

Appendix C

TERMS OF REFERENCE CHECKLIST

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TOR Checklist

TOR #	Statement	Section addressed	How addressed
a)	The consultation plan and project plan for the study (in Microsoft Office Gantt Chart).	Appendix N	A multi-layered consultation plan was developed including meeting with the Key Stakeholder Group (KSG), introducing the review to other stakeholders, collecting and collating information (councils) questionnaire, in-depth interviews and site inspections. A Gantt chart project plan was prepared at tender stage and updated at the start of the project. Actual project timelines were as agreed with the Client and generally conformed to the project plan.
b)	Questionnaire survey (incorporating IGEM methodology).	Appendix N	A questionnaire was prepared and distributed to 78 local councils throughout Queensland including a package of materials.
c)	Creation of a detailed risk based methodology and analysis tool to be used to determine network improvements and weighting assessment. The performance of Risk/Opportunity assessments and their resultant registers.	Section 7.2, and Appendix E	A detailed risk methodology was developed early in the project, adapted slightly during the project as analysis proceeded. The methodology was peer reviewed by the client's advisors.
d)	Create a complete Asset Inventory of Instrumentation and related systems used in the Flood Warning Network in parallel with Spatial Network Analysis, including a full break down by class, type, Geospatial location, Data output form, O&M agency, Installation date, Design Life etc. This element of work should occur concurrently with specific spatial network Analysis and prior to the commencement of specific engineering field review. The data is to be stored on a suitable software platform with applicable revision/data controls.	Section 6.1, and Provided separately	A geospatially linked asset database was developed and was exported to a spreadsheet for manipulation. The database has been provided to the client as a separate deliverable.
e)	Description of current network, on a catchment by catchment basis, with mapping showing the Class & Type of installations present with acknowledgement of the Asset Inventory of Instrumentation.	Section 3, and Appendix J	Maps have been provided at river basin and council municipal area basis of all gauges considered to be part of the FWGN. The major exclusion from mapping is the VHF radio network and measured signal strength used for the ALERT system. Signal strength maps for the 3G and 4G telecommunication networks have not been provided.
f)	Produce Engineering conditional assessment report of the identified instrumentation / monitoring equipment used in the flood warning network, and evaluation of their performance and suitability for ongoing flood warning	Section 6.2, and Appendix P	81 of the 1845 (4.4%) of gauges were inspected during the project. Many of the faults related to fixed gauge boards. Electrical

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	purposes by BoM. This assessment must contain key measurable quantitative, qualitative and repeatable metrics to form a base line analysis for the network devices and the system.		connections to assess signal, battery life and calibration were not made assessments were visual only. A check list was developed and used for the visual inspections. Key qualitative and repeatable metrics were developed for this assessment (refer to Appendix O) however many of these metrics could not be checked as access inside the gauge housing was not available.
g)	Recommendations/opportunities for augmenting the Flood Warning Gauge (FWG) network using existing non-flood-warning hydrometric installations. This should include the views of the owners of the non-flood warning equipment on their potential use in the BoM network.	Section 8, and Appendix D	A list of settlements requiring gauges was developed (see Appendix F) and maps are provided in Appendix D which identify an indicative proposed location for new gauges. The location of new gauges should incorporate an assessment at a catchment level to identify the most appropriate locations for new gauges or existing gauges which require augmentation.
h)	Recommendations for the upgrade of existing equipment, which currently does not meet desired standards for BoM use.	Section 6	In order to achieve this recommendation in full - nationally consistent standards of instrumentation should be developed and BOM need to make instrumentation requirements available for review. This will allow equipment manufacturers to understand the desired equipment specifications and provide appropriate instrumentation. An assessment of the condition of the assets visited is included in Section 6.
i)	Solutions to respond to issues with current identified Instrumentation / monitoring equipment performance (requiring rehabilitation or replacement) of ALERT devices or its compatibility with new program intent, emerging technologies or ALERT2 equipment proposed for future FWG installations. Solutions (including costs) will need to be proposed for the integration of legacy systems and that of the emerging technologies; this will need to be recognised within Specification, Guidelines and Standards both now and in transition.	Section 6.4, and Appendix H	A list of readily available public standards and guidance documents has been provided in Appendix H. Findings of this report highlight the need for nationally consistent standards of instrumentation, this would include specifications for gauges that are to be connected to the ALERT system and the proposed changes resulting from ALERT2 technology. ALERT2 system protocols and requirements are still being developed and not yet ready for full adaptation in Australia, until BoM releases details of the protocols, specifications and standards cannot be prepared.

