Technical Brief

Flood Study

Template

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# Preface

This document provides a starting point for the preparation of a Technical Brief to support Council procurement of specialist services to undertake a Flood Study.

The document is intentionally generic to provide flexibility and local tailoring in study objectives, deliverables, scope, methodology, available study inputs, applicable flood mechanism and scale. There is an expectation that Council will consider the individual study requirements and tailor the brief as needed. Where required, both QRA and the Peer Review and Advisory Panel are available to provide advice and input.

The development of this guide has a been directly informed by Australian Rainfall and Runoff (2019), Australian Disaster Resilience Handbook Collection Handbook 7 (Handbook 7), Managing the Floodplain: Best Practice in Flood Risk Management in Australia, and the Queensland Flood Risk Management Framework (2021) to ensure compatibility with current national best practice.

This brief template does not cover general tendering or contractual matters.

Template text, which requires editing has been indicated as *[enter information specific to study].*

Guidance text that should be removed from the final project brief is indicated as *guidance information for deletion.*

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# Introduction

*[Council]* has received financial support through the Flood Risk Management Program, a jointly funded Australian and Queensland Government funding package managed by Queensland Reconstruction Authority (QRA), to undertake a flood study for the *[location and/or catchment name]*.

## Project Stakeholders and Governance

Governance arrangements and stakeholders for *[this project]* are shown in *Figure [XX]* and Figure 1 below.

*Please provide a diagram of Council governance arrangements to reflect internal arrangements.*

**Queensland Reconstruction Authority**

Coordinator of funding for Flood Risk Management Program (FRMP)

**Independent Peer Review Panel and Advisory**

To ensure consistency with industry standards and current best practice

**Department of Resources**

Responsible for capture of LiDAR as part of FRMP

***Council***

Responsible for completing this Flood Study

**Successful Tenderer**

Responsible for delivering scope of work outlined in this technical brief

Figure 1: Project Stakeholders

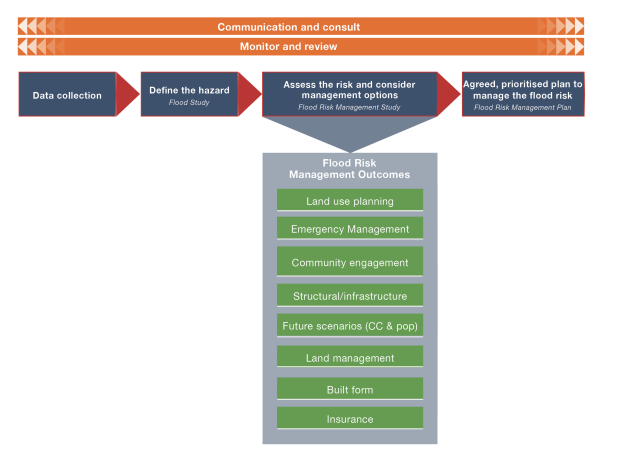
## Study Objectives

*[Council]* require a flood study to provide a comprehensive technical investigation of flood behaviour for *[location and/or catchment name]*. In line with the Queensland Flood Risk Management Framework (refer Figure 2), the primary objective of the Flood Study is to define the flood hazard across the study area. The Flood Study will form the initial stages of the flood risk management process and will provide the technical foundation to further develop a flood risk management study and plan.

The aim of the project is to provide a better understanding of flood behaviour across the full range of design flood events. The study will include consideration of the local flood history, available collected flood data, and the development of hydrologic and hydraulic flood models that are calibrated and verified, where possible, against historic flood events.

The primary objectives for this flood study are to:

* Develop a *[calibrated and or validated]* hydrologic and hydraulic flood model in line with industry best practice to understand flood behaviour across the full range of design flood events from the 50% AEP up to and including the PMF. The full range of design flood events are detailed in Section 5.3.3.
* Define current and future flood behaviour across *[location and / or catchment name]*
* Provide the required information to inform future flood risk management studies, local planning schemes, disaster management and future investment decisions
* To increase capacity and capability within *[Council]*
* Demonstrate best practice and set expectations for local flood risk management.

