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OPTION FM - RB05
1\% AEP EVENT HAZARD IMPACT

Appendix A

## APPENDIX A: GLOSSARY

## Taken from the Floodplain Development Manual (April 2005 edition)

acid sulfate soils<br>\section*{Annual Exceedance Probability (AEP)}

## Australian Height Datum (AHD)

Average Annual Damage (AAD)

## Average Recurrence Interval (ARI)

caravan and moveable home parks

## catchment

## consent authority

development

Are sediments which contain sulfidic mineral pyrite which may become extremely acid following disturbance or drainage as sulfur compounds react when exposed to oxygen to form sulfuric acid. More detailed explanation and definition can be found in the NSW Government Acid Sulfate Soil Manual published by Acid Sulfate Soil Management Advisory Committee.

The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of $500 \mathrm{~m}^{3} / \mathrm{s}$ has an AEP of $5 \%$, it means that there is a $5 \%$ chance (that is one-in- 20 chance) of a $500 \mathrm{~m}^{3} / \mathrm{s}$ or larger event occurring in any one year (see ARI).

A common national surface level datum approximately corresponding to mean sea level.

Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time.

The long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.

Caravans and moveable dwellings are being increasingly used for long-term and permanent accommodation purposes. Standards relating to their siting, design, construction and management can be found in the Regulations under the LG Act.

The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.

The Council, government agency or person having the function to determine a development application for land use under the EP\&A Act. The consent authority is most often the Council, however legislation or an EPI may specify a Minister or public authority (other than a Council), or the Director General of DIPNR, as having the function to determine an application.

Is defined in Part 4 of the Environmental Planning and Assessment Act (EP\&A Act).
infill development: refers to the development of vacant blocks of land that are generally surrounded by developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development.
new development: refers to development of a completely different nature to that associated with the former land use. For example, the urban subdivision of an area previously used for rural purposes. New developments involve rezoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power.

| disaster plan (DISPLAN) | A step by step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of connected emergency operations, with the object of ensuring the coordinated response by all agencies having responsibilities and functions in emergencies. |
| :---: | :---: |
| discharge | The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second $\left(\mathrm{m}^{3} / \mathrm{s}\right)$. Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second ( $\mathrm{m} / \mathrm{s}$ ). |
| ecologically sustainable development (ESD) | Using, conserving and enhancing natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be maintained or increased. A more detailed definition is included in the Local Government Act 1993. The use of sustainability and sustainable in this manual relate to ESD. |
| effective warning time | The time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions. |
| emergency management | A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding. |
| flash flooding | Flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain. |
| flood | Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami. |
| flood awareness | Flood awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures. |
| flood education | Flood education seeks to provide information to raise awareness of the flood problem so as to enable individuals to understand how to manage themselves an their property in response to flood warnings and in a flood event. It invokes a state of flood readiness. |
| flood fringe areas | The remaining area of flood prone land after floodway and flood storage areas | have been defined.

Is synonymous with flood prone land (i.e. land susceptible to flooding by the probable maximum flood (PMF) event). Note that the term flood liable land covers the whole of the floodplain, not just that part below the flood planning level
(see flood planning area).

| flood mitigation standard | The average recurrence interval of the flood, selected as part of the floodplain risk <br> management process that forms the basis for physical works to modify the <br> impacts of flooding. |
| :--- | :--- |
| floodplain | Area of land which is subject to inundation by floods up to and including the <br> probable maximum flood event, that is, flood prone land. |
| floodplain risk |  |
| management options | The measures that might be feasible for the management of a particular area of <br> the floodplain. Preparation of a floodplain risk management plan requires a <br> detailed evaluation of floodplain risk management options. |
| floodplain risk |  |
| management plan | A management plan developed in accordance with the principles and guidelines <br> in this manual. Usually includes both written and diagrammetic information <br> describing how particular areas of flood prone land are to be used and managed <br> to achieve defined objectives. |
| A sub-plan of a disaster plan that deals specifically with flooding. They can exist |  |


| flood storage areas | Those parts of the floodplain that are important for the temporary storage of <br> floodwaters during the passage of a flood. The extent and behaviour of flood <br> storage areas may change with flood severity, and loss of flood storage can <br> increase the severity of flood impacts by reducing natural flood attenuation. <br> Hence, it is necessary to investigate a range of flood sizes before defining flood <br> storage areas. |
| :--- | :--- |
| Those areas of the floodplain where a significant discharge of water occurs during |  |
| floods. They are often aligned with naturally defined channels. Floodways are |  |
| areas that, even if only partially blocked, would cause a significant redistribution of |  |
| flood flows, or a significant increase in flood levels. |  |$\quad$| Freeboard provides reasonable certainty that the risk exposure selected in |
| :--- |
| deciding on a particular flood chosen as the basis for the FPL is actually provided. |
| It is a factor of safety typically used in relation to the setting of floor levels, levee |
| crest levels, etc. Freeboard is included in the flood planning level. |
| freeboard |
| in a residential situation: a living or working area, such as a lounge room, dining |
| room, rumpus room, kitchen, bedroom or workroom. |$\quad$| in an industrial or commercial situation: an area used for offices or to store |
| :--- |

## mathematical/computer models

merit approach<br>minor, moderate and major flooding

## modification measures

## peak discharge

Probable Maximum Flood (PMF)

- water depths generally in excess of 0.3 m (in the major system design storm as defined in the current version of Australian Rainfall and Runoff). These conditions may result in danger to personal safety and property damage to both premises and vehicles; and/or
- major overland flow paths through developed areas outside of defined drainage reserves; and/or
- the potential to affect a number of buildings along the major flow path.

The mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain.

The merit approach weighs social, economic, ecological and cultural impacts of land use options for different flood prone areas together with flood damage, hazard and behaviour implications, and environmental protection and well being of the Stateas rivers and floodplains.

The merit approach operates at two levels. At the strategic level it allows for the consideration of social, economic, ecological, cultural and flooding issues to determine strategies for the management of future flood risk which are formulated into Council plans, policy and EPIs. At a site specific level, it involves consideration of the best way of conditioning development allowable under the floodplain risk management plan, local floodplain risk management policy and EPIs.

Both the State Emergency Service and the Bureau of Meteorology use the following definitions in flood warnings to give a general indication of the types of problems expected with a flood:
minor flooding: causes inconvenience such as closing of minor roads and the submergence of low level bridges. The lower limit of this class of flooding on the reference gauge is the initial flood level at which landholders and townspeople begin to be flooded.
moderate flooding: low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic routes may be covered.
major flooding: appreciable urban areas are flooded and/or extensive rural areas are flooded. Properties, villages and towns can be isolated.

Measures that modify either the flood, the property or the response to flooding. Examples are indicated in Table 2.1 with further discussion in the Manual.

The maximum discharge occurring during a flood event.
The PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event
should be addressed in a floodplain risk management study.

Probable Maximum Precipitation (PMP)
probability
risk
runoff
stage

## stage hydrograph

## survey plan

water surface profile
wind fetch

The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to PMF estimation.

A statistical measure of the expected chance of flooding (see AEP).
Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment.

The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.

Equivalent to water level. Both are measured with reference to a specified datum.

A graph that shows how the water level at a particular location changes with time during a flood. It must be referenced to a particular datum.

A plan prepared by a registered surveyor.
A graph showing the flood stage at any given location along a watercourse at a particular time.

The horizontal distance in the direction of wind over which wind waves are generated.

# Woolloomooloo Catchment Floodplain Risk Management Study and Plan 

June 2014

The City of Sydney is preparing a Floodplain Risk Management Study and Plan for the Woolloomooloo catchment area and we would like your help.

The study will tell us about the type of flood mitigation solutions feasible for the catchment and help us plan for and manage any flood risks.

Good management of flood risks can help reduce damage and improve social and economic opportunities.

## cityofsydney.nsw.gov.au/floodplain-management



The City of Sydney has engaged WMAwater to assist with the preparation of the Woolloomooloo Floodplain Risk Management Study and Plan.

The Woolloomooloo Flood Study was completed by WMAwater in July 2013, giving the City of Sydney a better understanding of the nature of flooding in your area. The next step in the NSW Government Flood Management Process is the preparation of a Floodplain Risk Management Study and Plan. The purpose of this study and plan is to identify and recommend appropriate actions to manage flood risks in the Woolloomooloo area.
This brochure is an introduction to the Floodplain Risk Management Study and Plan and its objectives.

Stages of the NSW Government Floodplain Management Process

## 1. Formation of a Committee

 - complete2. Data Collection - complete
3. Flood Study - complete
4. Floodplain Risk Management Study
5. Floodplain Risk Management Plan
6. Implementation of Plan.


Study area and flooding issues The Woolloomooloo study area includes parts of Woolloomooloo, CBD, Potts Point, Kings Cross and Darlinghurst.
Much of the flooding in this catchment occurs due to natural depressions and low points. In the past, flooding has caused property damage and posed a hazard to people and property located near drainage areas. The Floodplain Risk Management Study and Plan currently being undertaken is to manage these flood risks.

## Have your say

We want your comments about previous flood experiences and potential mitigation options.
The local knowledge of residents and business operators, including your personal experiences of flooding is a valuable source of information.

The information you provide in the accompanying questionnaire will help the City of Sydney determine how to manage the floods in your area.
For more information about this project, please contact the City of Sydney or WMAwater via the details provided.

For more information please contact:

## WMAwater

Steve Gray
Phone 0292992855
Fax: 0292626208
gray@wmawater.com.au

City of Sydney Shah Alam Phone: 0292885925 salam@cityofsydney.nsw.gov.au


## Floodplain risk

## management options

The following list of floodplain risk management options are examples of the type of strategies that could be considered to minimise risk and reduce the impact of flooding in the catchment. These options will be investigated in more detail during the preparation of the Management Study and Plan. The general categories of these options are:
Flood modification options.
Examples include:

- Construction of detention/retarding basins to reduce the peak flow downstream;
- Upgrading of drainage systems, upgrade of existing pipes or construction of new pipes; and
- Regrading of roads to provide better overland flowpaths.


