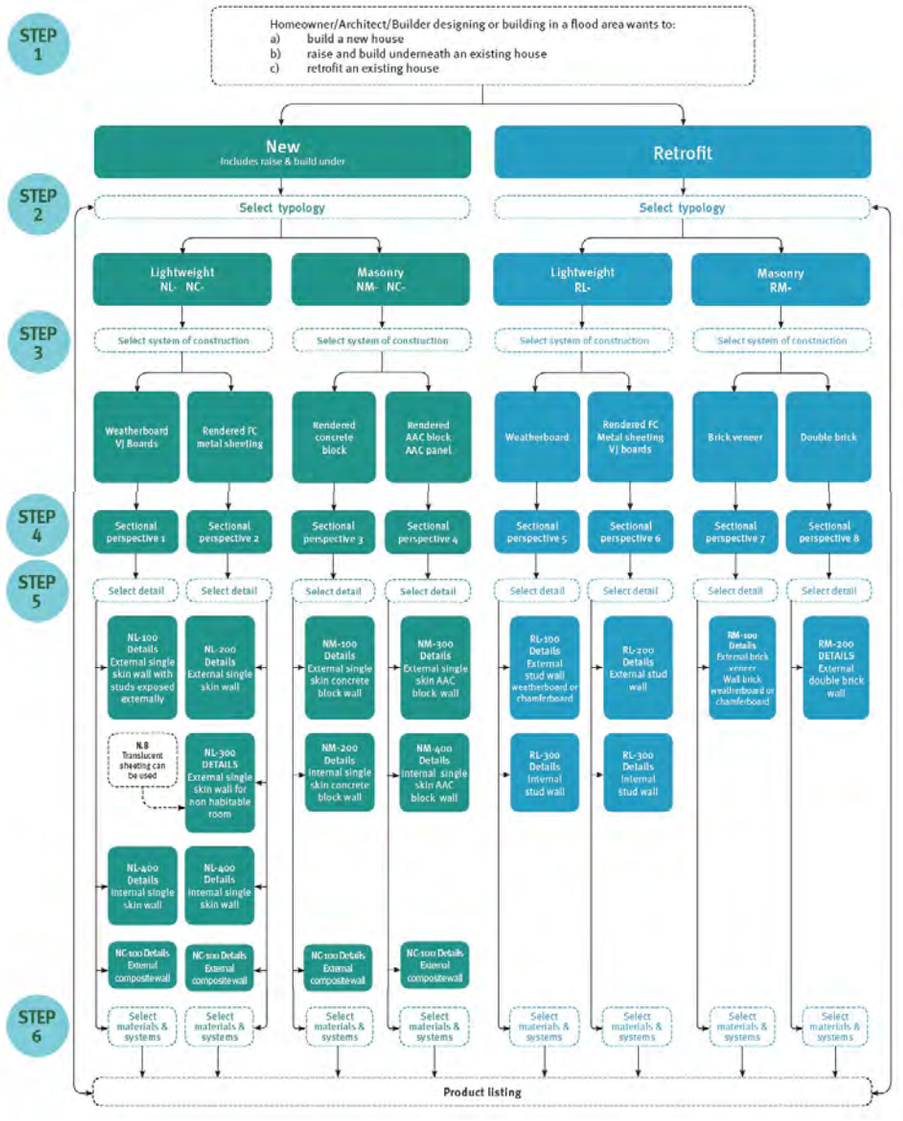
Sectional perspective 2
New home
Lightweight | Rendered FC

Sectional perspective 3
New home
Masonry | Rendered Concrete Block

Sectional perspective 4
New home
Masonry | Rendered AAC Block

[5] The Requirements of the Queensland Development Code must be met with respect to elevation of the finished floor level.

Figure 1. User guide flowchart



QRA Flood Resilient Building Guidance for Queensland Homes

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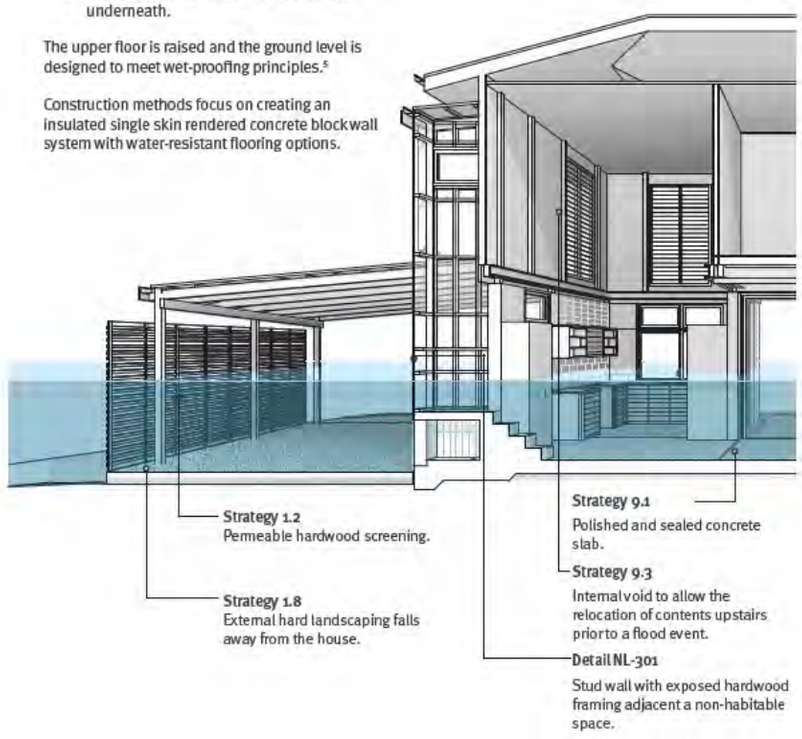
Sectional perspective 3

The design strategies, materials and associated construction details contained in this building type are relevant for:

- new construction
- raising an existing house and building underneath.

The upper floor is raised and the ground level is designed to meet wet-proofing principles.[5]

Construction methods focus on creating an insulated single skin rendered concrete blockwall system with water-resistant flooring options.



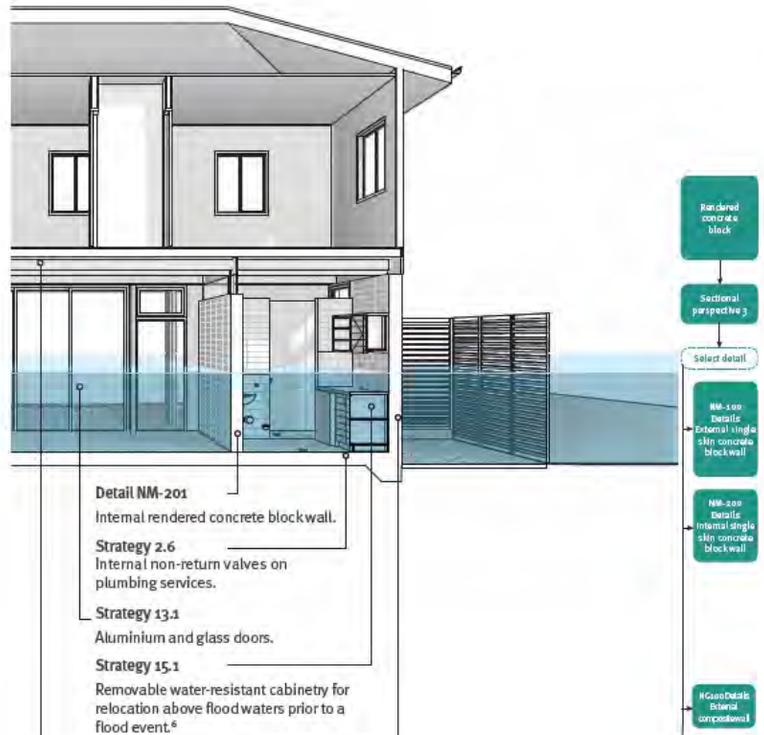
Strategy 1.2
Permeable hardwood screening.

Strategy 1.8
External hard landscaping falls away from the house.

Strategy 9.1
Polished and sealed concrete slab.

Strategy 9.3
Internal void to allow the relocation of contents upstairs prior to a flood event.

Detail NL-301
Stud wall with exposed hardwood framing adjacent a non-habitable space.



Detail NM-201
Internal rendered concrete blockwall.

Strategy 2.6
Internal non-return valves on plumbing services.

Strategy 13.1
Aluminium and glass doors.

Strategy 15.1
Removable water-resistant cabinetry for relocation above flood waters prior to a flood event.[6]

Detail NM-101
External rendered concrete block wall.

Strategy 9.2
No ceiling linings to steel or hardwood structure (depending on flood heights).

New

Masonry | Rendered Concrete Block

QRA Flood Resilient Building Guidance for Queensland Homes

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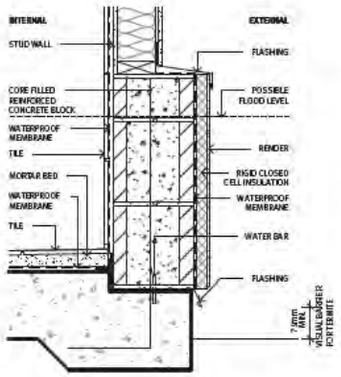
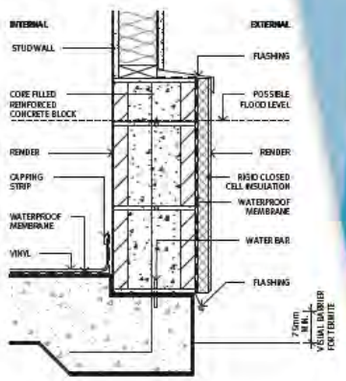


TYPOLOGY:	COMPOSITE - LIGHTWEIGHT/MASONRY
WALL TYPE:	EXTERNAL | CONCRETE BLOCK AND STUD WALL
FLOOR FINISH:	CONCRETE FLOOR FINISH
R-VALUE:	1.63
CODE:	NC-103
Structure:	Core filled reinforced concrete block to above flood level. Standard stud wall construction on top of blockwork.
Insulation:	Rigid closed cell insulation
External lining:	Render
Internal lining:	Tile + waterproof membrane to above flood level
Skirting:	N/A
Floor finish:	Tile + bedding + waterproof membrane



TYPOLOGY:	COMPOSITE - LIGHTWEIGHT/MASONRY
WALL TYPE:	EXTERNAL | CONCRETE BLOCK AND STUD WALL
FLOOR FINISH:	CONCRETE FLOOR FINISH
R-VALUE:	1.6
CODE:	NC-104
Structure:	Core filled reinforced concrete block to above flood level. Standard stud wall construction on top of blockwork.
Insulation:	Rigid closed cell insulation
External lining:	Render
Internal lining:	Render
Skirting:	Coved vinyl or other water resistant skirting
Floor finish:	Vinyl + waterproof membrane

NC-103
External | composite wall
Tile floor finish | wet area

NC-104
External | composite wall
Vinyl floor finish

New
Lightweight + Masonry | Composite Wall

Strategy reference	Flood resilient strategy	Diagram
9	**Internal floors and ceilings**	
9.1	**Install water-resistant flooring** ⓘ Refer to the **Flood resilient materials table and product listing.**	
9.2	**Design ceilings without linings and cavities** ⊕ ⓘ This strategy is only recommended where flood waters reach ceiling height. Ceilings under roofs are typically used as diaphragms for horizontal loading. If removed, an alternative mechanism may be required.	
9.3	**Design internal voids and elevated storage spaces** ⓘ Internal voids and elevated storage spaces above the possible flood line can be used to relocate house contents out of the way of waters before a flood. Spaces intended for such use need to be designed for appropriate imposed loads.	
10	**Internal walls**	
10.1	**Install water-resistant linings** ⓘ Refer to the **Flood resilient materials table and product listing.**	
11	**Wet areas**	
11.1	**Avoid baths with low height cavity walls** ⓘ Alternatives are: • free standing baths that can be cleaned underneath • showers	
12	**Internal stairs**	
12.1	**Design without cavities under stairs** ⓘ To enable post-flood clean-out, the following strategies may be appropriate: • remove all cavities under stairs that are below the possible flood line and replace with open bolt-fixed removable treads made of water-resistant materials • replace the existing stair with a solid concrete stair below the possible flood line. Refer to the **Flood resilient materials table and product listing.**	

QRA Flood Resilient Building Guidance for Queensland Homes

JDA

Flood Resilient Homes Program

An initiative of

Dedicated to a better Brisbane

In partnership with

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Brisbane City Council's Sustainability Agency

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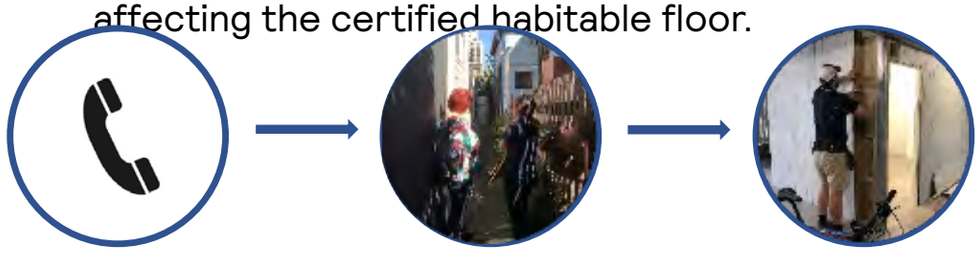
The Flood Resilient Homes Program

- The Flood Resilient Homes Program is an initiative of Brisbane City Council, delivered in partnership with its sustainability agency CitySmart. The program is designed to help residents prepare for, and recover from, overland flow flood events.

- The Flood Resilient Homes Program consists of a:
- • Home Service – a free in-home assessment of your property's flood-resilience
- • Home Service Resident's Report – a tailored property report providing flood-resilience information and
- recommendations for you and your property
- • Incentive Scheme – in eligible cases, providing financial assistance for property modifications.

- A voluntary home purchase will only be considered where there is no viable alternative. Council may consider, but is not obligated, to purchase flood-affected homes. The property must have a 50% annual chance of overland flow adversely affecting the certified habitable floor.