**

*This Study*

Figure 2: Flood Risk Management Process (QRA, 2021)

# Background

*Provide the rationale for why this catchment has been chosen for development of a flood study, and sufficient information to describe the key characteristics of the catchment. The following sections should be tailored to support the area and Council’s needs for the project. Where a section is not relevant to the project, remove.*

## Study Area Overview

*Provide a summary of the following information where available:*

* *The catchment / city / town*
* *Defined area for flood risk definition*
* *Flood mechanism(s) to be defined (riverine, creek, and / or overland flow flooding)*
* *History of development*
* *Any key industries, cultural or community facilities*
* *Current planned major infrastructure projects (e.g. levees, weirs, dams, major culverts, bridges etc).*

*Provide a reference to a map (or maps).*

## Catchment Description

*Provide a summary of the following information where available and relevant:*

* *Catchment size (include a figure if available)*
* *Watercourses*
* *Topography (e.g., steep upper sections, flat flood plain) and any key topographic features*
* *Geology, soils and hydrogeology*
* *Ecosystems of interest and any important (marine and freshwater) water-dependent ecosystems*
* *Receiving waters*
* *Locations of environmental or cultural significance*
* *The general form and extent of drainage and any water sensitive urban design (WSUD) features*
* *The form and extent of residential/commercial/horticultural/other development across the catchment.*
* *Current and future planned infrastructure within the catchment/floodplain (e.g. levees, weirs, major culverts and bridges etc) which may have the potential to influence flood behaviour of the catchment.*

## Socio-political Context

*Provide a summary of the following information where available and relevant:*

* *The local government area(s) involved*
* *The suburbs wholly or partially within the study area*
* *Any specific local government entities within the jurisdiction (e.g., regional subsidiaries)*
* *The relevant emergency services (i.e., State Emergency Service, Queensland Rural Fire Service, LDMGs and DDMGs, other local groups)*
* *Key legislative and policy instruments that are likely to have an influence on development and infrastructure in the area (Planning Schemes, Neighbourhood Plans, Strategies, Local Government Infrastructure Plans, water allocation plans etc.).*

## Flood Behaviour Description

*Provide a summary of the current understanding of flood behaviour the area including the following information where available and relevant:*

* *Previous studies related to the area*
* *Source of flooding (i.e., riverine, creek, tidal, and / or overland flow)*
* *Warning time and catchment response time*
* *Flooding duration (hours, days, months)*
* *Known flooding hot spots in the study area*
* *Areas subject to groundwater flooding (i.e., where the water table can rise above the surface of the ground and pond for periods of time)*
* *Frequently inundated areas and exacerbating factors (e.g., blockage, high tides, antecedent conditions)*

*Major hydrologic and hydraulic features (including natural or constructed hydraulic controls, dams, bridges) as well as coincident tributary flooding.*

## Flood History Description

*Provide a summary of the following information where available and relevant:*

* *Description of most recent events including warning time, duration and magnitude if known*
* *Largest recorded events (in terms of their peak height and / or flow)*
* *Historic areas of inundation*
* *Impacts to the community (e.g., damage to property and community facilities, loss of life, areas cut off, disruption to community function)*
* *Any notable occurrences (e.g., levee was overtopped, bridge was blocked and overtopped)*
* *Data availability such as gauges, flood marks, photographs, videos etc.*

## Purpose and Future Use of Flood Study Outputs

*Provide a summary which reflects on the needs and focus of the identified user groups. The summary should reflect:*

* *The strategic nature of the flood study and its role in outlining/defining future works*
* *Councils intended approach to Community Consultation.*
* *Intended Council next steps including but not limited to:*
  + *Future studies (i.e., mitigation study or floodplain risk management study and plan)*
  + *Planning scheme updates*
  + *Master drainage study and plan*
  + *Asset management plans*
  + *Updates to total flood warning systems etc.*

*Where relevant and available it is useful to provide a map of adequate resolution to describe the study area clearly delineating the extent of flood risk definition. The map should also identify key features, such as waterways, receiving waters, towns/suburbs, main roads, key infrastructure etc.*