## Property modification options and planning control.

Examples include:

- Building and development controls; and
- Flood-proofing measures, such as flood barriers.


## Response modification options.

Examples include:

- Revision of the Local Disaster Plan;
- Public awareness and education -locality-based flooding information for residents;
- Public awareness and education flooding information for schools;
- Flood depth markers at major (flood-affected) road crossings;
- Continuation of existing public awareness and education campaigns; and
- Data collection strategies for future floods.


## Local Resident/Land Owner Survey

The City of Sydney is carrying out a Floodplain Risk Management Study and Plan for the Woolloomooloo catchment. Please return your completed questionnaire in the reply-paid envelope by 20 July 2014. Or complete the questionnaire online at www.cityofsydney.nsw.gov.au/floodplain-management.

1
Please provide the following details as we may contact you to discuss some of the information you have provided us. This is optional.

Name:
Address:
Contact phone number: $\qquad$
Email:

2

What is the best way to contact you?
$\square$ Letter (post)
$\square$ EmailPhone


How many people regularly live/work on this property?
$\qquad$
$\qquad$
$\qquad$

How many of the permanent residents/workers are in age group below:
$\square 0-4$ years
$\square 5-14$ years
$\square$ 15-64 years
$\square 65+$ years


What is the main language spoken at this address?EnglishOther (please specify)

Is your property (please tick)
$\square$ owner occupied $\quad \square$ occupied by a tenant $\square$ Business
$\square$ other (please specify) $\qquad$

What type of structure is your property/business? (please tick)
$\square$ Freestanding house $\qquad$
$\square$ Apartment.
$\square$ Dual occupancy
$\square$ Industrial $\qquad$
$\square$ Commercial $\qquad$


How long have you lived, worked at, and/or owned this property?
Years
Months

9

Have you ever experienced flooding since living and/or working in the Woolloomooloo catchment? (please tick relevant boxes)
$\square$ Yes, floodwaters entered my house/business
$\square$ Yes, floodwaters entered my yard/surrounds of my business
$\square$ Yes, the road was flooded and I couldn't get to my car
$\square$ Yes, other parts of my neighbourhood were flooded
$\square$ No, I haven't experienced flooding

Do you have any materials or photos you can provide to evidence the flooding you experienced? If yes, when did this flood occur?
$\square$ No
$\square$ Yes - the flooding occurred on:

## As a local resident who may have witnessed flooding/drainage problems, you may have your own ideas about how to reduce flood risks. Which of the following do you prefer ( $1=$ most preferred, $5=$ least preferred)?

| Proposed option | Preference |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Retarding or detention basins (these temporarily hold water and reduce peak flood flows) Suggested location/other comments: | 1 | 2 | 4 | 5 |
| Improved flood flow paths Suggested location/other comments: | 1 | 2 | 4 | 5 |
| Pit and pipe upgrades Suggested location/other comments: | 1 | 2 | 4 | 5 |
| Levee banks or flood walls Suggested location/other comments: | 1 | 2 | 4 | 5 |
| Strategic planning and flood related development controls Suggested location/other comments: | 1 | 2 | 4 | 5 |
| Education of the community, providing greater awareness of potential hazards Suggested location/other comments: | 1 | 2 | 4 | 5 |
| Flood forecasting, flood warnings, evacuation planning and emergency response measures Suggested location/other comments: | 1 | 2 | 4 | 5 |

Other (please specify any options you think are suitable): $\qquad$
$\qquad$
$\qquad$
$\qquad$
If you have any further comments that relate to the Woolloomooloo Flood Management Study and Plan, please write them in the space below. Feel free to attach additional pages if necessary.
$\qquad$
$\qquad$
$\qquad$

## Glossary

Levee bank/flood wall - an embankment or wall, usually constructed from earth or concrete, built along the banks of a watercourse to help prevent overflow of its waters.
Retarding/detention basin - depression in the land surface that captures and holds stormwater runoff allowing it to slowly drain out of the basin into the adjoining natural drainage line or creek.

Privacy notice: The information supplied will be used by the City of Sydney and its consultants to consider flooding matters within the local government area. Personal information will remain confidential, however responses may be accessed by third parties through the Government Information (Public Access) Act 2009.