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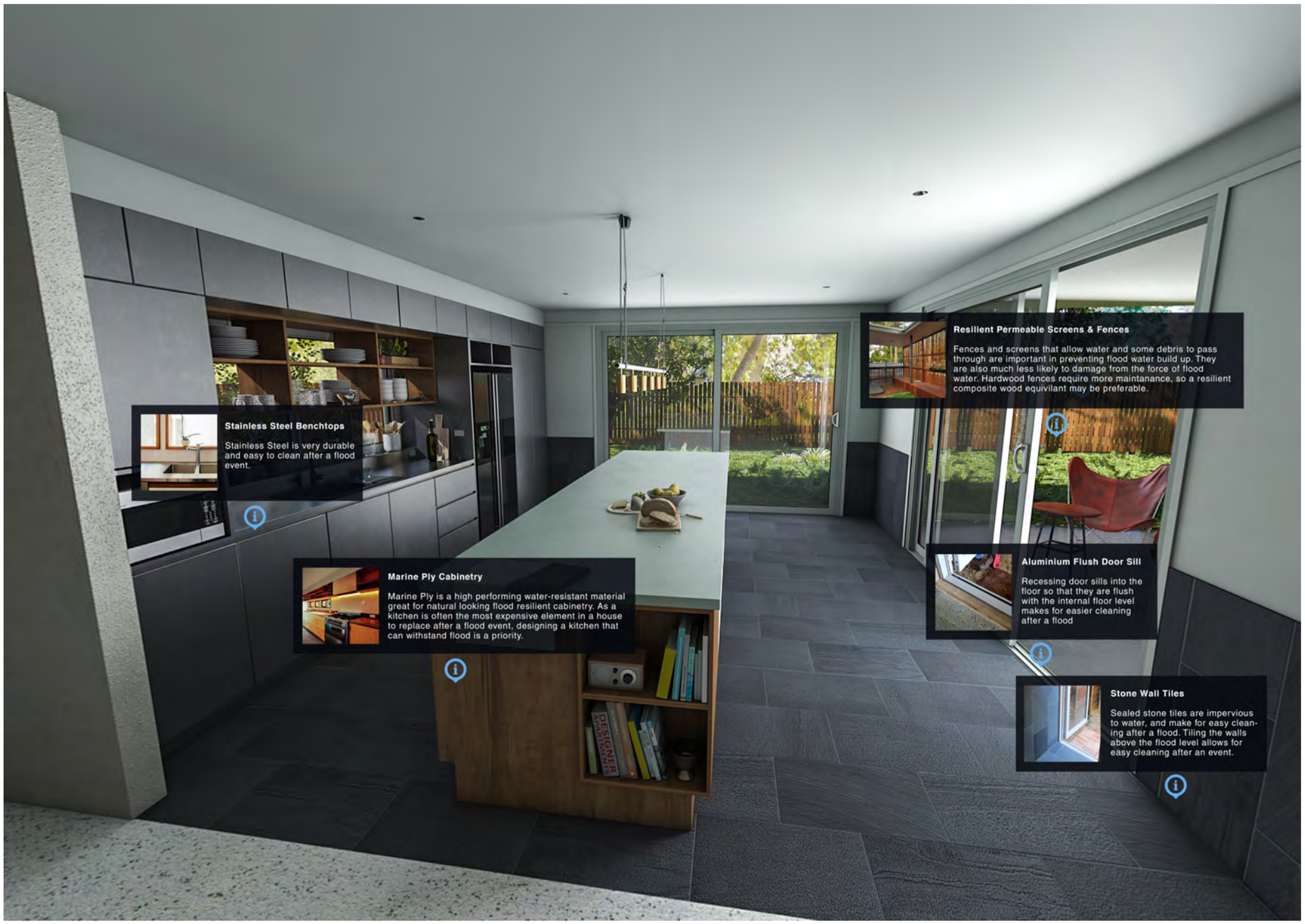

Virtual 360 Flood Hub

JDA

The Flood Hub

JDA

Funding

BRISBANE CITY

Project Management

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Technical Assessors & Advisors

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FRHP Process

Not Eligible
(Report Provided)

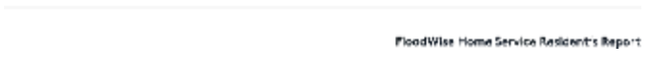
Home Service

3D Scan

Incentive Scheme
- Minor
- Major

Builder

Practical Completion
(Resilient Home)



JDA

Creating a flood resilient Brisbane

The Flood Resilient Homes Program is an initiative of Brisbane City Council, designed to help residents prepare for and recover from overland flow flooding.

This voluntary program is currently being rolled out in locations across the city that have a history of this type of flooding. If you have received a letter about the program, you are invited to participate.

The Flood Resilient Homes Program consists of a free in-home service, rebates to cover the costs, and an incentive scheme that provides financial assistance for some properties where building or design improvements have been recommended.

The program is delivered in partnership with Brisbane City Council's sustainability agency, CitySmart.

Book a free Home Service

If you have received a letter inviting you to the Flood Resilient Homes Program, book your free home Service now at **citysmart.com.au/floodwise**

For more information, please contact CitySmart on **07 3007 7013** or email **floodwise@citysmart.com.au**

Flood Resilient Homes Program

07 3007 7013
floodwise@citysmart.com.au
citysmart.com.au/floodwise

An initiative of

Delivered in partnership with

CITYSMART

What is overland flow flooding?

Overland flow is excess rainfall runoff on streets, driveways and other surfaces. While flooding caused by overflowing waterways is well known, overland flow flooding is another risk to consider. It occurs after rain when heavy rainfall is unable to enter stormwater drains quickly enough. It tends to affect localised areas rather than the whole city at once.

What is flood resilience?

Making your property flood resilient does not stop flooding, but it will allow you to recover faster. We do this by using flood resilient materials and methods with the least amount of disruption.

Steps in the Flood Resilient Homes Program

Step 1 – Home Service

For this free assessment, you will meet with a flood resilience consultant who will provide a personalised assessment of your property and discuss your property's flood risk.

Step 2 – Home Service Recommendations

The recommendations list in your Home Service. They may include recommended building or design works to increase the flood resilience of your property.

Step 3 – Incentive Scheme

If any building or design recommendations have been made in the resident's report, properties may progress to the incentive scheme for financial assistance. The scheme is designed to cover costs and project manage eligible flood resilient works.

Examples of works

Works are carried out by licensed tradespeople and managed by CitySmart on your behalf. Many flood-resilient building design measures can usually be completed within a short timeframe, with no disruption or displacement to owners or tenants.

Examples include:

- raising electrical outlets and fittings to higher levels
- raising air conditioning and hot water systems to higher levels
- raising washing machines and dryers to higher levels
- replacing carpets with tiles and other materials such as timber or vinyl
- replacing flooring with water resistant flooring
- replacing skirtings with water resistant skirting
- replacing lower walls with water resistant plasterboard
- replacing all new internal doors with hollow core doors
- raising the existing floor level in the house.

FRHP Flyer to Neighbourhood

JDA

Flood Resilient Homes Program

Assessor's Report

Date:
Assessor's Initials:
Resident's Initials:
3D Scan required:

PROPERTY DETAILS

Reference Number:
Property Owner:
Property Address:
Lot Size (m²):
Easements: Yes No

TYPE OF BUILDING/CONSTRUCTION

Type	Detached	Terrace house	Apartment
Construction	Lightweight Framing	Brick Veneer	Double brick
	Render	Fibro Cement	Timber Cladding
	Elevated Frame	Slab on Ground	Other
Planning	Heritage Overlay	Character Residential	Other
Age	Pre-1946	Post-1946	
Size	No. Bedrooms:	No. Bath/Pdr:	

FLOOD INFORMATION

Flood Event (%AEP)	Depth (m)	Level (mAHD)	With flood water entering from:
50 (1:2) Overland:			Street
1 (1:100) Overland:			Backyard
1 (1:100) River:			Neighbouring property
2 (1:50) River:			
Jan 2011 River:			
Lowest MGL:			
Highest MGL:			
Ground Floor Level:			
First Floor Level:			

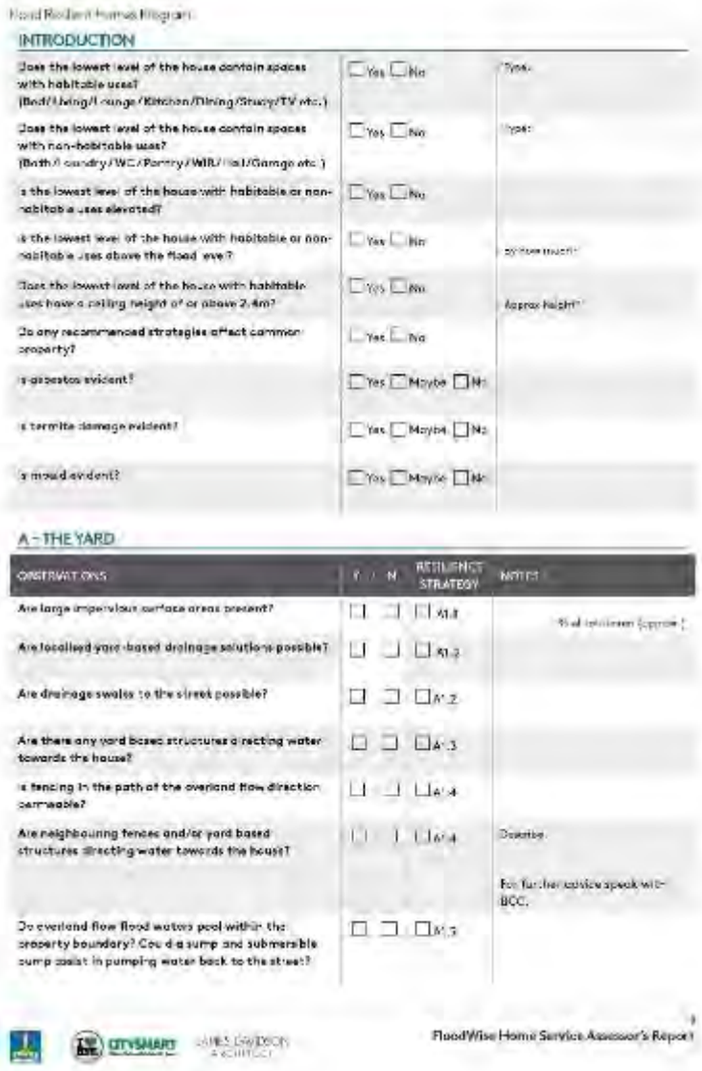
RESIDENT DISCUSSION

Are you an: Owner-occupier Landlord Property Manager Other

Notes:

DECISION

Retrofit (1) Retrofit (L) House Raise No Flood Impact Deemed flood resilient



INTRODUCTION

Does the lowest level of the house contain spaces with habitable uses? (Bed/Living/Lounge/Kitchen/Dining/Study/TV etc.)	Yes No	Type:
Does the lowest level of the house contain spaces with non-habitable uses? (Bath/Laundry/WC/Pantry/Wdb/Hall/Garage etc.)	Yes No	Type:
Is the lowest level of the house with habitable or non-habitable uses elevated?	Yes No	
Is the lowest level of the house with habitable or non-habitable uses above the flood level?	Yes No	By how much?
Does the lowest level of the house with habitable uses have a ceiling height of or above 2.4m?	Yes No	Approx height?
Do any recommended strategies affect common property?	Yes No	
Is asbestos evident?	Yes Maybe No	
Is termite damage evident?	Yes Maybe No	
Is mould evident?	Yes Maybe No	

A - THE YARD

OVERVIEW ONLY	Y	N	RESILIENCE STRATEGY	NOTES
Are large impervious surface areas present?			A1.1	Roof catchment (approx.):
Are localised yard-based drainage solutions possible?			A1.2	
Are drainage swales to the street possible?			A1.2	
Are there any yard based structures directing water towards the house?			A1.3	
Is fencing in the path of the overland flow direction permeable?			A1.4	
Are neighbouring fences and/or yard based structures directing water towards the house?			A1.4	Outside Refer further advice speak with BCC.
Do overland flow flood waters pool within the property boundary? Could a sump and submersible sump assist in pumping water back to the street?			A1.5	

Assessment Report

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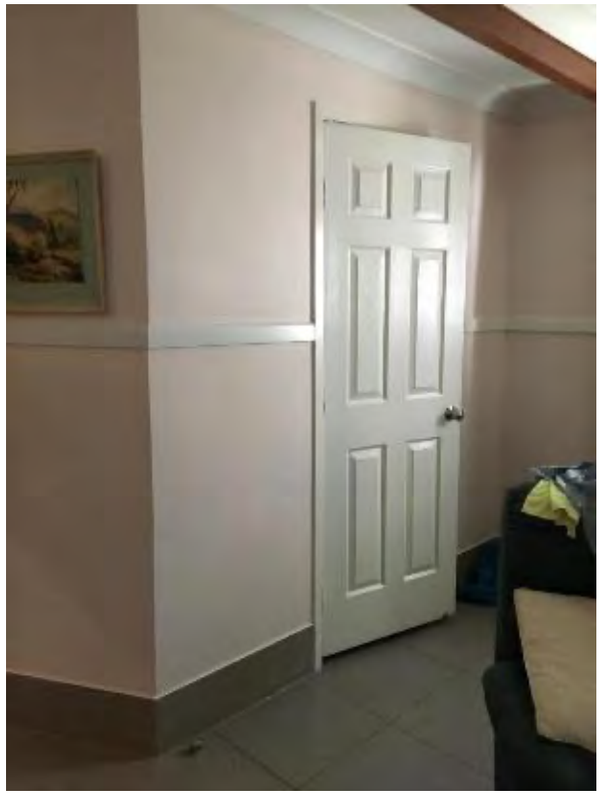

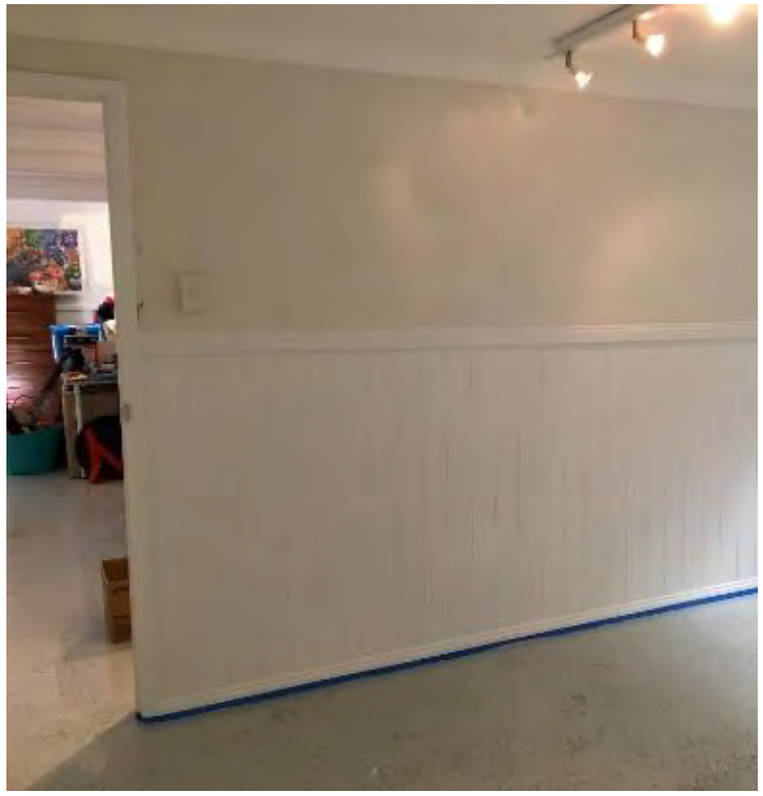

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Before

After

JDA

Before

After

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Before

After

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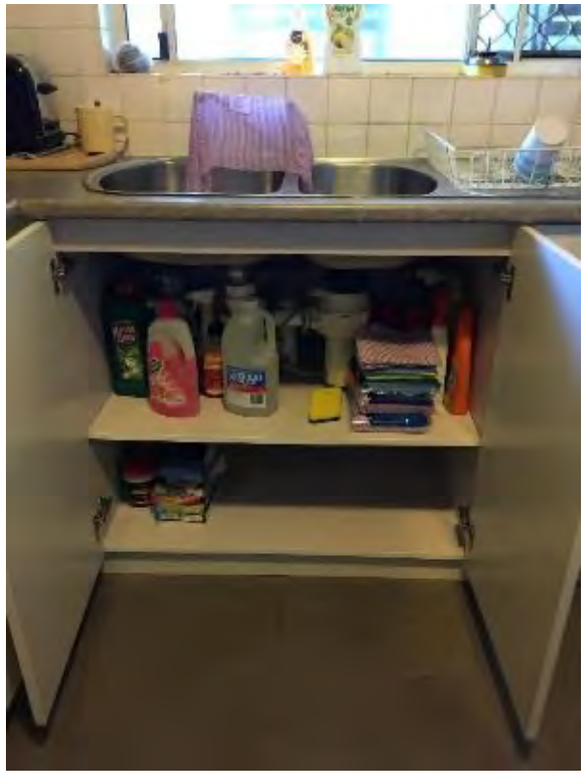
Before