*If practical the map(s) should overlay an aerial image and cadastral information. If this is not feasible due to depth of detail, then separate maps should be provided.*

*The maps(s) should include a legend, appropriate labelling to orient the reader, and should be produced at a minimum of A4 size.*

# Available Information

*Provide a summary of known available information, data format, known gaps and data which will require collection as part of this study. Data should be summarised with an attachment, or in table with a brief description, format, author or source, year, etc.*

*This data will likely include the following where available and relevant:*

* *Previous studies (flood studies, risk management studies, infrastructure studies etc.)*
* *Existing Models*
  + *Hydrologic models (including date, software, ARR methodology)*
  + *Hydraulic models (including date, software, ARR methodology)*
  + *Relevant models would be provided to the successful tenderer including model files, associated files and model log*
* *Historical flood information*
  + *Flood level marks and extents*
  + *Gauge data (rainfall, water level, stream flow)*
  + *Photos, videos (preferably with dates and times)*
  + *Antecedent conditions*
  + *Community complaints / comments*
  + *Anecdotal evidence, damage reports*
  + *Number of people / properties affected*
  + *Damage to infrastructure*
* *Spatial Datasets*
  + *Flood hazard overlay extents*
  + *Geographic information system (GIS) layers the Council or any other organisation has including cadastre, waterways, natural environment areas, street names, roads, building footprints, and land-use planning areas etc.*
* *Survey Data* 
  + *Digital Elevation Models (DEMs) or LiDAR data, creek / river cross sections or bathymetric surveys*
  + *Locations, dimensions and invert levels of drainage assets*
  + *Floor level information*
  + *Any survey data for current or existing structures (e.g., bridges, culverts, weirs, levees, irrigation channels, dams, asset management information systems).*

The data listed in Table 1 will be provided, or arrangements made for access prior to commencement of the project.

Table 1: Available information for *[this study]*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Dataset | Description | Format | Author / Source | Date | Relevant comments |
| *Previous Studies (flood studies, flood risk management studies etc.)* | *Provide a description of study purpose, outputs, use, gaps etc.* | *Report, hydrologic / hydraulic model availability etc.* | *Previous consultant, or if Council report* | *Date finalised* | *Any comments considered relevant.* |
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*Modify table setup and information as required.*

# Current Guidelines and References

The Flood Study should be delivered in line with current industry best practice guidelines, manuals and technical reference documents relevant to the project, including as listed but not limited to those in Table 2.

Table 2: Current Guidelines and References

|  |
| --- |
| **Reference Document** |
| Australian Rainfall and Runoff (ARR) 2019 - all projects and chapters  <https://arr.ga.gov.au/arr-guideline> |
| Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (Handbook 7) (AIDR, 2017)  <https://knowledge.aidr.org.au/media/3521/adr-handbook-7.pdf> |
| Queensland Urban Drainage Manual  <https://ipweaq.intersearch.com.au/ipweaqjspui/bitstream/1/4983/1/2042%20QUDM%20FINAL%2018%20August%202017%20%282%29.pdf> |
| Coastal hazard technical guide, Determining coastal hazard areas (former DEHP)  <https://www.qld.gov.au/__data/assets/pdf_file/0025/67462/hazards-guideline.pdf> |
| A guide to ‘good practice’ storm inundation mapping and modelling (DES, 2018)  <https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/93336e30-e1fd-4a1e-89e8-b4056692e26c/storm-tide-inundation-guidelines.pdf?ETag=2f101b1511eccc53dee83079b543d9ec> |
| State Planning Policy (SPP), Natural Hazards, Risks and Resilience – Flood  <https://dilgpprd.blob.core.windows.net/general/spp-guidance-natural-hazards-risk-resilience-flood.pdf> |

# Scope of Work

The primary purpose of this study is to better understand flood behaviour across the full range of design flood events. To achieve this and satisfy objectives outlined in Section 1.2, this study includes the development of a detailed hydrologic and hydraulic model. The proposed scope of work to be delivered is outlined below.