Woolloomooloo Floodplain Risk Management Study and Plan



| Table C1: <br> Item No. | Cost Estimate - Option FM-WLM01 - Woolloomooloo Trunk P | Upgrade | Unit | Ra |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | General Construction Costs |  |  |  |  |  |
| 1.1 | Site establishment, security fencing, facilities and disestablishment |  | item | 0 |  | 0 |
| 1.2 | Provision of sediment and erosion control |  | item | 0 |  | 0 |
| 1.3 | Construction setout and survey |  | item | 0 |  | 0 |
| 1.4 | Work as executed survey and documentation |  | item | 0 |  | 0 |
| 1.5 | Geotechnical supervision, testing and certification |  | item | 0 |  | 0 |
|  | SUBTOTAL (Assumed as 15\% of works cost) |  |  |  | \$ | 2,555,282 |
| 2 | Demolition and Clearing |  |  |  |  |  |
| 2.1 | Clearing and grubbing |  | sq. m | 11 |  | 0 |
| 2.2 | Strip topsoil and stockpile for re-use (assuming 150 mm depth) |  | cu. m | 27 |  | 0 |
| 2.3 | Dispose of excess topsoil (nominal 10\% allowance) | 0 | cu. m | 65 |  | 0 |
| 2.4 | Pull up and dispose existing road surface | 3,752 | sq. m | 38 |  | 141,834 |
|  | SUBTOTAL |  |  |  | \$ | 141,834 |
| 4 | Installation of Drainage |  |  |  |  |  |
| 4.8 | Supply, excavate, bed, lay, joint, backfill and provide connections 1.8 m dia. Pipe | 401 | lin. m | 3564 |  | 1,427,409 |
| 4.24 | Supply, excavate, bed, lay, joint, backfill and provide connections $1.8 \mathrm{~m} \times 1.2 \mathrm{~m}$ culvert | 141 | lin. m | 3456 |  | 485,716 |
| 4.26 | Supply, excavate, bed, lay, joint, backfill and provide connections $2.1 \mathrm{~m} \times 1.2 \mathrm{~m}$ culvert | 87 | lin. m | 3240.00 |  | 282,514 |
| 4.28 | Supply, excavate, bed, lay, joint, backfill and provide connections $2.1 \mathrm{~m} \times 2.1 \mathrm{~m}$ culvert |  | lin. m | 4320.00 |  | 20,419 |
| 4.30 | Supply, excavate, bed, lay, joint, backfill and provide connections $2.7 \mathrm{~m} \times 1.2 \mathrm{~m}$ culvert | 95 | lin. m | 4228.00 |  | 403,530 |
| 4.31 | Supply, excavate, bed, lay, joint, backfill and provide connections $2.7 \mathrm{~m} \times 1.5 \mathrm{~m}$ culvert | 377 | lin. m | 4428.00 |  | 1,670,709 |
| 4.33 | Supply, excavate, bed, lay, joint, backfill and provide connections $2.4 \mathrm{~m} \times 2.1 \mathrm{~m}$ culvert | 71 | lin. m | 4336.00 |  | 309,109 |
| 4.37 | Supply, excavate, bed, lay, joint, backfill and provide connections $3.0 \mathrm{~m} \times 1.5 \mathrm{~m}$ culvert | 59 | lin. m | 5508.00 |  | 322,322 |
| 4.38 | Supply, excavate, bed, lay, joint, backfill and provide connections $3.0 \mathrm{~m} \times 1.8 \mathrm{~m}$ culvert | 205 | lin. m | 5708.00 |  | 1,169,510 |
| 4.39 | Supply, excavate, bed, lay, joint, backfill and provide connections $2 \times 3.0 \mathrm{~m} \times 1.5 \mathrm{~m}$ culvert | 42 | lin. m | 5940.00 |  | 250,511 |
| 4.40 | Supply, excavate, bed, lay, joint, backfill and provide connections $2 \times 3.0 \mathrm{~m} \times 2.1 \mathrm{~m}$ culvert | 394 | lin. m | 6140.00 |  | 2,416,222 |
| 4.49 | Install new drainage/junction pit (assumed 1 pit per 5 m of pipe) | 375 | each | 4,320 |  | 1,620,000 |
| 4.51 | Adjustment of existing services (nominal allowance) (assumed 50\% of drainage installation cost) | 7,440,427 | item | 74,547 |  | 7,440,427 |
|  | SUBTOTAL |  |  |  | \$ | 15,393,987 |
| 7 | Footpath and Road Surfaces |  |  |  |  |  |
| 7.1 | Reinstate disturbed road pavement, including demolition and disposal of additional material to provide good jointing | 3,752 | sq. m | 130 |  | 486,288 |
|  | SUBTOTAL |  |  |  | \$ | 486,288 |
|  | Traffic Management |  |  |  |  |  |
| 9.1 | Control of traffic during works (nominal allowance) (assumed $\$ 500$ per lin.m) | 1,876 | lin. m | 540 |  | 1,013,101 |
|  | SUBTOTAL |  |  |  | \$ | 1,013,101 |
|  |  |  |  |  |  |  |
|  | CONSTRUCTION SUBTOTAL |  |  |  | \$ | 19,590,492 |
| 11 | Contingencies |  |  |  | \$ | - |
| 11.1 | 50\% construction cost |  |  |  | \$ | 9,795,246 |