After

Monitor works under construction

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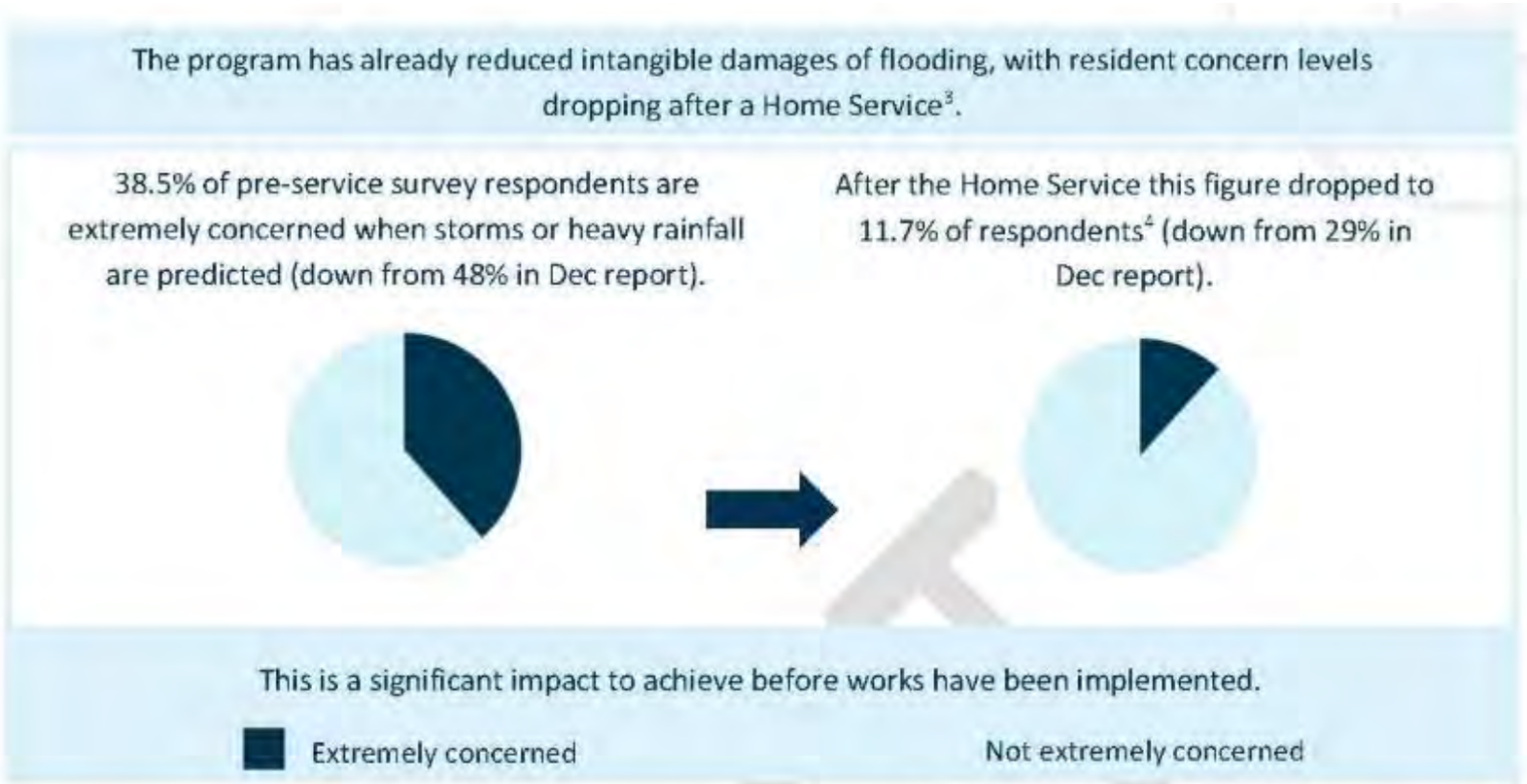
Flood Resilient Homes Program



Evaluation Report

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Flood Resilient Homes Program

Our customers

At a glance

House type:
Single-level 1960's chamferboard

Location:
Inala

Resilience works:

- Raised the air conditioning condenser unit
- Raised the hot water unit
- Raised the washing machine
- Replaced cabinetry and internal linings with water-resistant materials
- Installed separate circuits (with breakers)

Philip's story

With floodwater having recently lapped just inches away from their door, Inala residents Philip and Julieann Dodds were relieved and grateful to be invited to Council's Flood Resilient Homes Program.

"Twenty-eight years of rates and I'm getting it back!" was Philip's reaction when his property proceeded to the Incentive Scheme, following a Home Service visit and recommendations report by the program team.

"They were very respectful of my property, they were polite, there was no question I could ask that they couldn't answer."

Philip agreed to have some major works done on his property to improve its flood resilience including replacement of cabinets, floor coverings and wall linings. Given this scope of works, he was initially concerned about the logistics involved in moving stuff out of the way.

"Like, I've got a slate pool table which is extremely heavy. I've also got shelving with a library of 1500 science fiction novels out the back. I've got a bad back so I can't be moving all that stuff to allow them to get to the walls. They said, no worries we'll be able to get all that sorted out, it won't be a problem. They were really good."

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Flood Resilient Homes Program

Our Customers

At a glance

House type:
Post-war timber cottage

Location:
Paddington

Resilience works:

- Raise the hot water unit
- Raise the washing machines
- Install separate circuits (with breakers) on ground level and upper levels.

Peter's Story

Property owner Peter rents out his post-war timber cottage in suburban Brisbane and has seen a number of overland flow flooding issues over the years. His tenants have lost two washing machines due to flooding.

Peter was delighted when he received a letter from Council inviting him to participate in the program. He booked a FloodWise Home Service and had a meeting at the property with the two flood resilience experts.

Following the Home Service, Peter received his report which recommended a number of solutions including building high benches in the laundry for the washing machine and dryer, and having separate electricity circuits on different levels of the house.

"I think [the Flood Resilient Homes Program] is excellent. I'm surprised they are putting so much effort into it and I'm really stoked about the whole program. For me it costs nothing and I'm getting a great service and my tenants are tickled pink!"

CITYSMART

Homeowner response

JDA

Designing homes that accept water on the floodplains of Brisbane River

23 OCTOBER 2018 FEATURE

SHARE

“What we’ve been able to do is assess this property individually which has led to a 50% reduction in their insurance premium”
Josh Kelland (Suncorp Executive Manager Consumer Products)

JDA

Cover photo: Penny Stephens, The Age

Flood resilient guide to retrofitting your home

Melbourne Water
Enhancing Life and Liveability

JDA

1 The benefits of a flood resilient home

1.1 What is a flood resilient home?

A flood resilient home is one which is fitted, finished, designed and surfaced to reduce, as much as practical, the impacts of flooding, allowing you to recover sooner from flooding.

Flood resilient design measures include your house and outdoor areas. You can improve your home's flood resilience by retrofitting it with approaches and materials that are less likely to be damaged during multiple flood events.

1.2 How can you benefit from a flood resilient home?

Flood resilient homes have the potential to:

- Reduce the inconvenience and damage caused by flooding
- Save costs in the long-term from having to pay for temporary relocation and repairs
- Help you to acquire, maintain and potentially, reduce your insurance premiums
- Inspire new approaches to retrofitting your home
- Ensure that your home is suited to changing flood conditions in the longer term, particularly from climate change
- Allow you, as a homeowner, to prepare for, live through and recover from flood events.

This document is designed to get you started on the path to retrofitting your home to improve flood resilience.

Before you continue

This guide has been created for existing flood affected homes which have not been built to relevant flood protection standards, to reduce the impacts using flood resilient design. New homes should be constructed with raised floor levels to minimise the chance of flooding inside the home. All new homes should be designed and constructed in accordance with the objectives and standards outlined by the Department Environment Land Water and Planning (DELWP) guidelines for 'Development in Flood Affected Areas' and Melbourne Water's 'Planning for Sea Level Rise Guidelines'.

2 How to use this guide

2.1 Who is this guide for?

This is a self-help guide for people who want to reduce the cost, concern, and inconvenience of flooding, by retrofitting their home to prepare for future flood events.

Please note

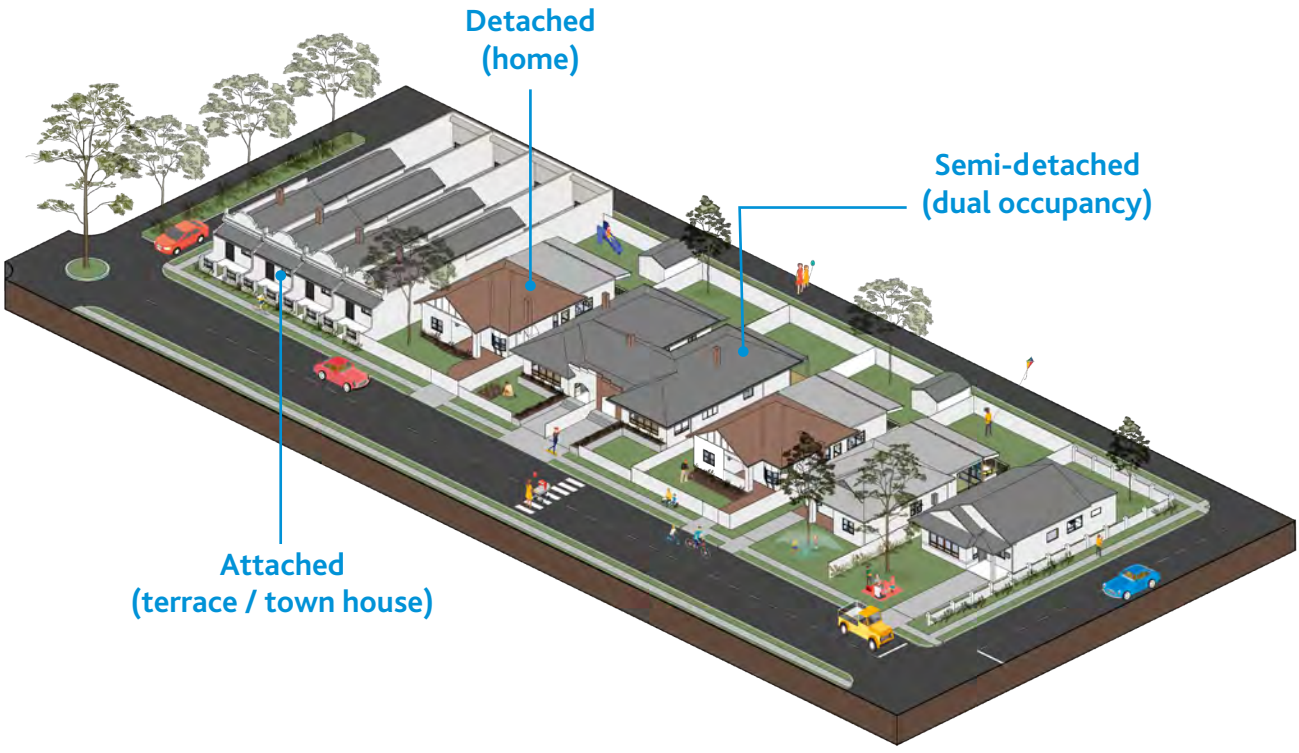
This guide is for information purposes only, it is not a mandatory requirement.

2.2 What is the purpose of this guide?

The purpose of the guide is to provide practical and affordable options to retrofit three common types of homes in Melbourne:

1. Detached (home)
2. Semi-detached (dual occupancy – which may be two detached or two joined homes)
3. Attached (terrace / town house)

Although this document does not cover all types of homes, the guidance in this document is intended to be applied to other types of dwellings, such as apartment buildings.



3 The importance of flood resilience in Melbourne

Whilst there is an extensive drainage network in place across greater Melbourne that helps to reduce the severity of flooding, we cannot entirely prevent flood events from occurring. Learning to live with flooding by making our homes and properties more flood resilient is one of the ways to reduce the impact of flooding. This includes making informed decisions about the materiality and construction systems in your home.

3.1 Why is flood resilience in our city important?

Do you remember the major floods we have experienced in Melbourne in recent years? In 2011 Melbourne was flooded with 150 mm of rain in 14 hours and significant floods have occurred in suburbs since then.

Flooding has always occurred in Melbourne as part of the natural weather cycle. The drainage network reduces flooding, however, extreme storms can mean rainfall exceeds the capacity of the drains and flooding occurs.

Adding to this, Melbourne has seen rapid development over the past few decades, and the increase in hard surfaces such as roads and roofs, combined with more frequent extreme storms means that more water is running into our drainage systems, rather than infiltrating into gardens and natural environments. This can make flooding worse. Coastal floods can also result from high tides and surges from the sea and will increase as sea levels continue to rise.

All these factors mean that many homes across Melbourne experience flooding.

3.2 What are the costs of flooding?

The costs of flooding are significant. People experience risks including loss of life and injury, loss of pets and valuable personal items, and a sense of fear and helplessness. People can be dislocated from their homes and experience ongoing stress and disruption. Flooding can damage the wall linings, carpets, flooring and electrical services of your property. There are more than 200,000 properties across the region with at least a 1% chance of flooding in any given year.

The total cost of flooding is estimated at $735 million a year. The costs include damage to property, infrastructure such as roads, disruption of services such as public transport and social impacts.

3.3 What are organisations doing to manage flooding?

Many organisations are responsible for flood management including Melbourne Water, state and local government and the Victoria State Emergency Service. These organisations have responsibilities for mapping flooding, managing drains and roads, and constructing new or enhanced drainage infrastructure, which are essential for flood management, and emergency response and recovery.

These organisations work with communities to help people prepare for flooding, know what to do when a flood happens, recover quickly, learn from our experiences and adapt over time.

Together we have made great progress on flood management however, with climate change, population growth and more development, we face many challenges.