## Data Collection

At the project inception, Council will provide the available data listed in Table 1. Additional data required for collection and / or development is outlined below.

*Note that data collection could be delivered by Council or included in the scope of works for the successful tenderer to arrange. The cost of survey capture and LiDAR acquisition would be included as an optional item with indicative costs only. Extent of capture and associated costs would be refined following engagement and receival of quotes from surveyors.*

*Upon engagement, the successful tenderer will seek quotes from a minimum of three subconsultants to submit to Council with a data collection brief outlining evaluation, recommendation and upper limit fee to undertake this portion of work. Following approval from Council, the successful tenderer shall arrange for data collection to be undertaken. The successful tenderer will be responsible for engagement and supervision of the approved subconsultant and will be responsible for ensuring the overall quality of the data.*

### Survey Capture

*This section is only required in the event of intended inclusion of survey capture in the scope of works of the flood study.*

*Provide a summary of required survey to complete this study including maps where required. Survey capture may include capture of:*

* *Bathymetric survey*
* *Survey of hydraulic structures (bridges and culverts) including invert levels, dimensions and lengths*
* *Survey of stormwater network where considered significant to understanding flood behaviour*

At a minimum the successful tenderer will either procure or complete:

* Survey of gauge zero at relevant gauges. Where there are only one or two gauges within the study area, it is critical cross-sections and gauge zeros are surveyed. This has the potential to be a significant source of error if not completed.

### DEM Development

The flood study requires development of a Digital Elevation Model (DEM) as a key input into hydrological and or hydraulic models. The tenderer should identify and provide a description of the methodology for DEM development.

### Data Review

A comprehensive data review should be completed as part of the initial stage of the study commencement. This should aim to identify if all necessary data is available, the quality of data available and provide recommendations to Council where additional datasets will be required. This should be raised with Council early to ensure a suitable methodology for addressing gaps can be identified and agreed.

## Site Visit

A site visit is to be undertaken as part of all studies to ensure the successful tenderer has an appreciation of catchment condition and major hydrologic and hydraulic features. Expected outcomes of the site visit include:

* Understanding of potential flooding mechanisms and flows paths
* Location of all key stormwater assets within the catchment to ensure accuracy of dataset
* Where information is missing, capture sizing and invert levels of key structures
* Ensure major hydraulic features including cross-drainage infrastructure and waterway crossings is identified.

It is recommended that the tender be accompanied by key Council staff to provide an opportunity for Council to raise any potential issues and highlight areas of interest.

## Flood Behaviour

This section outlines the proposed methodology and requirements to understand existing and future flood behaviour across the study area. This understanding of flood behaviour and data produced as part of the Flood Study will be used to inform future work and future studies including but not limited to a Floodplain Risk Management Study and Plan. The future requirements of the hydrologic and hydraulic flood models and data outputs should be considered as part of the model development to ensure compatibility with future requirements.

### GIS Systems

All analysis and modelling and study outputs are required to be undertaken under the following GIS specification.

* Datum GDA 2020
* Coordinate System *[MGA 54 /MGA 55 / MGA 56].*

### Software

Modelling software selected should be appropriate for the catchment characteristics and type of flooding. Any modelling software adopted should be industry standard package with no constraints for future use. Software selected should either be freely available or the costs for access and maintenance should be clearly articulated in the response.

The selection of hydraulic modelling software must be fit for the purpose of the study. Available 1D and 2D hydraulic modelling software for use include:

* TUFLOW
* Flood Modeller
* HEC-RES
* InfoWorks ICM
* MIKE Flood.

### Design Event and Sensitivity Scenarios

*Provide a list of the expected design events.*

Standard design events that should be included as a minimum for new flood studies are:

* 50% AEP,
* 20% AEP,
* 10% AEP,
* 5% AEP,
* 2% AEP,
* 1% AEP,
* 1% AEP including climate change,
* 0.5% AEP,
* 0.2%AEP,
* 0.1% AEP,
* 0.05% AEP design flood events,
* and the PMF.