| Table C3: Cost Estimate - Option FM-WLM03 -Victoria Street Pipe Upgrade |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Item No. | Description of work | Quantity | Unit | Rate | WLM03 |  |
|  | General Construction Costs |  |  |  |  |  |
| 1.1 | Site establishment, security fencing, facilities and disestablishment |  | item | 0 |  | 0 |
| 1.2 | Provision of sediment and erosion control |  | item | 0 |  | 0 |
| 1.3 | Construction setout and survey |  | item | 0 |  | 0 |
| 1.4 | Work as executed survey and documentation |  | item | 0 |  | 0 |
| 1.5 | Geotechnical supervision, testing and certification | 1 | item | 0 |  | 0 |
|  | SUBTOTAL (Assumed as 15\% of works cost) |  |  |  | \$ | 276,331 |
| 2 | Demolition and Clearing |  |  |  |  |  |
| 2.1 | Clearing and grubbing | 0 | sq. m | 11 |  | 0 |
| 2.2 | Strip topsoil and stockpile for re-use (assuming 150 mm depth) |  | cu. m | 27 |  | 0 |
| 2.3 | Dispose of excess topsoil (nominal 10\% allowance) | 0 | cu. m | 65 |  | 0 |
| 2.4 | Pull up and dispose existing road surface | 1,062 | sq. m | 38 |  | 40,159 |
|  | SUBTOTAL |  |  |  | \$ | 40,159 |
| 4 | Installation of Drainage |  |  |  |  |  |
| 4.20 | Supply, excavate, bed, lay, joint, backfill and provide connections $1.0 \mathrm{~m} \times 1.0 \mathrm{~m}$ culvert | 531 | lin. m | 2,268 |  | 1,204,762 |
| 4.49 | Install new drainage/junction pit (assumed 1 pit per 50m of pipe) | 11 | each | 4,320 |  | 47,520 |
| 4.51 | Adjustment of existing services (nominal allowance) (assumed 10\% of drainage installation cost) | 137,751 | item | 74,547 |  | 33,516 |
|  | SUBTOTAL |  |  |  | \$ | 1,377,510 |
| 7 Footpath and Road Surfaces |  |  |  |  |  |  |
| 7.1 | Reinstate disturbed road pavement, including demolition and disposal of additional material to provide good jointing SUBTOTAL | 1,062 | sq. m | 130 |  | 137,687 |
|  |  |  |  |  | \$ | 137,687 |
| 9 | Traffic Management |  |  |  |  |  |
| 9.1 | $\qquad$ (assumed $\$ 500$ per lin.m) | 531 | lin. m | 540 |  | 286,848 |
|  | SUBTOTAL |  |  |  | \$ | 286,848 |
| 11 |  |  |  |  |  |  |
|  | CONSTRUCTION SUBTOTAL |  |  |  | \$ | 2,118,534 |
|  | Contingencies |  |  |  | \$ | - |
| 11.1 | 50\% construction cost |  |  |  | \$ | 1,059,267 |
| - |  |  |  |  |  |  |
|  | CONSTRUCTION TOTAL, exc. GST |  |  |  | \$ | 3,177,801 |
|  | GST |  |  |  | \$ | 317,780 |
|  | CONSTRUCTION TOTAL, inc. GST |  |  |  | \$ | 3,495,581 |
|  | CONSTRUCTION TOTAL, rounded |  |  |  | \$ | 3,495,600 |
|  | MAINTENANCE |  |  |  |  |  |
| 11 |  |  |  |  |  |  |
| 11.1 | Maintenance of mitigation option |  | item |  | \$ | 5,312 |
|  |  |  |  |  |  |  |

Table C5: Cost Estimate - Option FM-WLM05 -Victoria Street Pipe Upgrade

| Item No. | Description of work | Quantity | Unit | Rate | WLM05 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | General Construction Costs |  |  |  |  |  |
| 11 | ste estadisnment, securty rencing, facilities and disestablishment |  | item | 0 |  | 0 |
| 1.2 | Provision of sediment and erosion control |  | item | 0 |  | 0 |
| 1.3 | Construction setout and survey |  | item | 0 |  | 0 |
| 1.4 | Work as executed survey and documentation |  | item | 0 |  | 0 |
| 1.5 | Geotechnical supervision, testing and certification |  | item | 0 |  | 0 |
|  | SUBTOTAL (Assumed as $15 \%$ of works cost) |  |  |  | \$ | 79,799 |
| 2 | Demolition and Clearing |  |  |  |  |  |
| 2.1 | Clearing and grubbing |  | sq. m | 11 |  | 0 |
| 2.2 | Strip topsoil and stockpile for re-use (assuming 150 mm depth) |  | cu. m | 27 |  | 0 |
| 2.3 | Dispose of excess topsoil (nominal 10\% allowance) |  | cu. m | 65 |  | 0 |
| 2.4 | Pull up and dispose existing road surface | 450 | sq. m | 38 |  | 17,010 |
|  | SUBTOTAL |  |  |  | \$ | 17,010 |
| 4 | Installation of Drainage |  |  |  |  |  |
| 4.2 | Supply, excavate, bed, lay, joint, backfill and provide connections 0.6 m dia. Pipe | 35 | lin. m | 1,053 |  | 36,855 |
| 4.3 | Supply, excavate, bed, lay, joint, backfill and provide connections 0.9 m dia. Pipe | 190 | lin. m | 1,296 |  | 246,240 |
| 4.49 | Install new drainage/junction pit (assumed 1 pit per 50 m of pipe) |  | each | 4,320 |  | 21,600 |
| 4.51 | Adjustment of existing services (nominal allowance) (assumed 10\% of drainage installation cost) | 33,516 | item | 74,547 |  | 33,516 |
|  | SUBTOTAL |  |  |  | \$ | 335,165 |
| 7 | Footpath and Road Surfaces |  |  |  |  |  |
| 7.1 | Reinstate disturbed road pavement, including demolition and disposal of additional material to provide good jointing | 450 | sq. m | 130 |  | 58,320 |
|  | SUBTOTAL |  |  |  | \$ | 58,320 |
| 9 | Traffic Management |  |  |  |  |  |
| 9.1 | Control of traffic during works (nominal allowance) (assumed $\$ 500$ per lin.m) | 225 | lin. m | 540 |  | 121,500 |
|  | SUBTUTAL |  |  |  | \$ | 121,500 |
|  | CONSTRUCTION SUBTOTAL |  |  |  | \$ | 611,794 |
| 11 | Contingencies |  |  |  | \$ | - |
| 11.1 | 50\% construction cost |  |  |  | \$ | 305,897 |
|  |  |  |  |  |  |  |
|  | CONSTRUCTION TOTAL, exc. GST |  |  |  | \$ | 917,691 |
|  | GST |  |  |  | \$ | 91,769 |
|  | CONSTRUCTION TOTAL, inc. GST |  |  |  | \$ | 1,009,460 |
|  | CONSTRUCTION TOTAL, rounded |  |  |  | \$ | 1,009,500 |
|  |  |  |  |  |  |  |
|  | MAINTENANCE |  |  |  |  |  |