You can be a part of reducing the impact of flooding in your life. You can learn about how to be prepared for flooding and the Victoria State Emergency Service offers support: https://www.ses.vic.gov.au/get-ready/flood. You can also make changes to your home.

Costs of flooding

The total cost of flooding is estimated at $735 million for the greater Melbourne region.

4 Understanding local planning

4.1 What are the different organisations responsible for?

Following is a quick reference table of the key organisations that are responsible for flood management and their responsibilities.

Table 1. Organisations responsible for flood management and their responsibilities.

Organisation	Responsibility
Melbourne Water	• Coordinates planning and delivery of regional flood management and drainage services • Undertakes catchment and coastal flood modelling and mapping • Provides flood advice for new land use and development as a referral authority • Contributes information to warning services, particularly, manages flood warning hydrographic infrastructure • Manages regional drainage systems • Manages waterways • Contributes to development and use of integrated water management (IWM) knowledge and tools • Undertakes technical research
The 38 councils in the Melbourne region	• Administer and enforce planning schemes, which include state and local flood policies and controls • Manage local drainage systems • Undertake flood modelling and mapping of local drainage systems • Support local flood planning and coordinate local emergency planning • Support development of local community resilience • Implement state and regional strategies through the application of appropriate zones and overlays, and flood management decision-making and activities • Can develop local water management strategies and plans • Support community recovery from flood events
Victorian goverment departments and agencies	• Set policies, guidelines, standards and strategies for floodplain management, urban planning and development, water resource management, and emergency management • Support recovery from floods.
Emergency services agencies	• Lead emergency preparation and response • Deliver community awareness and education programs • Provide flood warnings to the community (Emergency Management Victoria) • Are the designated control agency for floods (Victoria State Emergency Service)
Australian government departments and agencies	• Set national policies and guidelines for flood and emergency management • Coordinate national research and data on a range of flooding, weather and climate change issues • Contribute to delivery of warning services • Contribute funding to flood prevention and recovery activities.
Insurance Industry	• Projects and shares the financial consequences and recovery costs.
Communities, individuals and businesses	• Are responsible for understanding personal and local risks, and being prepared for floods • Can contribute to development of local flood management projects and plans

4.2 What are the chances of my home flooding?

4.2.1 Relevant planning overlays

An overlay is a map in a council planning scheme showing the location and extent of special features, such as where land may be subject to flooding. Overlays are intended to give you an overview of your local area.

The relevant planning overlays illustrated on the map below in Melbourne are:

Land subject to inundation overlay:
Identifies land in a flood storage or flood fringe area affected by riverine and coastal flooding.

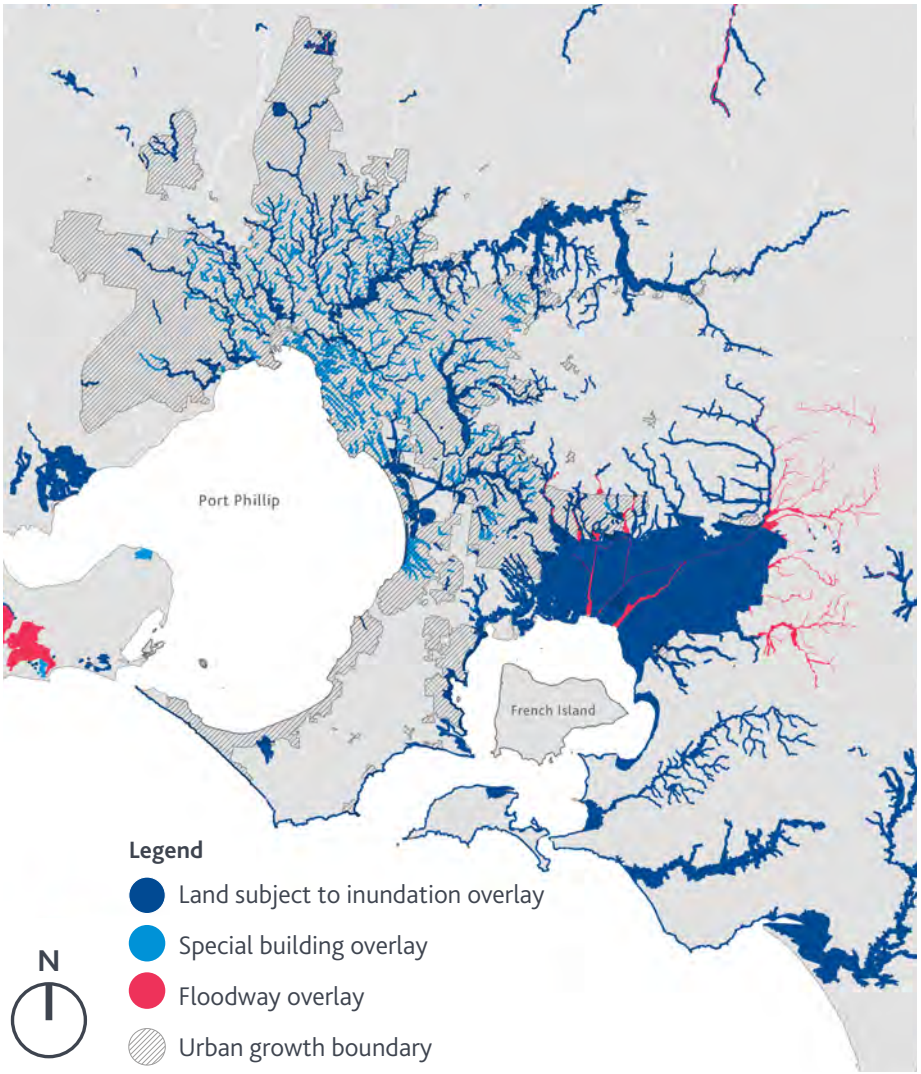
Special building overlay:
Identifies land at risk of overland stormwater flooding due to the capacity of the drainage system being exceeded.

Floodway overlay:
A floodway overlay identifies waterways, major floodpaths and high hazard areas with the greatest risk and frequency of being affected by flooding.

4.2.2 Finding out about your property

A flood level certificate is a document that is specific to your property and will tell you how high the water could go and what chance there is of a flood occurring. To get the most up to date information, it is recommended that homeowners in flood prone areas apply for a flood level certificate as there is a delay in flood data being available in the planning scheme.

For more information: https://www.melbournewater.com.au/planning-and-building/apply-to-build-or-develop/property-flood-level-information



5 Insurance and flood resilient design

Many homes at higher risk of flooding face increasingly high insurance premiums. The insurance industry has begun to recognise the effectiveness of flood resilient design in reducing damage costs, which means that flood resilient homes could benefit from reductions in premiums.

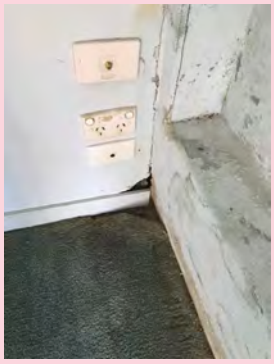
There are examples in other capital cities where flood resilient design principles were incorporated into the lower level of a home at high risk of flooding resulting in reduced premiums. The retrofitting at the property pictured on the following page includes some of the strategies outlined in this document.

5.1 What should I discuss with my insurance agency?

While there is no guarantee your insurance agency will reduce your premium it is worth having a discussion with them. Insurance premiums consider a number of factors - one of these is flooding. Get in contact with your insurer prior to doing any work on your property to ask if they are open to reducing premiums if flood resilient retrofitting is done. It's also worth checking that your insurance covers you for all types of flooding on your property.

Common problems from flooding

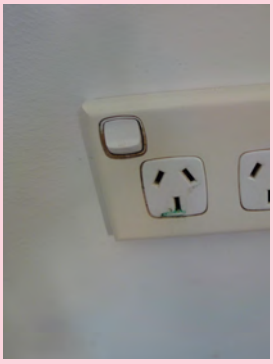
Some parts of the home are more vulnerable to flooding in the short and long term.



Mould and rot

Disintegration of linings

Swelling of cabinetry



Malfunctioning services

An example of a home retrofitted for flood resilience.
Photo credit: Scott Burrows Photographer

6 Approaches to flood resilient design

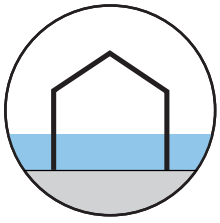
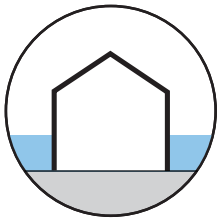
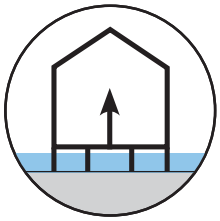
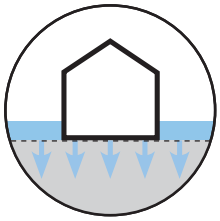
6.1 What is flood resilient building design?

Repairing your home after a flood event can be a costly exercise. By using a resilient approach, some of these costs can be avoided. Flood resilient building design refers to modifications that adapt your home to reduce the impacts of flooding.

This is typically done using landscaping, water-resistant materials, raising floor levels and preventing flood waters from entering a house. Introducing flood resilient measures means it is easier to clean-up following a flood so life can get back to normal with minimal disruption. If your home is flood affected, you can explore several approaches to make it flood resilient.

6.2 What are the different approaches to making my home flood resilient?

There are four flood resilient design approaches. While considering what is physically and financially practical in your situation, you can use a combination of wet-proofing, dry-proofing, elevation and absorption to increase your home's flood resilience.

Strategy	Description	
Wetproofing		Wet proofing involves using flood resilient materials and construction methods to allow flood waters to enter the house with a minimised chance of damage and moisture problems afterwards. By accepting a level of risk through wetproofing, and creating space for water to flow, you can be better prepared for any future flooding that may occur. This means going with the flow and working with water rather than against it.
Dryproofing		Dry proofing involves sealing the exterior of your house to prevent water from entering. Flood doors are one of the options to do this. For low-level floods this is effective, however, greater depths can result in an increase in force on the building and result in cracking or movement of foundations. It's worth noting that this method can also displace more water onto neighbouring properties.
Elevation		Raising the level of the house or its services above the projected flood level can be effective. Footings, posts, slabs and other structures all need to withstand an overland flow of water across the site. Services such as air conditioners, hot water units and electrical meter boards can be easily raised above the flood level to minimise the chance of important utilities failing.
Absorption		It's also important to think about your property as a 'sponge' that can receive and slowly absorb water into ground surfaces. By increasing permeable surfaces on your property, you can decrease the amount of water flowing into your home, onto other properties and streets.

7 Examples of flood resilient homes

This section illustrates flood resilient strategies, and how they can apply to three common houses found in Melbourne's flood-affected areas. While this is not an exhaustive list of house types, the strategies are common for many types of buildings and can help you reduce the impact of flooding in your home.

Talk to your neighbours

Talking to your neighbours is an important part of developing flood resilience. You can talk about each other's experiences with flooding, approaches to reduce flooding, and ways you might work together in a flood event. Knowing about your risk, preparing for flood events, knowing what to do when it floods, and knowing how to get support can help to decrease your concern about flooding.

Prepare and plan for floods

A well prepared community can reduce the impact of flooding by up to 80%[1]. People who are prepared are more likely to respond to floods appropriately and safely. To help you plan and prepare for floods visit the VICSES website: https://www.ses.vic.gov.au/get-ready/at-home.

[1] Source: Grothmann, T., Reusswig, F. People at Risk of Flooding: Why Some Residents Take Precautionary Action While Others Do Not. Nat Hazards 38, 101–120 (2006). https://doi.org/10.1007/s11069-005-8604-6

7.1 Detached homes

Detached homes refer to free-standing homes on a block of land that usually have a yard.

7.2 Semi-detached homes

Semi-detached homes refer to two homes that share a common wall, such as dual occupancy town houses.

7.3 Attached homes

Attached homes refer to homes that share one or multiple walls, these include but are not limited to terrace or row houses, and town houses.

7.1 Detached

Concrete slab on ground floors and timber framed walls with timber external cladding

Legend

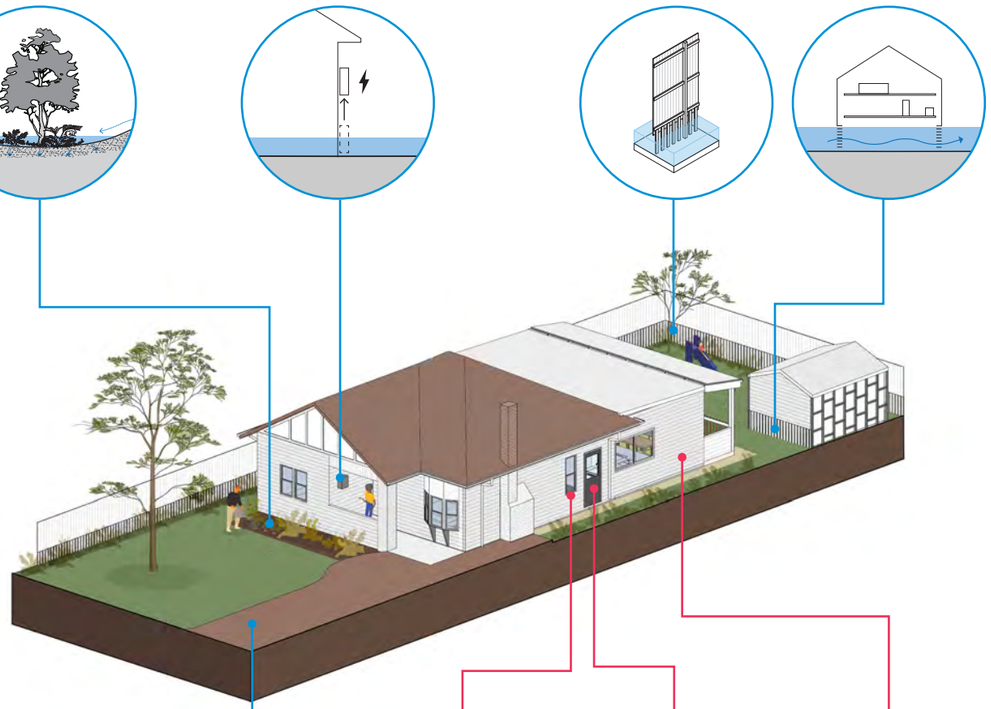
- Wet proofing strategies
- Dry proofing strategies

Garden beds with deep friable soils can help to slow, filter and collect water

Raise electrical switchboards to above flood level to minimise damage

Replace existing fences with permeable fences that allow water to flow through

Ensure outbuildings are permeable for water to flow through



Replace hard surfaces with permeable materials to absorb and slow the flow of water