*Note, this section requires some Council input. Where items are not relevant to the study, remove, or update to tailor to the study requirements and Councils needs*

Additional sensitivity scenarios to consider including where appropriate:

* Tailwater conditions including consideration of coincident flooding where discharging to a larger river system
* Tidal conditions if the downstream water body is tidal
* Dam break scenario
* Levee failure
* Blockage scenarios in line with ARR19
* Modifications to Manning’s ‘n’ to understand model sensitivity
* Current and future planned major infrastructure (if detailed assessment and design details are available) within the immediate catchment / wider floodplain that has potential to influence flood behaviour within the study area (e.g. levees, weirs, major culverts and bridges etc) to be assessed to the best extent possible.

Tenders should include a description of how sensitivity scenarios will be assessed as part of the project.

### Climate Change

A climate change scenario should be included in all flood studies. Where considered appropriate a flood event rarer than the design event can be utilised as a proxy for a climate change scenario.

As a minimum RCP 4.5 and RCP 8.5 should be assessed to understand the catchments sensitivity to climate change.

### Hydrologic modelling

*Note, this section requires some Council input. Where items are not relevant to the study, remove, or update to tailor to the study requirements and Councils needs. For example, if no localised IFDs available, remove as this is not relevant.*

The hydrologic model shall be developed in line with ARR19 methodologies. Tenders should consider the following in their proposed hydrologic modelling methodology:

* Software selection should consider application (for example there may be a requirement for future use in flood forecasting) and study needs
* Software selected should either be freely available or the costs for access and maintenance should be clearly articulated in the response
* Catchment delineation
  + Catchment delineation with suitable detail for the catchment size, areas of interest and consideration of inflow locations for the selected hydraulic model
  + Where catchments have been delineated using automated software, catchments should be checked manually to ensure sizing and shape are representative of hydrologic features
  + Catchment outlets should support the development of the hydraulic model and should consider the overall intent of the study (i.e., creek / riverine versus overland flow)
  + For areas of the catchment not included in the hydraulic model extent, consideration should be given to any potential attenuation or lag.
* Hydrologic parameters selected should be in line with ARR19 methodologies
* Where localised IFDs are available these should adopted
* Catchment land use scenario should consider future model use, where it is anticipated a Flood Risk Management Study will be completed consider two land use scenarios:
  + Existing land use (base case)
  + Ultimate development (representing a fully developed catchment based on the most recent planning scheme zoning)
* Model validation should consider the following options:
  + Existing hydrologic model / information
  + Regional methods
  + Flood frequency analysis
  + Model calibration

Reporting should clearly articulate methodology, calibration and validation results, selected parameters and justification and all model assumptions and limitations. The successful tenderer must provide all required files to ensure Council or future consultants can view, modify and run the hydrologic model. Where internal scripts or tools have been prepared and are required to modify and run the model, these will be provided along with instructions of use.

### Hydraulic modelling

*Note, this section requires some Council input. Update and tailor to the study requirements and Council’s needs. For example, provide details of intended future use of the study outputs or details of the downstream water body.*

Development of the hydraulic model must be in accordance with the recommendations of ARR19. Tenders should ensure the proposed methodology must consider the following items:

* Necessary balance between model simulation time and required detail for the study
* Future use of the model (i.e., for use in a future floodplain risk management study, development assessments, infrastructure upgrades etc.)
* Use of latest software features where appropriate, such as sub-grid-sampling, quadtree as examples
* Ensure adequate detail is provided around areas of interest
* Representation of land use using Manning’s ‘n’ should consider the future use of the model. This may require the assessment of two land use scenarios:
  + Existing land use (base case)
  + Ultimate development (representing a fully developed catchment based on the most recent planning scheme zoning)
* Other hydraulic modelling parameters including key hydraulic features, 1D structures and stormwater elements, and boundary conditions
* Where the study area discharges to a larger downstream river system, coincident flooding with this system should be incorporated into modelling methodology.