| $\mathbf{1 1 . 1}$ | Maintenance of mitigation option |  | item |  | \$ |
| ---: | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |

Table D1: Residential Tangible Damages - Option FM - WLM01

| Event | No. Properties Affected (Flooded below floor) | No. Properties Flooded Above Floor Level | Total Damages for Event |  | Ave. Damage Per Flood Affected Property |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| PMF | 202 | 155 | \$ | 8,608,800 | \$ | 42,600 |
| 1.0\% | 143 | 48 | \$ | 3,027,200 | \$ | 21,200 |
| 2.0\% | 125 | 33 | \$ | 2,284,700 | \$ | 18,300 |
| 5.0\% | 107 | 26 | \$ | 1,856,300 | \$ | 17,300 |
| 10.0\% | 99 | 21 | \$ | 1,483,700 | \$ | 15,000 |
| 20.0\% | 92 | 11 | \$ | 949,900 | \$ | 10,300 |
| 50.0\% | 82 | 5 | \$ | 511,800 | \$ | 6,200 |
| Average Annual Damages (AAD) |  |  | \$ | - | \$ | - |

Table D2: Commercial Tangible Damages - Option FM - WLM01

| Event | No. Properties Affected (Flooded below floor) | No. Properties Flooded Above Floor Level | Total Damages for Event |  | Ave. Damage Per Flood Affected Property |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| PMF | 112 | 92 | \$ | 15,124,600 | \$ | 135,000 |
| 1.0\% | 83 | 42 | \$ | 6,317,700 | \$ | 76,100 |
| 2.0\% | 82 | 34 | \$ | 5,287,200 | \$ | 64,500 |
| 5.0\% | 76 | 28 | \$ | 4,319,000 | \$ | 56,800 |
| 10.0\% | 74 | 13 | \$ | 2,273,300 | \$ | 30,700 |
| 20.0\% | 68 | 10 | \$ | 1,804,700 | \$ | 26,500 |
| 50.0\% | 60 | 6 | \$ | 1,133,400 | \$ | 18,900 |
| Average Annual Damages (AAD) |  |  | \$ | - | \$ | - |

Table D3: Combined Tangible Damages - Option FM - WLM01

| Event | No. Properties Affected (Flooded below floor) | No. Properties Flooded Above Floor Level | Total Damages for Event |  | Ave. Damage Per Flood Affected Property |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| PMF | 314 | 247 | \$ | 23,733,400 | \$ | 75,600 |
| 1\% | 226 | 90 | \$ | 9,344,900 | \$ | 41,300 |
| 2\% | 207 | 67 | \$ | 7,571,900 | \$ | 36,600 |
| 5\% | 183 | 54 | \$ | 6,175,300 | \$ | 33,700 |
| 10\% | 173 | 34 | \$ | 3,757,000 | \$ | 21,700 |
| 20\% | 160 | 21 | \$ | 2,754,000 | \$ | 17,200 |
| 50\% | 142 | 11 | \$ | 1,645,200 | \$ | 11,600 |
| Average Annual Damages (AAD) |  |  | \$ | - | \$ | - |