Ensure window sills are above flood level to minimise the chance of water entry

Replace external doors with flood doors to minimise the chance of water entry

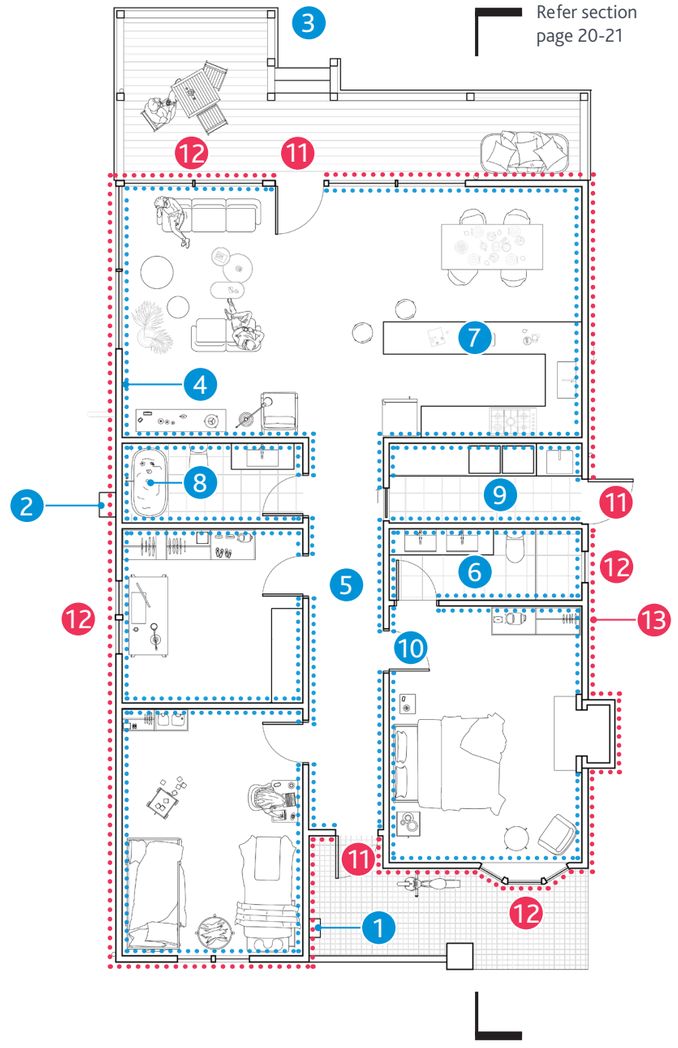
Seal external wall under existing cladding to minimse water entry

Wet proofing

1. Raise electrical switchboard to above flood level to minimise damage.
2. Raise gas hot water unit to above flood level onto a concrete plinth, steel brackets or stainless steel framed bench to minimise damage.
3. Replace existing stairs with open stairs made from flood resilient materials to minimise damage.
4. Replace internal wall linings with flood resilient wall linings to minimise damage.
5. Replace flooring with flood resilient flooring to minimise damage.
6. Seal existing tiled areas to minimise the chance of mould.
7. Replace cabinetry with flood resilient materials to minimise damage.
8. Replace built-in bathtubs with freestanding bathtubs or showers
9. Raise washing machine and dryer above flood level onto a flood resilient cabinetry or a stainless steel framed bench to minimise damage.
10. Replace hollow core doors with solid core doors to minimise damage.

Dry proofing

11. Replace external doors with flood doors to minimise the chance of water entry.
12. Ensure window sills are above flood level to minimise the chance of water entry.
13. Seal external wall under existing cladding to minimise the chance of water entry.



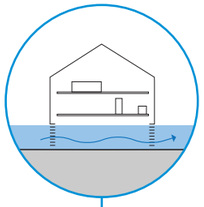
7.1 Detached

Concrete slab on ground floors and timber framed walls with timber external cladding

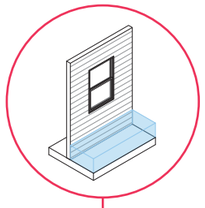
Legend

- Wet proofing strategies
- Dry proofing strategies

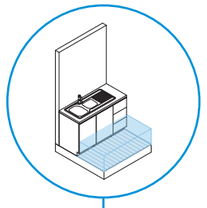
Ensure outbuildings are permeable for water to flow through



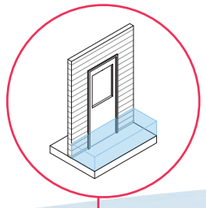
Ensure window sills are above flood level to minimise the chance of water entry



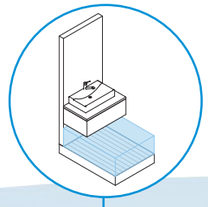
Replace cabinetry with flood resilient materials to minimise the chance of damage



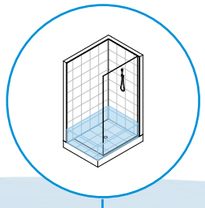
Replace external doors with flood doors to minimise the chance of water entry



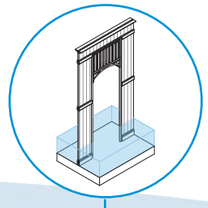
Where possible, raise cabinetry above the flood level to minimise damage

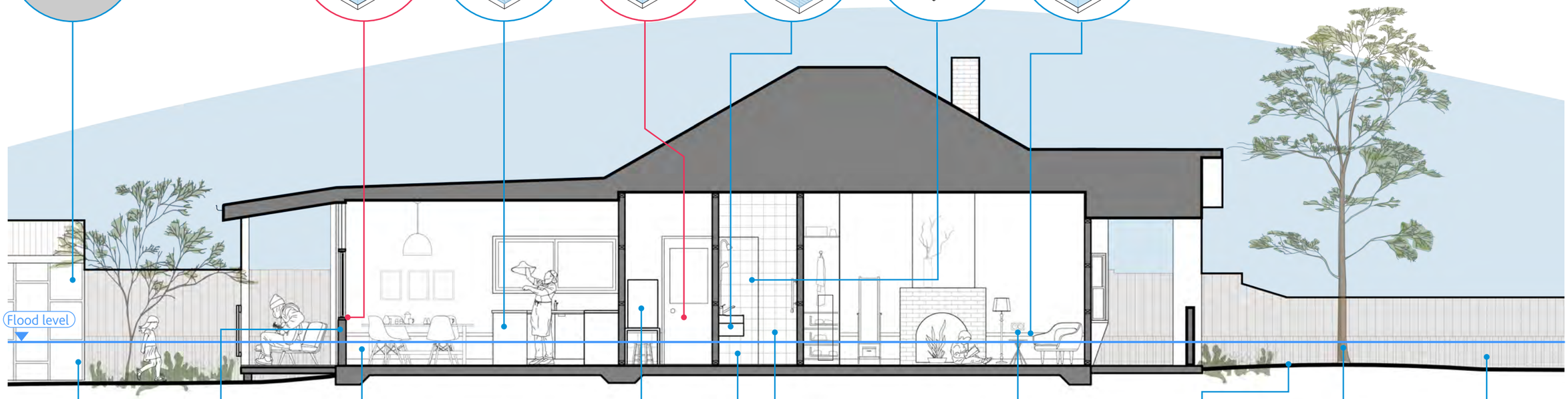


Replace built-in bathtubs with showers to minimise mould

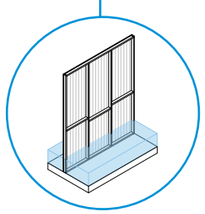


Replace mouldings with flood resilient mouldings to minimise damage

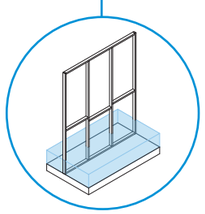




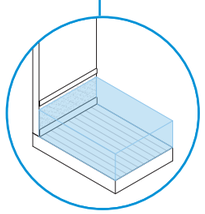
Where possible, replace cavity walls with non-cavity walls to minimise the chance of mould



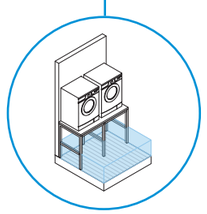
Use flood resilient wall framing to minimise the chance of mould or damage



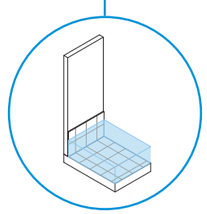
Replace wall linings with flood resilient wall linings to minimise damage



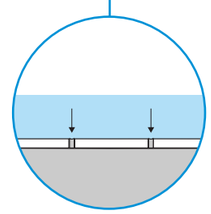
Raise washing machine and dryer above flood level to minimise damage



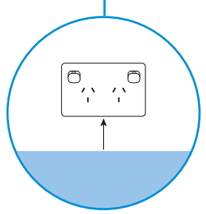
Apply flood resilient sealant existing tiled areas to minimise the chance of mould and damage



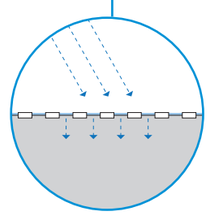
When replacing tiles, ensure a flood resilient grout is used to minimise the chance of mould



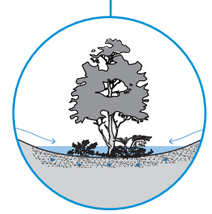
Raise data and electrical points above flood level to minimise the chance of damage



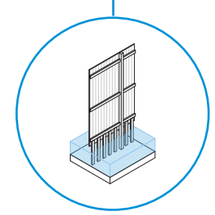
Permeable ground cover can help to absorb and slow the flow of water



Garden beds with deep friable soils can help to slow, filter and collect water



Replace existing fences with permeable fences that allow water to flow through

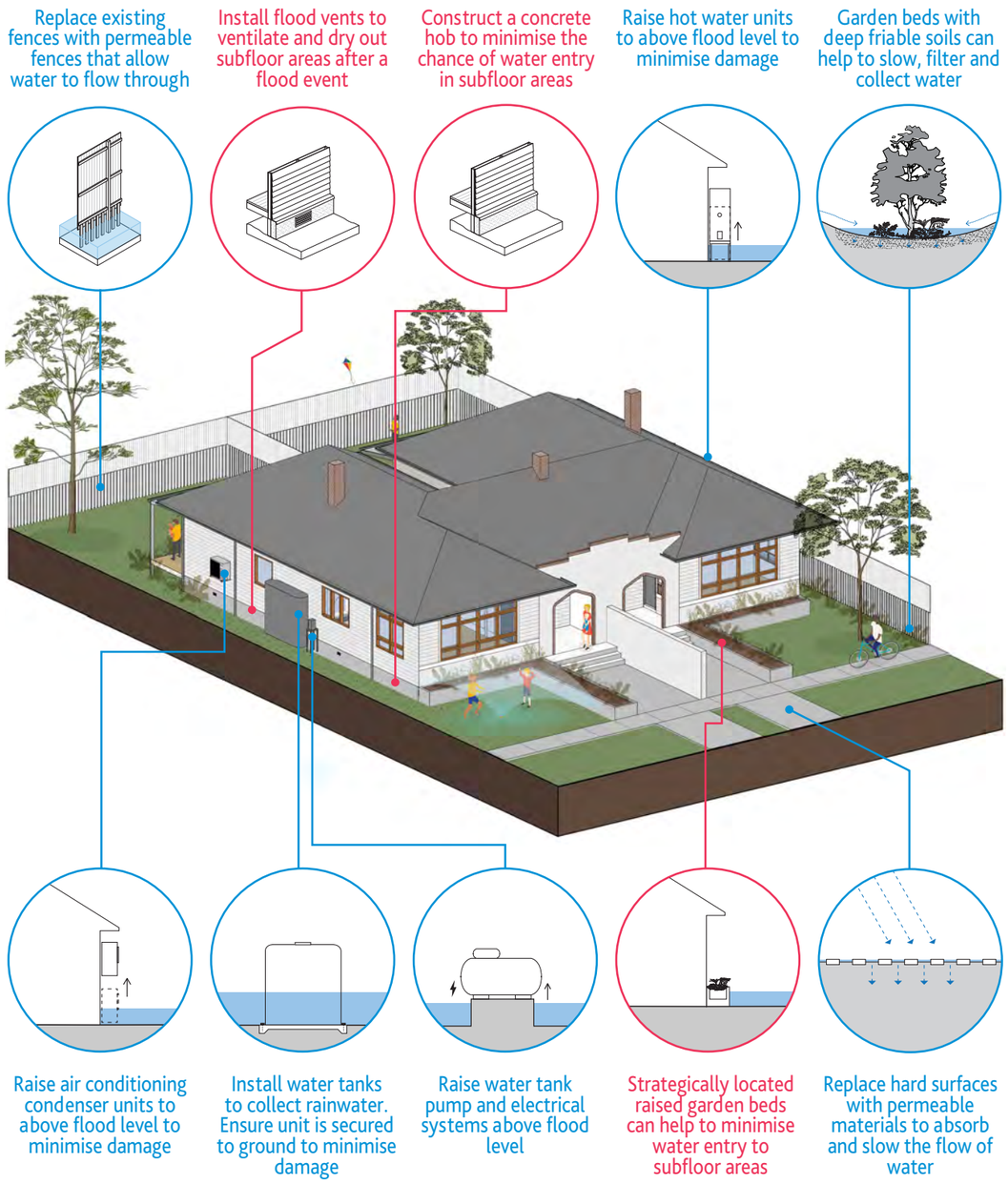


7.2 Semi-detached

Suspended (raised) timber floors with timber framed walls and timber external cladding