As part of the response, the tenderer must provide evidence that the hydraulic modelling software selected can meet the requirements of the brief. Where the selected software has ongoing costs associated with the visualisation or analysis of results this cost should be clearly defined so that Council has a clear understanding of ongoing costs. The successful tenderer must provide all required files including the model log to ensure Council or future consultants can view, modify and run the hydraulic model. Where internal scripts or tools have been prepared and are required to modify and run the model, these will be provided along with instructions of use.

#### Required Outputs

*Council to consider and add any additional outputs required from the hydraulic model.*

The successful tenderer should ensure the following items are included in deliver:

* Water surface level (m AHD)
* Flood depth
* Flood velocity
* Velocity x Depth Product (Z0)
* A fit-for-purpose approach to flood hazard definition in line with ADR Guideline 7-3, Flood Hazard (2017) (ZAEM1)
* Timeseries Outputs (XMDF) *[Council will have to specify which design events and scenarios this is required].*

### Calibration Events

*Where Council know which historical events they wish to be included in the model calibration, include a list of calibration and verification historical events. If this section is not relevant to the study, delete.*

Tenders should include a discussion on proposed calibration methodology including:

* Selection of calibration and verification events to at least three historical events of varying magnitude where available
* Development or the use of existing rating curves
* A flood frequency analysis to inform design event flows

Calibration to flood / debris marks where available. Flood / debris marks have an element of uncertainty, and this should be considered when assessing calibration results.

## Community Consultation

*Community consultation has a multitude of benefits to the flood study process and should be incorporated as part of every Flood Study. The extent of community consultation will be different for each study.*

A community consultation process will be completed as part of the Flood Study. This will include two main components, initial consultation to inform the public and collect information and public exhibition where the Draft Flood Study will be made available for comment by the community. *This process should be tailored for the study requirements, however, may include the following:*

* Preparation of an information leaflet providing information around the planned Flood Study and details of how the community can be involved
* Preparation of a questionnaire form seeking information around historic flood behaviour, flood marks, photographs and videos, known key issues and general information about flooding in the study area
* Where public exhibition is planned, advertisement of where and how the community can review the Draft Flood Study report (i.e., via Council website, mail drop, newspaper, etc.)
* Two week period where the community are able to review results and the report and provide any questions, comments or additional information
* Organised community consultation sessions where the community can drop-in and ask questions or provide feedback
* Two to four week period where the successful tenderer will address or answer any comments provided by the community.

Following this process, the Flood Study will be considered by Council for approval and finalisation.

## Deliverables

Deliverables to be provided are outlined in Table 3 below. It is expected deliverables will be provided via a data handover pack, which will include a description of file location, information included and how to interpret if necessary.

Table 3: Deliverable Requirements

|  |  |  |
| --- | --- | --- |
| Deliverable | Item | Requirements |
| Data | Any captured, generated and processed data. | Where data has been captured (i.e., ground survey, floor level etc.) provide a corresponding QA report. |
| Spatial information | Any captured, generated and processed data. | *Council to specify what GIS format is required (i.e., \*.shp or \*.tab)* |
| Model Files (hydrologic and hydraulic) | Modelling input files |  |
| Output files (raw) | Water surface level, depth, velocity, Z0, ZAEM1  *Input which grid type is preferred (i.e., \*.flt or \*.asc)* |
| Hydrologic analysis | Catchment and sub-catchment delineation (\*.shp), ARR Data Hub download, and temporal pattern analysis. |
| Processed output files | Water surface level, depth, velocity, Z0, ZAEM1  *Input which grid type is preferred (i.e., \*.flt or \*.asc)*  Datum GDA 2020  Coordinate System *[MGA 54 / MGA 55 / MGA 56]* |
| Timeseries outputs (XMDF) | *Input which design events and scenarios you would like timeseries information.* |
| Log files and check files | Only required for one design event not all |
| Modelling log | Should include any necessary instructions for model use, a summary of design events, scenario setup including sensitivity runs and details of critical duration assessment. |
| Mapping | Water surface level (m AHD) | PDF |
| Flood depth (m) |
| Flood velocity (m/s) |
| Velocity x depth |
| Hazard (ZAEM1) |
| Reporting | Final Report | PDF  Individual maps and figures to be provided as separate files. |
| Any interim reports not included in the final report. | PDF |
| Community Consultation | Summary of community consultation comments and how these have been responded to or addressed. | Excel or word |