| Floor Level Survey (undertaken in 2012 as part of Woolloomooloo Flood Study) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  | RESIDENTIAL BUILDINGS |  |  |  |  |  | NON RESIDENTIAL BUILDINGS |  |  |  |  |  |
| Parcel Tag as on Council cadastre (GIS Tag) | Photograph name | Total <br> number <br> of <br> buildings | $\begin{array}{\|c\|} \hline \begin{array}{c} \text { Street } \\ \text { Number } \end{array} \\ \hline \end{array}$ | Street Name | Indicative <br> Ground Level (m AHD) | Lowest <br> Habitable <br> Floor Level <br> (m AHD) | Single <br> (S) or <br> Double <br> storey <br> (D) | $\begin{array}{\|l\|} \hline \text { Do people live } \\ \hline \text { on the Ground } \\ \hline \text { Floor }(\mathrm{Y} \text { or } \mathrm{N}) \\ \hline \end{array}$ |  | Floor <br> Construction <br> Pier (P) or <br> Slab (S) Other <br> describe | Wall Construction Brick, Stone or Rendered ( $B$ ), Clad (C), Mixed (M) | Type (Commercial $=$ C, Industrial $=$ I, Public $=$ P) | Name and Nature of Use/Business | Lowest <br> Floor <br> Level <br> Im <br> AHD)$\|$ | $\begin{array}{\|c\|} \hline \text { Approximate } \\ \frac{\text { Floor Area }}{\left(\mathrm{m}^{2}\right)} \end{array}$ | Floor <br> Construction <br> Pier (P) or <br> Slab (S) Other <br> describe | Wall Construction Brick, Stone or Rendered (B), Clad (C), Mixed (M) |
| 596915 | Stanley-047-596915 | 1 | 47 | Stanley Street | 15.12 | 15.44 | D | Y | M | P | B |  |  |  |  |  |  |
| 596914 | Stanley-045-596914 | 1 | 45 | Stanley Street | 15.21 | 15.48 | , | Y | M | P | B |  |  |  |  |  |  |
| 531707 | Thomson-008-531707 | 1 | 8 | Thomson Street | 38.50 | 39.14 | 3 | Y | M | P | B |  |  |  |  |  |  |
| 531711 | Thomson-016-531711 | 1 | 16 | Thomson Street | 38.63 | 39.45 | D | Y | M | P | B |  |  |  |  |  |  |
| 531710 | Thomson-014-531710 | 1 | 14 | Thomson Street | 38.63 | 39.42 | D | Y | M | P | B |  |  |  |  |  |  |
| 531709 | Thomson-012-531709 | 1 | 12 | Thomson Street | 38.60 | 39.42 | D | Y | M | P | B |  |  |  |  |  |  |
| 531708 | Thomson-010-531708 | 1 | 10 | Thomson Street | 38.55 | 39.44 | D | Y | M | P | B |  |  |  |  |  |  |
| 634063 | Victoria-075-634063 | 1 | 75 | Victoria Street | 25.77 | 23.78 | 3 | Y | M | S | B |  |  |  |  |  |  |
| 632506 | Victoria-065-632506 | 1 | 65 | Victoria Street | 24.22 | 2.51 (Approx | 4 | Y | M | S | B |  |  |  |  |  |  |
| 532144 | Victoria-171-173-532144 | 1 | 171-173 | Victoria Street | 32.00 |  |  |  |  |  |  | c | Piccadilly Hotel | 32.41 | 480 | 5 | B |
| 532136 | Victoria-169-532136 | 1 | 169 | Victoria Street | 31.92 |  |  |  |  |  |  | c | Golden Apple | 30.12 | 150 | S | B |
| 532130 | Victoria-165-167-532130 | 1 | 165-167 | Victoria Street | 31.69 |  | 5 | N | L | s | B | c | Doughboy \& Express Food Catering | 29.13 | 340 | S | B |
| 532123 | Victoria-163-532123 | 1 | 163 | Victoria Street | 31.63 | 32.39 | 3 | Y | M | S | B |  |  |  |  |  |  |
| 532119 | Victoria-161-532119 |  | 161 | Victoria Street | 31.59 | 99.86 (Approx | 3 | Y | M | S | B |  |  |  |  |  |  |
| 532114 | Victoria-159-532114 | 1 | 159 | Victoria Street | 31.52 | 29.81 | 4 | Y | L | S | B |  |  |  |  |  |  |
| 532111 | Victoria-157-532111 |  | 157 | Victoria Street | 31.46 | 29.12 (Approx | 4 | Y | L | S | B |  |  |  |  |  |  |
| 532107 | Victoria-155-532107 | 1 | 155 | Victoria Street | 31.38 |  |  |  |  |  |  | C | Ms Gs Restaurant | 31.41 | 120 | s | B |
| 532004 | Victoria-123-125-532004 | 1 | 123-125 | Victoria Street | 30.21 |  |  |  |  |  |  | c | Mezalona Ristorante Italiano | 27.39 | 290 | s | B |
| 532000 | Victoria-119-121-532000 | 1 | 119-121 | Victoria Street | 30.14 | 28.73 | 4 | Y | L | s | B |  |  |  |  |  |  |
| 531998 | Victoria-117-531998-Rear | 1 | 117 | Victoria Street | 11.93 | 14.41 | 11 | Y | L | S | B |  |  |  |  |  |  |
| 531981 | Victoria-101-115-531981 | Abt 8 | 101-115 | Victoria Street | 27.37 | 27.70 | 12 | Y | L | S | B |  |  |  |  |  |  |
| 599219 | William-077-083-599219 | 1 | 77-83 | William Street | 13.73 |  | 4 | N | L | s | B | C | First Blood | 14.09 | 300 | S | B |
| 599218 | William-073-075-599218 | 1 | 73-75 | William Street | 13.27 |  |  |  |  |  |  | c | Thrifty Car Rental | 13.44 | 250 | S | B |
| 599231 | William-061-071-599231 | 1 | 61-71 | William Street | 12.57 |  |  |  |  |  |  | c | Hertz Car Rental, Food Store, Archit | (Basem | 330 | S | B |
| 606332 | William-060-070-606332 | 1 | 60-70 | William Street | 12.59 |  | 13 | N | L | S | B | c | Paramount Apartments (Restauran | 12.63 | 850 | S | B |
| 599235 | William-053-059-599235 | 1 | 53-59 | William Street | 12.68 |  |  |  |  |  |  | C | Goldstein Catering Equipment | 2 (Basem | 450 | S | B |
| 600939 | William-052-058-600939 | 1 | 52-58 | William Street | 12.80 |  | 7 |  | L | 5 | B | c | "Peejays" Commercial Offices | 12.83 | 820 | S | B |
| 599241 | William-051-599241 |  | 51-51A | William Street | 12.79 |  |  |  |  |  |  | C | Currently vacant | 12.93 | 80 | S | B |
| 599243 | William-047-049-599243 | 1 | 47-49 | William Street | 12.94 |  |  |  |  |  |  | c | Hotel William | 13.00 | 270 | S | , |
| 533234 | Yurong-058-533234 |  | 58 | Yurong Street | 19.19 |  |  |  |  |  |  |  | Chiston-Browne-Crossley Solicitors | 19.19 | 80 | P | B |
| 533232 | Yurong-056-533232 | 1 | 56 | Yurong Street | 20.05 |  |  |  |  |  |  | c | Prentice Jaruin Lawyers | 20.44 | 80 | P | B |
| 533230 | Yurong-054-533230 |  | 54 | Yurong Street | 19.72 | 20.19 | D | Y | M | P | B |  |  |  |  |  |  |
| 533228 | Yurong-052-533228 | 1 | 52 | Yurong Street | 19.29 | 17.66 | 3 | Y | M | P | , |  |  |  |  |  |  |
| 533210 | Yurong-004-016-533210 | 1 | 004-016 | Yurong Street | 12.89 |  |  |  |  |  |  | c | Omnilab media | 13.42 | 1300 | s | B |
| 533213 | Yurong-022-533213 | 1 | 22 | Yurong Street | 13.60 |  |  |  |  |  |  | c | Luce Plan Costanza | 14.87 | 1260 | 5 | B |
| 533212 | Yurong-020-533212 | 1 | 20 | Yurong Street | 12.66 |  | 4 | Y | L | S | B | C | Museum Lodge | 12.85 | 460 | S | B |