Legend

- Wet proofing strategies
- Dry proofing strategies



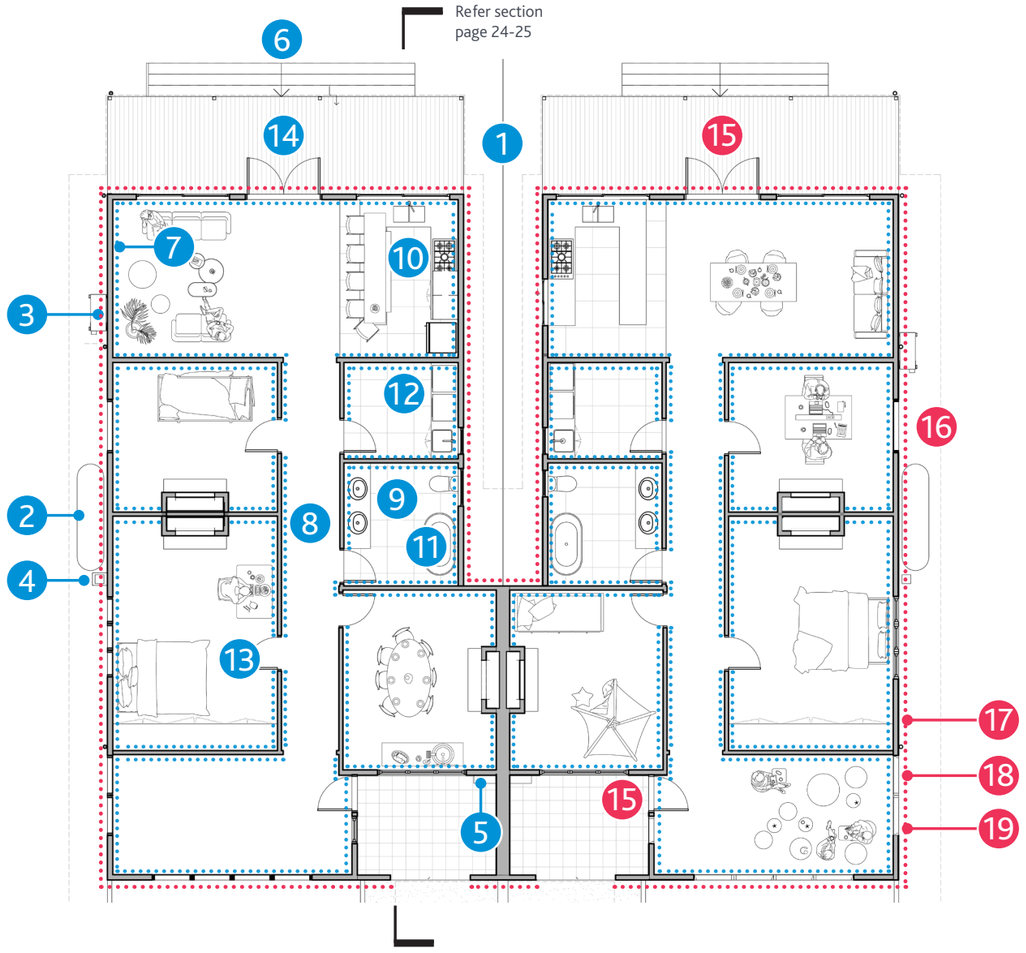
Wet proofing

1. Replace existing fences with permeable fences that allow water to flow through.
2. Install water tanks to collect rainwater. Ensure unit is secured to the ground to minimise damage.
3. Raise air conditioning condenser units to above flood level to minimise damage.
4. Raise water tank pump and electrical systems above flood level to minimise damage.
5. Raise electrical switchboard to above flood level to minimise damage.
6. Replace existing stairs with open stairs made from flood resilient materials to minimise damage.
7. Replace internal wall linings with flood resilient linings to minimise chance of damage.
8. Replace existing flooring with flood resilient flooring to minimise damage.
9. Seal existing tiled areas to minimse chance of mould.
10. Replace cabinetry with flood resilient materials to minimise damage.
11. Replace built-in bathtubs with freestanding bathtubs or showers to minimise mould.
12. Raise washing machines and dryers above flood level to minimise damage.
13. Replace hollow core doors with solid core doors to minimise damage.
14. Enlarge ground floor openings to allow water to flow through

Dry proofing

15. Replace existing external doors with flood doors to minimise the chance of water entry.
16. Ensure window sills are above flood level to minimise the chance of water entry.
17. Seal external wall under existing cladding to minimse the chance of water entry.
18. Construct a concrete hob around house perimeter to minimise the chance of water entry in subfloor areas.
19. Install flood vents to ventilate and dry out subfloor area after a flood event.

Refer section page 24-25

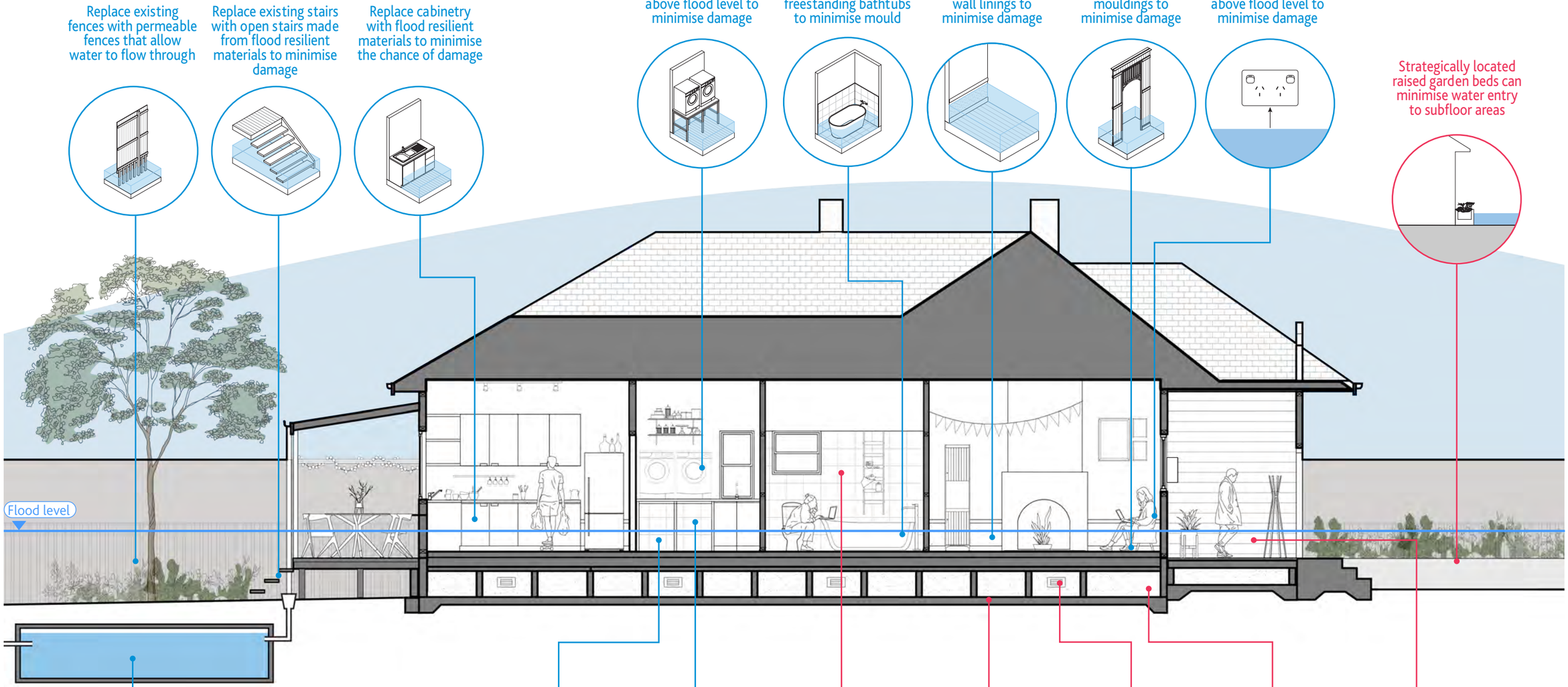


7.2 Semi-detached

Suspended (raised) timber floors with timber framed walls and timber external cladding

Legend

- Wet proofing strategies
- Dry proofing strategies



7.3 Attached

Suspended (raised) timber floor and double brick walls at the front. Concrete slab on ground floor and brick veneer cavity walls at the rear.

Legend

- Wet proofing strategies
- Dry proofing strategies

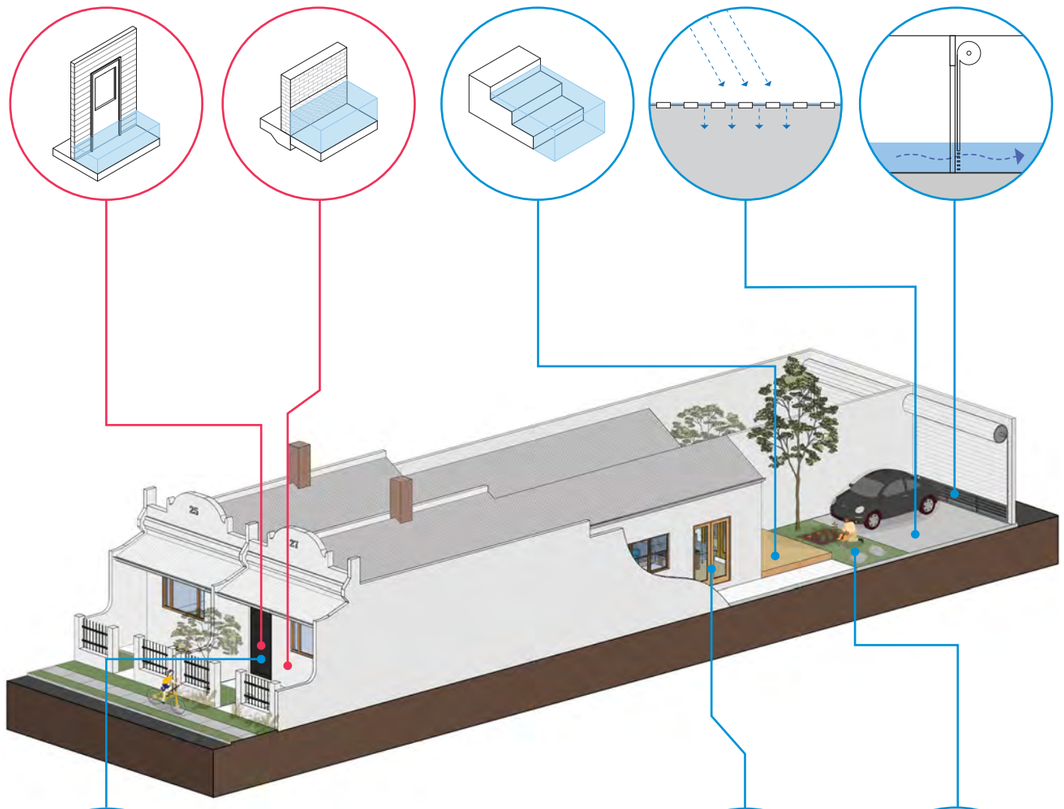
Replace external doors with flood doors to minimise the chance of water entry

Apply cementitious render to porous brick walls to minimise chance of water entry

Add strategically placed terracing to help direct water away from the house

Replace hard surfaces with permeable materials to absorb and slow the flow of water

Retrofit garage doors with permeable doors to allow water to flow through



Install flush door thresholds to ensure easy cleaning after a flood event

Enlarge door and window openings to allow water to flow through

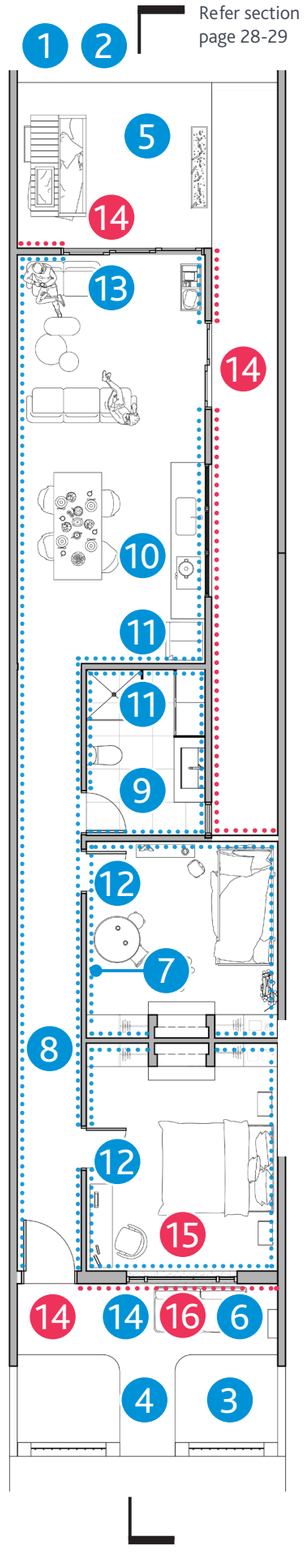
Garden beds with deep friable soils can help to slow, filter and collect water

Wet proofing

1. Retrofit garage doors with permeable garage doors to let water flow through.
2. Remove structures (incl. garages) that block natural flow paths.
3. Garden beds with deep friable soils help to slow, filter and collect water.
4. Replace hard surfaces with permeable materials to absorb and slow the flow of water.
5. Add strategically placed terracing to help direct water away from the house and subfloor areas.
6. Raise electrical switchboards to above flood level to minimise the chance of damage.
7. Replace internal wall linings with flood resilient linings to minimise the chance of damage.
8. Replace flooring with flood resilient flooring to minimise the chance of damage.
9. Apply flood resilient sealant to existing tiled areas to minimise the chance of mould and damage.
10. Replace cabinetry with flood resilient materials to minimise the chance of damage.
11. Raise kitchen and laundry appliances to above flood level onto flood resilient cabinetry or a stainless steel framed bench to minimise damage.
12. Replace hollow core doors with solid core doors to minimise damage.
13. Enlarge door and window openings to allow water to flow through.

Dry proofing

14. Replace existing external doors with flood doors to minimise the chance of water entry.
15. Ensure window sills are above flood level to minimise the chance of water entry.
16. Apply a cementitious render to porous brickwork walls to minimise the chance of water entry.

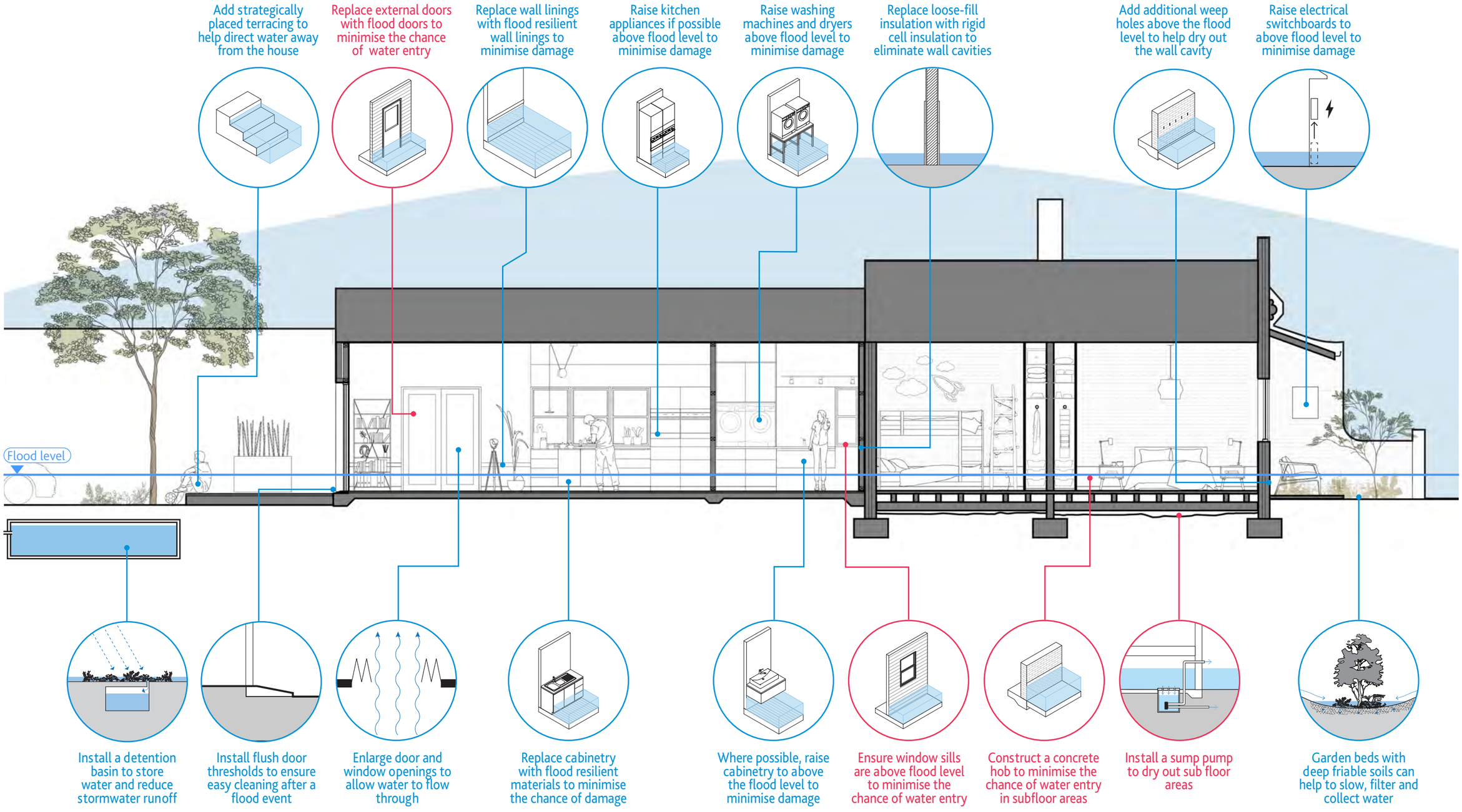


7.3 Attached

Suspended (raised) timber floor and double brick walls at the front. Concrete slab on ground floor and brick veneer cavity walls at the rear.