### Reporting

*Note, this section requires some Council input. Update and tailor to the study requirements and Council’s needs. For example, where calibration is not possible remove from reporting requirements.*

The Flood Study report should include, as a minimum but not limited to, the following:

* Description of study area, catchment characteristics, land use across the catchment, key features and historic flood information.
* Hydrologic modelling methodology, key assumptions, data used, software selection, relevant calculations, model checks and any major hydrologic features (for example significant storage areas).
* Description of hydraulic modelling methodology, model schematisation, model checks, floodplain characteristics, assumptions and relevant calculations.
* Calibration and validation assessment. This should include a comparison of water levels and stream flows at gauges and comparison to flood level marks.
* Selected design events, critical duration and temporal pattern assessment. Where focal points have been used across the catchment, these should be mapped and details provided.
* Description of sensitivity assessments including the impact on flood behaviour and significance of the parameter or scenario tested (for example is the catchment particularly sensitivity to changes to land use or tidal conditions etc.).
* Written description of design and historical flood behaviour for a range of events for locations across the study area.
* Presentation of model results showing extents, depths, levels, velocities and hazard of design flood events. Results should be mapped for the entire study area and tabulated results at key locations across the catchment.

Preliminary identification and assessment of existing problem / hot spot areas across the study area.

# Intellectual Property

All data, models, modelling inputs and results, and reports associated with the development of the *Flood Study* is licensed by *Council* under a Creative Commons Attribution (CC BY) 4.0 international licence. To view a copy of this licence, visit: <https://creativecommons.org/licenses/by/4.0/>

The successful tenderer must provide all required files to ensure Council or future consultants can view, modify and run the hydrologic and hydraulic model. This includes instructions of use, a detailed model log, results and details of post processing to ensure final results can be replicated.

Where internal scripts or tools have been prepared and are required to modify and/or run models, or post process results, these will be provided along with instructions of use.

# Program and Milestones

Under the FRMP funding arrangements there is a requirement that studies be completed by June 2026.

Tenderers are requested to provide a high-level schedule as part of their response outlining how the project will be delivered to meet the timeframe requirements with program dates specified for the milestones documented in Table 4 below.

Table 4: Draft Project Program

|  |  |
| --- | --- |
| Milestone | Target Date |
| Completion of hydrologic and hydraulic model setup and schematisation | *Input desired target dates* |
| Peer review hold point |  |
| Completion of Calibration and or validation results |  |
| Peer review hold point |  |
| Completion of design event modelling and sensitivity assessments |  |
| Peer review hold point |  |
| Draft Flood Study |  |
| Community Consultation |  |
| Finalisation of Flood Study |  |

## Peer Review Process

QRA has arranged an Independent Peer Review and Advisory Panel to ensure projects delivered are consistent with industry standards and current best practice. This review process will include a minimum of three review points for flood studies. Council may require more than three review points depending on the complexity of the project and Council’s needs.

To achieve project program and budgetary constraints, the proposed review process is recommended to be collaborative and proactive. That is, the successful tenderer is required to engage with the appointed project peer reviewer and with Council in an open forum to discuss the proposed approach prior to undertaking tasks. To this end, the project peer reviewer will attend and provide input into the project progress meetings documented in the subsequent section.

Proposed review points are detailed in Table 5 below, additional review points may be added as needed. To support the Peer Review process there is a minimum expectation that at each review point the successful tenderer will provide to Council and the reviewer the following:

* Draft reporting documenting the appropriate sections of the ultimate flood study report
* Modelling files and results
* Modelling QA log.

Where the peer reviewer does not have a license to the selected modelling software, it is expected the successful tenderer will provide a licence to ensure the peer reviewer is able to complete their review. This cost will be paid for by the successful tenderer.