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j)	A final program of staged improvements (including costs) to the current FWG network used by BoM, with mapping identifying the locations of the proposed upgrades as well as the current network, and recent (post 2011) upgrades.	Section 8, and Appendix D	<p>The location of new gauges has been developed and mapped but the actual locations need to be assessed on a catchment basis in consultation with BoM, council and LDMG.</p> <p>Budget estimates have been provided in Section 8, however these costs are indicative only and will be susceptible to change based on the outcome of catchment based assessment.</p> <p>A final program cannot be developed until the governance model has been determined.</p>
k)	Compilation of the known technical standards and documentation for the existing Flood Warning Gauge & Hydrometric Networks into a central depository and compile a manageable register of said documentation. Perform Gap Analysis to assist in the development of a set of technical standards and guidelines for flood warning network Installations, Operations & Maintenance and Quality Assurance.	Section 6.4, and Appendix H	A list of current standards and guidelines has been compiled. A performance specification for new gauges used by BoM was not obtained.
l)	Compile and define detailed description of the current accountabilities and agreements for the FWGN, including identification of the authorities responsible for operation and maintenance, and the existing cost sharing arrangements. Proposed recommendations (as necessary) to the responsibility and accountability matrix for parties to the Flood Warning Gauge Network over its lifecycle.	Section 5, and Section 9	<p>Roles and responsibilities of existing and proposed management arrangements and governance models have been developed.</p> <p>Cost sharing arrangements to be finally adopted will depend on the governance model to be developed.</p> <p>Operational methods and issues have been outlined.</p>
m)	Review of issues with respect to the current asset management arrangements across the Flood Warning Gauge Network. This may include assessing the capacity of the asset owners to provide effective ongoing operation and maintenance support of their gauges, and ultimately to provide funding for their replacement/renewal/ or alternate solutions to do so. Make recommendations to ensure the ongoing optimisation of the network whilst ensure the functional intent and integrity of the system is maintained.	Section 9	<p>Operational methods, maintenance frequencies and potential solutions, including funding for staff and training have been outlined.</p> <p>Optimisation of the management of assets within the FWGN is dependent upon the future governance model for the FWGN and the relationship of asset owners to the FWGN</p>
n)	Evaluation and provision of options (including costs) for changes to the current arrangements for operation and maintenance to improve the efficiency, quality, and effectiveness of the flood warning network. This may include consolidation of the responsibilities for operation and maintenance. Evaluate and provided	Section 9.1	There are a number of entities that currently own, operate and maintain gauges from which data is provided for the issuing of flood warnings. These entities all employ different maintenance arrangements with varying costs. As many of the assets have been

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	documented options with brief cost benefit analysis and Risk based assessment of each. Acknowledge Flood Warning Network Asset Management's models of other state jurisdiction to ensure learnings are captured.		installed for purposes other than flood warning, it is difficult to verify and centralise the maintenance of assets as each entity has differing operation and maintenance responsibilities and requirements. The costs provided to improve the FWGN and operational strategies developed are broad and should be explored on a more catchment specific basis. Data limitations prevented the full assessment of the benefits that might accrue from improved flood warnings and the costs associated with new installations will depend on the governance models adopted for each jurisdiction.
o)	Recommendations for changes to the current arrangements (including funding and responsibilities) for asset management with justification for the proposed changes.	Section 9.4	Most of the recommendations for changes to the current arrangements are directed to councils and relate to funding of new equipment, operation and maintenance and supply and training of staff. The adopted governance model will affect the arrangements for funding and responsibilities for ongoing operation of assets within the FWGN.
p)	Process (including performance indicators) for evaluating ongoing network effectiveness.	Refer to Section 5	The effectiveness of a flood warning system is dependent upon the co-operative involvement of stakeholders. The adopted governance model will ultimately affect the form of any network effectiveness KPIs. Once the governance model is established, performance indicators should be developed to ensure all components are functioning in an integrated manner
q)	Preparation of an assessment and implementation guidelines to be utilised by entities/agencies/authorities when seeking capital funding for installation of new gauges or network upgrade.	Refer to Section 8	Implementation guidelines for additional funding for new gauges, or upgrade of existing assets requires cross-agency buy-in. The specification for information which BOM require should be incorporated and a form of accreditation system should be developed.
r)	Evaluations of the rating curve reliabilities and gauge datum completeness for river height stations.	Section 11	The accuracy of rating curves and tables in not certain at high stages. Rating curves should be reviewed during each flood study

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			followed by an appraisal of flood frequency analyses and resulting impacts on infrastructure flood immunity.
s)	Consult and investigate the standards defined and implemented for the current FWG stations. Define survey tolerances criteria with regard to the geo-location Datum information plotted against the current asset base is required. A survey of random sampling of sites across varied asset owner sites may also be required to re-enforce confidence in the geo-location data (plotting) we currently hold for network stations, this will apply relevance to station data.	Section 6, Appendix P, and Section 11.3, and Asset Database	<p>A condition assessment of some of the gauges within the FWGN was included in Section 6. This assessment was limited by the accessibility at many of the gauges inspected. The results of the assessment are presented in Section 6 and Appendix P.</p> <p>A small number of geo-location issues were identified in the assessment (refer to Section 11.3). It is recommended that these issues be further examined on a catchment basis.</p>
t)	Any other significant issues identified during the course of the study.	Findings and recommendations	Several significant issues were identified and these are presented at the commencement of each report section.