Legend

- Wet proofing strategies
- Dry proofing strategies



8 Flood resilient strategies

8.1 General considerations

1. These strategies are recommendations only. Please consult a builder to find out which of these strategies is possible and practical for your home.

2. Generally, slab on ground houses are easier to keep the water out of. Dry proofing strategies can be an effective way of increasing flood resilience. Engage a professional builder to assist in determining the right approach for your home.

3. When considering flood vents, seek guidance from your builder or a Victorian Registered Professional engineer to determine whether this solution is appropriate for your home.

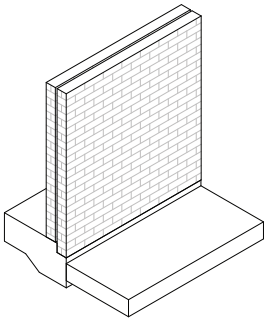
4. Generally, houses constructed with a raised floor level and sub floor area are harder to keep water out of. Wet proofing strategies can therefore help to increase flood resilience. Engage a professional builder to assist in determining the right approach for your home.

5. Flood doors and vents are used commonly throughout the world and work best with masonry structures. Seek guidance from a Victorian Registered Professional engineer to ensure minimum structural requirements are in place.

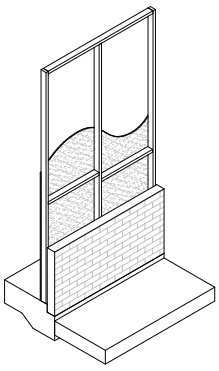
6. Avoid 'floating timber floors' over concrete slabs (either composite or hardwood) where possible to prevent damage to flooring.

7. Refer to the National Construction Code provisions relating to condensation, damp and weatherproofing, and energy efficiency of houses. Refer also to managing the risks of condensation in the non-mandatory Condensation in buildings Handbook by the Australian Building Codes Board.

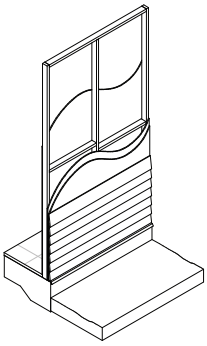
8. Speak to your builder about how your home is constructed. There are four common construction types found among detached, semi-detached and attached homes in Melbourne. These are shown in the diagram in the figures below. If you're not sure which one is relevant to your home, engage a professional builder to find out more information.



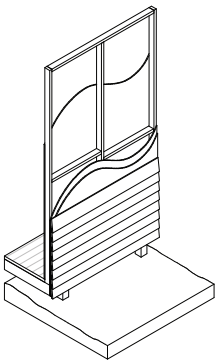
Concrete slab on ground
Double brick wall



Concrete slab on ground
Brick veneer cavity wall



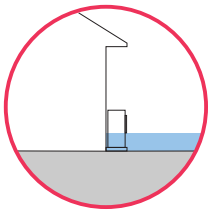
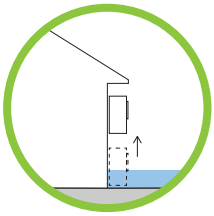
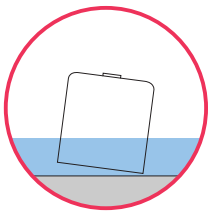
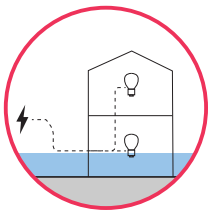
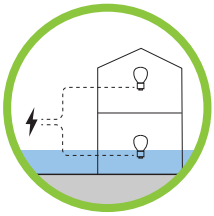
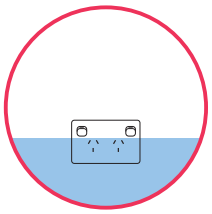
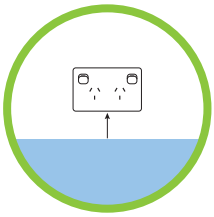
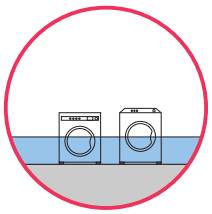
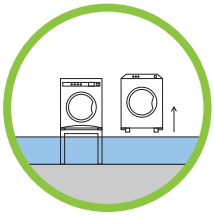
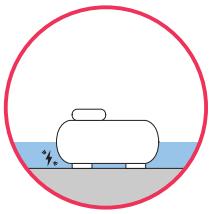
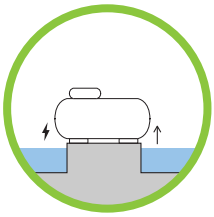
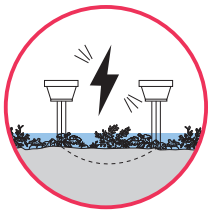
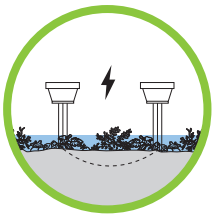
Concrete slab on ground
Timber-framed cavity wall



Raised timber floor
Timber-framed cavity wall

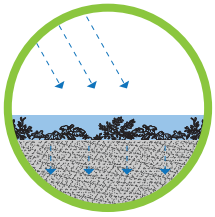
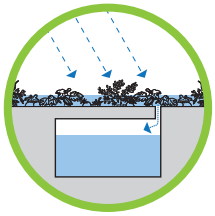
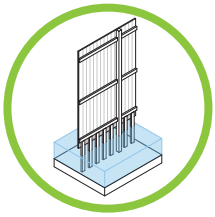
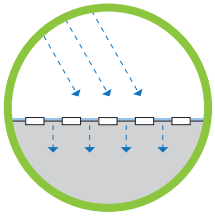
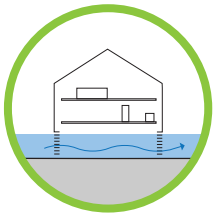
8.2 Strategies

Power and plumbing

	Strategy	Do Not's	Do's
Raise external services	Raise external services, such as air conditioner condensers, hot water units and electrical meter boards above the possible flood level to keep your house's utilities functioning and minimise the chance of damage. Note: Consult an electrician.		
Secure external structures, such as rainwater tanks & sheds	Ensure external structures and rain water tanks are fixed to a concrete slab. Floods have the ability to uplift structures such as rain water tanks and sweep them downstream toward other properties causing serious damage.		
Install separate circuits on the lower and upper levels	Install separate circuits to each storey of your house. This allows electricity to run on the upper level if lower levels circuit cuts off in a flood event. Note: Consult an electrician.		
Raise powerpoints	Ensure the power points, data points and all other electrical services are raised to above the flood level to minimise the chance of power outages and faults. Allow provision for safety cut-off switches. Note: Consult an electrician.		
Raise appliances	Raise stand-alone appliances such as washing machines and dryers to above the flood level on stainless steel framed benches, wall brackets or cabinetry made from flood resilient materials in order to minimise the chance of damage.		
Raise pool / water tank pumps and power systems	Pool and tank pumps are often very costly to repair, and flooding of the electrical components can be the cause of their breakdown. This can also affect other electrical equipment in the property. Raise pumps and pump power systems to above the flood level to minimise the chance of damage.		
Use low voltage garden lighting	Use low voltage (12 volt) garden lighting where possible and minimise any high voltage (240 volt) cabling within garden areas to minimise the chance of electrical issues.		

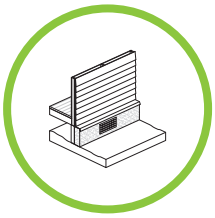
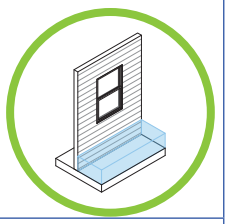
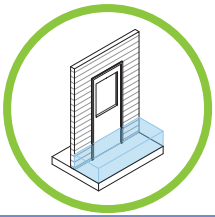
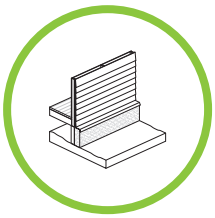
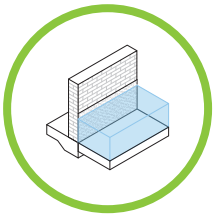
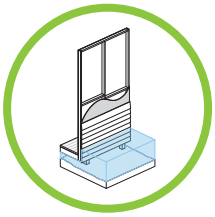
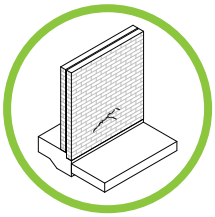
8.2 Strategies

In the yard

Strategy	Description	Do's
Create a rain garden system	Rain gardens collect water and are vegetated with water loving plants and help slow, filter and collect flood water. Note: Consult a landscape architect.	
Increase garden bed areas and use deep friable soil or mulch	Increasing the garden areas on your property can help filter & slow flood waters. Deep friable top soils are recommended for a greater collection of water and healthy growth of plants and collection. Note: Consult a landscape architect.	
Install water tanks below your driveway, lawns or gardens	Underground water tanks can be installed to reduce the amount of site run-off, and in low-level floods help reduce the level of flood around the property. They are also useful in times of drought for water storage. Note: Consult a registered structural engineer and/or landscape architect.	
Replace solid fences and screening with permeable fences	Reduce flood damage to fences by ensuring the fence is water permeable and made of resilient materials. If privacy or noise is a concern, fences should be permeable up to a height that allows water to flow through with ease, and then solid above that point. Some suggested screening materials include: aluminium, composite timber, hardwood timber, and recycled plastic palings. Note: Consult a builder.	
Increase permeable surface areas	Use permeable paving materials and/or remove any unnecessary hard surfaces to allow ground to absorb water. Some options include: gravel, decomposed granite, permeable pavers, permeable concrete. It is recommended to reduce the width of large paved areas such as driveways, or only paving the tyre tread tracks. Note: Consult a registered structural engineer if there are expansive soils and/or if surfaces are close to house.	
Remove or make garden structures permeable that block natural flow paths	Strategically place garden structures to help in maintaining existing flow paths to reduce adverse impacts on neighbouring properties. Make garden structures permeable so that they do not block the natural flow of water and restrict the use of retaining walls that could act as barriers. Note: This type of works may require a planning permit, please consult Melbourne Water.	
Install a smart water tank	Consider retrofitting a smart tank system to automatically release water and increase water storage capacity before a flood event.	

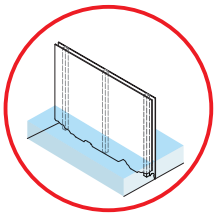
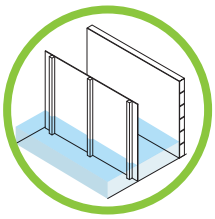
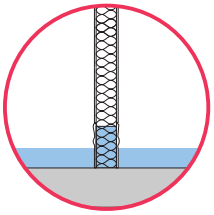
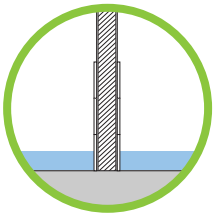
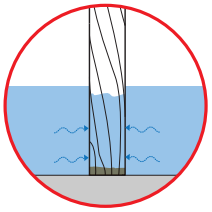
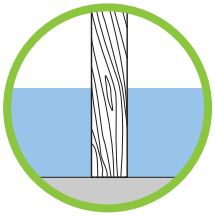
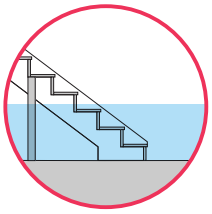
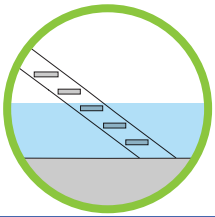
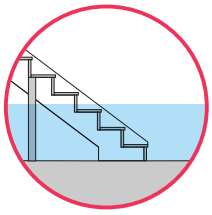
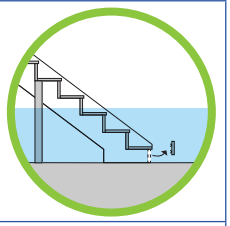
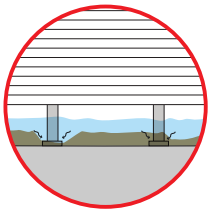
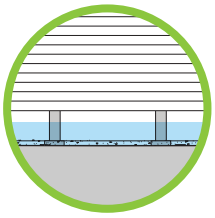
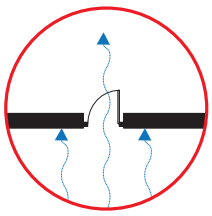
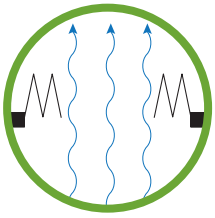
8.2 Strategies

Around the house - dry proofing

Strategy	Description	Do's
Install flood vents below flood level to assist in drying out subfloor spaces	Flood vents are designed to prevent water entry, whilst allowing water to escape subfloor spaces and assist in drying out after a flood event. Note: consult a Victorian Registered Professional engineer to ensure minimum structural requirements are in place.	
Ensure window sill heights are above flood level to prevent water entry	Similar to doorways, windows are point of ingress where water can flow in. If dry-proofing strategies are being used, such as flood doors, ensure that the bottom (sill) of all windows is above the predicted flood line to minimise the chance of water entry.	
Replace external doors with flood doors to prevent water entry	For low-level floods below 600mm, flood doors can be a viable option to prevent water from entering the building through doorways. These doors must be used in conjunction with strategies preventing water entering through exterior walls as the must create a seal around the building perimeter. Note: consult a Victorian Registered Professional engineer to ensure minimum structural requirements are in place.	
Construct concrete hob to prevent water entering subfloor space	For buildings with floors elevated low above the ground, a concrete hob can be used to prevent water entering the space under the floor, avoiding issues such as mould and odours after a flood. The hob should be used in conjunction with flood vents to ensure any water trapped in the subfloor space can dry out or escape. Note: consult a Victorian Registered Professional engineer to ensure minimum structural requirements are in place.	
Apply cementitious render to porous brick walls to minimise water entry	Treating the external wall finishes of spaces that are likely to be flooded is highly recommended. In situations where there is existing brick externally, a cementitious render can be used to make the wall less porous, helping to prevent water entering through the bricks.	
Seal under existing external cladding to minimise water entry	Install a flood resilient fibre cement substrate and apply a waterproof membrane underneath existing external cladding to minimise the chance of water entry into the house. This strategy is most effective when installed in conjunction with installing flood doors.	
Repair and/ or seal all possible gaps to minimise water entry	When dry proofing, treating the external wall finishes of spaces that are likely to be flooded like is highly recommended. In situations where there are gaps in the external walls below the flood line, these should be sealed to prevent water from entering. Please note that this does not include existing weep holes.	