At each specified review point, the project peer reviewer will have a single opportunity to review the provided information and provide a single completed review document. Each item will be classified as OK, minor or major issue, with all major issues requiring rectification by the successful tenderer and close out with the peer reviewer before proceeding.

Table 5: Peer Review Points

|  |  |  |
| --- | --- | --- |
| Proposed review points | Deliverable | Target Date |
| Review Point 1 | Model Schematisation | *Anticipated date* |
| Review Point 2 | Model Calibration / Validation | *Anticipated date* |
| Review Point 3 | Draft Report | *Anticipated date* |

## Progress Reporting

*Council should update this section as required for internal reporting requirements. It may be necessary to request an informal monthly team catch-up.*

Project progress shall be communicated and tracked via regular project meetings and project progress reports. Project meetings will be arranged as needed, however, will include the following key points:

* Inception meeting
* Presentation of data review and, hydrologic and hydraulic model setup and schematisation
* Presentation of calibration and validation results
* Completion of design event modelling and sensitivity assessments
* Final Flood Study Report presentation.

It is expected the successful tenderer will provide high level progress reporting monthly. This report will include the project status based on the agreed project schedule, work completed in the reporting month, work to be completed next month, any emerging risks or issues, and decisions required from Council.

# Glossary

|  |  |
| --- | --- |
| Term | Definition |
| Annual Exceedance Probability (AEP) | Annual Exceedance Probability (AEP)  expresses the probability of an event being equalled or exceeded in any year in percentage terms, for example, the 1% AEP design flood discharge. (ARR, 2019) |
| Australian Height Datum (AHD) | Australian surface level datum approximately corresponding to mean sea level. |
| Catchment | Area of land draining to a particular site downstream. |
| Digital Elevation Model (DEM) | Spatial dataset representing the topographic surface of the earth excluding buildings and trees. |
| Discharge | Rate of flow of water in terms of volume per time (m3/s). |
| Floodplain | Extent of land which could be subject to inundation from floods up to and including the PMF. |
| Flood risk | Flood risk considers the likelihood and consequences including the flood behaviour across the full range of design events, exposure, land use, vulnerability, tolerability, evacuation or isolation, other risks including loss of services. Flood risk should be determined at the local level to reflect local context. |
| Hydraulics | Represents the study of how water flows through waterways and estimates flood behaviour parameters such as water level, depth and velocity. |
| Hydrology | Refers to the rainfall runoff process and provides a way to estimate peak flows, volumes and flow hydrographs at specified locations within the catchment. |
| Hydrograph | A graph showing the flood flow or level (stage) for different times during a flood. |
| LiDAR | Laser imaging, detection and ranging (LiDAR) uses remote sensing to measure the elevation of objects on the ground. Raw LiDAR will include trees and building measurements. |
| Overland Flow Flooding | Overland flow is the surface runoff following  rainfall, concentrated in natural lower lying areas and swales across the landscape. Flooding is usually ‘flashy’ with peaks occurring shortly after rainfall. |
| Riverine Flooding | Flooding within large river systems where floods increase and break out of the riverbanks to inundate adjacent floodplains. Flooding is  generated from rainfall across the broad catchment area. It may take many hours, or even days, for peak flood levels to occur as rainfall  slowly drains from the catchment. |
| Hydrologic and hydraulic models | Computer modelling of rainfall and surface runoff to simulate real world flood conditions and therefore estimate likely flood extents and flood behaviour for theoretical future conditions and events. |
| Probable Maximum Flood  (PMF) | Denotes the largest possible flood that could occur at a particular location. The PMF is generally estimated based on the PMP. |
| Probable Maximum  Precipitation (PMP) | The PMP represents the largest depth of rainfall that could occur over a given catchment area. |
| Rating curve | A graph plotting flow versus stage (water level) at stream flow gauges. |
| Runoff | The amount of rainfall that will result in overland flow or streamflow. |
| Stage | Another term for water level and is measured based on a specified datum. |
| Water Sensitive Urban Design | Design and planning of the urban environment to consider the natural ecosystem and sustainable water management. |

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