Floor Level Survey (undertaken in 2014 as part of Woolloomooloo Floodplain Risk Management Study)

|  |  |  |  |  |  | RESIDENTIAL BUILDING |  | NON-RESIDENTIAL BUILDING |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Parcel Tags | Photo Name | Street Number | Street Name | Easting (m) | Northing (m) | Indicative | Lowest Habitable | Type Commercial ( () | Additional Comments |
| 523755 | 219 Palmer Street.png | 219 | Palmer Street | 335009.0 | 6249955.0 | 24.85 | 24.85 | Commercial(C) | Rear of Building Intersection Langley Street/Kings Lan ¢ |
|  |  | 219 | Palmer Street | 335036.0 | 6249949.5 | 29.64 | 29.96 | c | Front Building Palmer Street |
| 533141 |  | 24 | Woods Lane | 335024.0 | 6250055.0 | 23.27 | 23.62 | Residential(R) |  |
| 527818 |  | 72 | Elizabeth Bay Road | 336135.7 | 6250626.0 | 20.85 | 20.90 | R |  |
| 527819 |  | 74 | Elizabeth Bay Road | 336146.5 | 6250621.7 | 19.78 |  | R |  |
| 531277 |  | 2-4 | Sir John Young Cre | 335175.0 | 6250780.0 | 3.84 | 4.20 | R |  |
| 531279 |  |  | Sir John Young Cre | 335154.5 | 6250774.0 | 3.86 | 4.59 | R |  |
| 531280 |  |  | Sir John Young Cre | 335152.0 | 6250771.5 | 3.85 | 4.47 | R |  |
| 531281 |  | 10 | Sir John Young Cre | 335148.0 | 6250768.0 | 3.85 | 3.91 | R |  |
| 531284 |  | 22-40 | Sir John Young Cre | 335111.0 | 6250730.0 | 4.40 | 4.40 | R |  |
| 516978 |  | 60-72 | Sir John Young Cre | 335062.0 | 6250620.0 | 3.66 | 1.64 | R | Lower Basement Floor Level Each Unit-RL4.57 Ground Floor Crown Street Frontage |
| 523068 |  | 18 | Onslow Avenue | 335026.0 | 6250712.5 | 23.85 | 24.20 | Residential(R) | Foyer Level Front Entrance |
|  |  | 18 | Onslow Avenue | 335026.0 | 6250712.5 |  | 18.10 | R | Ground Level Side/Rear Building |
| 523076 | 28 Onslow Avenue.png | 28 | Onslow Avenue | 336092.5 | 6250654.0 | 25.26 | 25.42 | R | Entrance Door Level |