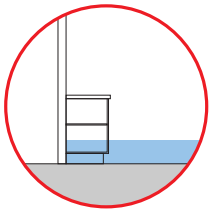
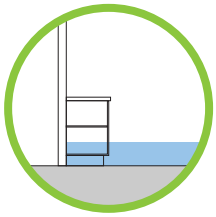
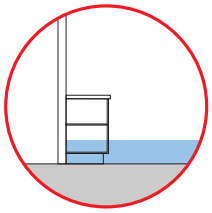
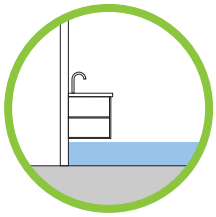
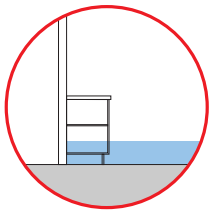
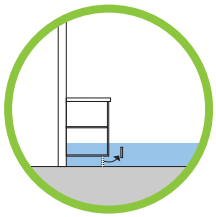
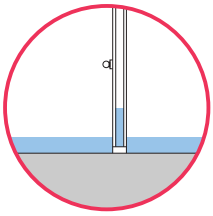
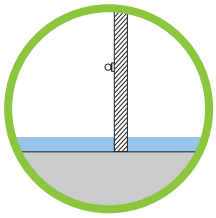
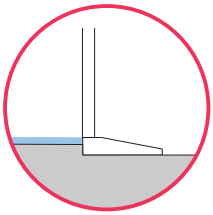
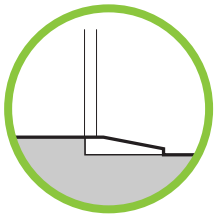
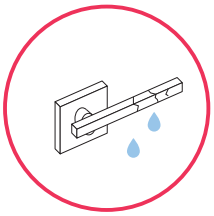
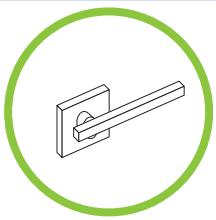
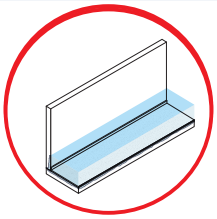
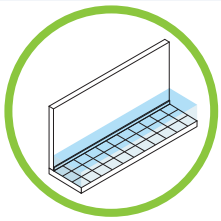
8.2 Strategies

Around the house - wet proofing

Strategy	Description	Do Not's	Do's
Use single-skin walls rather than cavity walls where possible	Walls with cavities such typical plasterboard stud walls are prone to trapping water within the wall linings, damaging the wall framing, and forming mould. Where possible, replacing cavity walls with single-skin construction walls is recommended. Seek guidance from your builder when considering replacing walls.		
Replace loose-fill insulation with rigid insulation	Loose-fill insulation such as 'batts' found in wall cavities absorb a great deal of moisture and must be replaced after a flood to avoid moulding. Replace loose-fill insulation with rigid or closed-cell insulation such as extruded polystyrene insulation as it is flood resilient and helps to fill the gap in a typical cavity wall.		
Use flood resilient wall framing	When building framed walls, it is not recommended to use softwoods such as pine as it is prone to rot and mould after inundation and can decay quickly. Use hardwood timber or steel framing where possible. Consider using sustainable plantation hardwood timbers.		
Construct flood resilient open stairs	Make stairs resilient by using flood resilient materials, such as metals or hardwood and make them open to avoid water being trapped in any cavities beneath the stair. This should be used in conjunction with other wet-proofing strategies if stair is internal.		
Make the bottom riser of stairs removable	If an existing cavity stair on your property is at risk of flooding and you cannot retrofit the stair to have open risers, make the bottom riser removable to enable easy post-flood clean-out.		
For houses with suspended timber floors, construct a concrete blinding layer in subfloor area	A concrete blinding layer is a thin layer of concrete which can be added to the space under a house to allow for easy clean out after a flood event. This seals the underlying material and prevents dirt and mud from interfering with the structure of the house.		
Create large door and window openings on the ground floor	Having only few small openings in your ground floor makes it difficult for water entering your house to escape, trapping water inside and taking longer to dry after a flood event. By having large openings, water can flow out quickly, reducing pressure on your walls and provides more ventilation to dry out after a flood.		

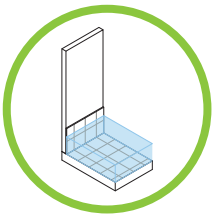
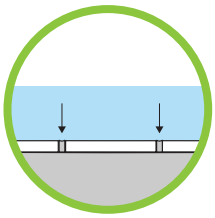
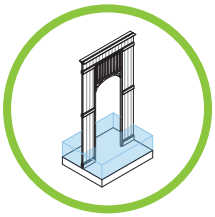
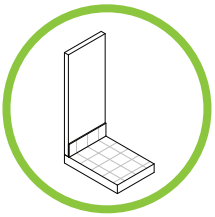
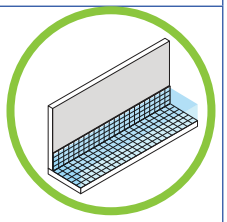
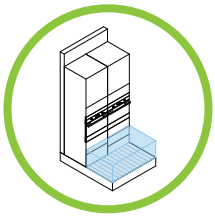
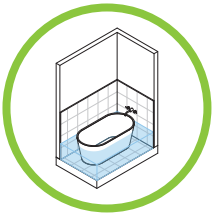
8.2 Strategies

Around the house - wet proofing

Strategy	Description	Do Not's	Do's
Replace non resilient with flood resilient cabinetry	Cabinetry is often the most expensive element in a house to replace after a flood event. This can be avoided through using flood resilient materials for all cabinetry including the carcass (frame).		
Raise cabinetry above flood level where possible	Raise cabinetry above the flood level where possible (e.g. vanity basin in bathrooms). And ensure you have a safe place above the flood level to store belongings in preparation of a flood event.		
Make cabinetry kickboards removable	Make the kickboard on cabinetry units removable to enable easy post-flood clean-out.		
Replace hollow core doors with solid core doors	Avoid the use of hollow core doors to mitigate damage and limit mould growth after a flood event. As an alternative, use solid core, aluminium or glass doors.		
Install flush thresholds in doorways, external pavements and garden edges	Small steps and sills are often the cause of a small layer of water to remain inside of a house, complicating the clean up process after a flood event. Limit thresholds which obstruct the drainage and discharge of flood waters from the interior of your home by installing flush thresholds recessed into a concrete floor.		
Install corrosion resistant door and window hardware	Install corrosion resistant door and window hardware so these do not need to be repaired or replaced following a flood event.		
Replace non resilient flooring with flood resilient flooring and substrate	Replace non resilient flooring with flood resilient flooring materials. When replacing flooring, ensure non resilient substrates (subsurface materials) are replaced with flood resilient substrates. This will minimise warping, rot and damage to the flooring and below the floor.		

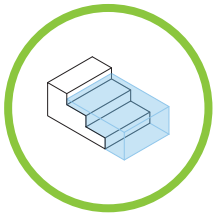
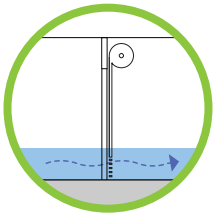
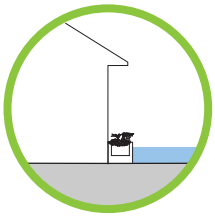
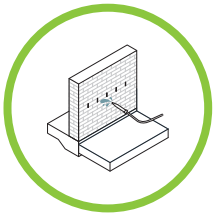
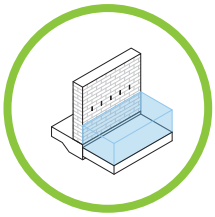
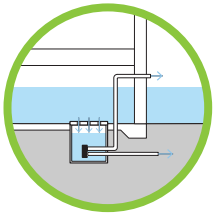
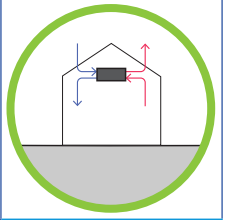
8.2 Strategies

Around the house - wet proofing

Strategy	Description	Do's
Apply sealant to existing tiled areas to above flood level to minimise damage	Apply a grout sealant to an existing tiled floor with non flood resilient grout. Adding a grout sealant will help to increase the water-resistance of the grout, which will minimise the chance of mould and water damage to the tiles after a flood event.	
Use flood resilient grout when tiling or re-tiling wet areas	When tiling or re-tiling wet areas, ensure flood resilient grout is used. Otherwise referred to as 'semi-epoxy' this grout is less porous and ensures that the wall lining beneath tiles is protected and minimises the chance of mould.	
Replace mouldings with flood resilient mouldings	Pine and other softwood moulding is prone to buckling after becoming wet. Replace these with flood resilient mouldings, such as composite or hardwood to ensure resilience. For very low levels of flooding, flood resilient moulding can also be used to protect the bottom of a wall.	
Replace non flood resilient skirtings with flood resilient skirtings	Replace non flood resilient skirtings with flood resilient skirtings such as hardwood timber or tiles to minimise the effects of flood damage. Non flood resilient skirtings such as pine and other softwoods are prone damage such as warping and rot after becoming wet. Flood resilient skirtings also allow for easy wash out after a flood event.	
Replace non-resilient wall linings with flood resilient wall linings	Replacing wall linings in areas that are likely to be flooded is highly recommended. This means using fibre cement or villaboard linings instead of plasterboard, and floor finishes such as tiles or polished concrete instead of carpet. If a timber floor is desired, ensure it is a hardwood floor. Apply waterproofing membrane onto a substrate such as fibre cement sheeting underneath internal wall linings	
Raise kitchen appliances if possible above flood level	If possible, ensure fridges, dishwashers, ovens and all other appliances are installed above the possible flood line to keep your houses kitchen functioning and prevent failure. This is useful for low levels of flooding or when kitchen cabinetry is being made resilient.	
Replace cavity bathtubs with freestanding bathtubs or showers	Built-in baths with cavities, often built into cabinetry or in tiled areas, are prone to trapping water in the gap between the tub and exterior, damaging the framing, and forming mould. A freestanding bathtub or shower eliminates gaps where water can be trapped and enables easy access for cleaning around the entire tub.	

8.2 Strategies

Around the house - wet proofing

Strategy	Description	Do's
Create terraced landscape	Terraced areas are a way of preserving external space while acting as a flood barrier. They can also help reduce the scale of walls, or elevated parts of a building. These should be constructed out of a flood resilient materials and have appropriate structural reinforcing.	
Install permeable garage door to let water flow	Permeable garage doors can help in maintaining existing flow paths to reduce adverse impacts building structures and on neighbouring properties. Make garage doors permeable so that they do not block the natural flow of water. This should be used in conjunction with other wet-proofing strategies if the garage is inside a building.	
Create raised garden beds adjacent to the house	Raised garden beds made from concrete or blockwork can help to act as a flood barrier. These should be constructed out of a flood resilient materials and have appropriate structural reinforcing.	
Clean out any existing weep holes to assist in drying out wall cavities	It is important to clean out any existing weep holes to prevent water getting trapped in the wall cavity.	
Add additional weep holes and air vents above flood level in cavity walls	Installing additional weep holes and air vents will allow subfloor areas and garages to dry out after a flood.	
Retrofit a sump pump to dry out subfloor areas	Install an automatic submersible pump and sump at the lowest point under your home to assist in the removal of flood water in a subfloor area after a flood event.	
Add mechanical heat recovery ventilation systems to dry internal spaces	Mechanical heat recovery ventilation systems (MHRVs) ventilate and dry out internal spaces by allowing fresh air into the house and reduce condensation build up.	

8.3 Materials

Identify which of the following non resilient materials (shown in the middle column) are present in your home and where possible, replace with flood resilient materials (shown in the right hand column).

Building element	Non flood resilient materials	Flood resilient materials
External ground cover (Increase permeable surfaces)	- Concrete - Asphalt	- Grass - Mulch, deep friable soil - Permeable concrete - Permeable paving - Gravel, stones
Fencing (Create openings for water to flow through and construct from resilient materials)	- Pine and other softwoods	- Hardwood timber fencing - Composite timber fencing - PVC gencing - Metal fencing
Wall construction (Where possible, replace cavity walls with single skin walls)	- Wall with cavities	- Single skin stud walls - Single skin brick walls - Solid block walls - Off-form concrete walls
Wall framing (Where possible, replace non resilient materials with flood resilient materials)	- Pine	- Hardwood - Steel
Internal wall linings (Where possible, replace non resilient materials with flood resilient materials)	- Plasterboard - Panelling made from pine or other softwoods - MDF (medium-density fibreboard)	- FC (fibre cement sheeting) - Villaboard - Tiles - Hardwood panelling - Metal - Polycarbonate / translucent sheeting - Marine grade / moisture-resistant plywood
Internal flooring (Where possible, replace non resilient materials with flood resilient materials)	- Carpet - Floating timber floors - Vinyl on a non resilient substrate - Cork	- Polished concrete - Tiles - Hardwood flooring on a flood resilient substrate - Rubber / vinyl on a flood resilient substrate

Please note

This table is to be read in tandem with the flood resilient strategies shown in sections 7, 8.1 and 8.2 of this document.

Building element	Non flood resilient materials	Flood resilient materials
Internal floor substrate (Where possible, replace non resilient materials with flood resilient materials)	- MDF - Paticle board (yellow tongue sheet flooring) - Low grade, non-marine plywood	- FC (fibre cement sheeting)
Insulation (Eliminate wall cavities by replacing loose fill insulation with rigid insulation)	- Wool and fibre cement batts - Other spray products	- XPS (rigid) insulation - Closed cell flexible sheet insulation - Sprayed polyeurethane foam
Doors and windows (Replace cavity doors)	- Hollow core doors	- Solid core doors (wet proofing) - Flood doors (dry proofing)
Cabinetry frame (Where possible, replace non resilient materials with flood resilient materials)	- Particle board - MDF panels	- Compact laminate - Acrylic solid surface - Marine grade ply - Composite timber panels - Stainless steel frame (open)
Cabinetry benchtops (Where possible, replace non resilient materials with flood resilient materials)	- Laminate - Particle board - MDF	- Acrylic solid surface - Marine grade ply - Stone - Composite stone - Stainless steel
Grout (When retiling, use a flood resilient grout)	- Cementitious grout	- Semi-epoxy grout - Epoxy grout - Polymer resin grout

Thank you