QUEENSLAND FLOODS COMMISSION OF INQUIRY

I, **Bryan Alfio Ottone**, of care of Council Chambers, corner of Egerton Street and Borilla Street, Emerald in the State of Queensland, Chief Executive Officer, Central Highlands Regional Council, declare that:-

The following is a true statement containing my response to the queries raised by the Commission in its letter dated 10 August 2011:

1. **Whether all documents requested by the Requirement dated 1 March 2011 have been provided to Commission;**
   All documents requested by the Queensland Floods Commission of Inquiry, dated 1 March 2011, have been provided in full.

2. **The details of any draft flood studies obtained or made available to the Council since March 2011;**

   Council internal activities:
   - Council staff completed accurate land inundation extent mapping for Emerald, Rolleston and Bluff townships.
   - The Emerald mapping was completed first, and presented to Council meeting in late March by the Manager Corporate Governance, Central Highlands Regional Council.
   - The Rolleston map was presented and discussed at a Community meeting in Rolleston in June 2011.
   - A draft digital Geographic information system file of the Emerald land inundation was supplied to DERM 21-1-2011 (land valuation section - Central Region, and Spatial Information unit - Brisbane) The spatial information unit loaded this dataset up on the Qld Reconstruction Authority interactive flood map website for public viewing and access.
   - This map was then validated and checked as time and data permitted and an updated copy of final map was sent to DERM Spatial Unit [redacted] in June 2011 for uploading onto the QRA website.
   - Council also engaged a registered surveyor and over the period from January to July 2011, has captured an accurate dataset of flood heights throughout Emerald township, Rolleston Township, Bluff and at some key infrastructure - bridges and rail.
   - A series of draft flood height maps suitable for Council applying for a Temporary Local Planning Instrument are currently being prepared to be presented to Council, then to be submitted to the State for approval, whilst awaiting consultant final hydrologic studies, which could take upwards of twelve months to finalise output.

   Consultants:
   - KBR flood data and data gap analysis:
     A Draft report was received by Council staff in mid July 2011. KBR is currently finalising edits and it is expected this report will be in a form to take to Council by mid September 2011.
   - KBR Project Variation is to investigate impacts on or affected by infrastructure in Emerald.
     There is still work in progress by KBR in relation to this in relation to this.

QFCI

Date: 29/09/11 TM

Exhibit Number: 683

- C and R Consulting Upper Nogoa Catchment:
  [redacted] provided a presentation of work to date at a Council meeting on 1 August 2011. Some property rainfall records and a brief interim report has been received, but the final report and exchange of all data not expected until early September 2011.
- C and R Consulting Fairbairn Dam to town:
  Work is still in progress on this report.
- In all of the above instances - Council has been proactively capturing additional survey data and providing this to both consultants. It has also instructed both consultants to share all of their data.
- BMT WBM was engaged to assist Council on assessing likely costs for complying with SPP1/03.

3. Any changes to the Council's land planning processes, policies or other statutory instruments in response to flooding that occurred during the period 1 December 2010 to 31 January 2011, including drafts, considerations and adopted documents of Council;

Since the 2010/2011 flood event of the Nogoa River, Council has passed a number of resolutions in relation to land use planning processes and has repealed delegations to ensure matters are considered by the full sitting of Council. Copies of these resolutions are attached.

On Monday, 6 June 2011, Council also resolved to prepare a Temporary Local Planning Instrument for the Emerald Township. An excerpt from the minutes of this meeting, identifying this resolution is included below:

"Temporary Local Planning Instrument
Resolution:
Cr Brimblecombe moved and Cr Haylock seconded 'That Council resolve to prepare a temporary local planning instrument to establish an interim residential flood level for known flood affected areas of Emerald in accordance with the Sustainable Planning Act 2009 and Statutory Guideline 02/09.'

Carried"

To enable this Temporary Local Planning Instrument to be prepared, mapping has been collated to identify the highest known flood height for all areas of Emerald, and reference has been made to the Temporary Local Planning Instruments prepared by other flood affected local governments, specifically Brisbane City Council and Ipswich City Council. Council officers have also discussed the process to adopt a Temporary Local Planning Instrument with the Department of Local Government and Planning, and sought to engage a consultant to assist in this process.

The Temporary Local Planning Instrument has yet to be drafted, but once the mapping referred to in point 2 of this statement is finalised it is anticipated that the draft document would be prepared by Council and referred to the Department of Local Government and Planning for State-interest checking within approximately six (6) weeks.

Council is proceeding with this approach to ensure that measures are in place in time for the next wet season, and to enable time to prepare a new Planning Scheme to be developed that comprehensively addresses the requirements of State Planning Policy 1/03. The Temporary Local Planning Instrument will incorporate all existing information from both the 2008 and 2010/2011 flood events of the Nogoa River, and will enable measures to be taken without further delay as detailed hydrologic studies are not expected to be completed for at least six (6) to twelve (12) months.

4. **How information about flood risk for specific properties is made available and any processes for obtaining this information applicable to each of the following:**

    a) **Members of the public;**
    b) **Insurance companies; and**
    c) **Prospective developers and their representatives.**

a. Members of the public

- Face to face when possible to explain context and flood behavior.
- Land inundation map is on full display in the Emerald office Council foyer and public advice is given of this in Council's recovery newsletters.
- Individual maps with flood inundation and known flood elevations have been supplied by email to residents on request.
- Residents have also been advised by front counter staff to log onto the QRA website.
- The public has also been advised to fill out a flood height request form in some instances.
- At times, at the request of the resident, Council has also supplied a letter and map to Centrelink or the residents' insurance company to verify if water had been over the floor.

b. Insurance Companies.

- Generally, Council provided data about inundation on specific properties to insurance companies via and at the request of the resident / policy holder for that property.
- Otherwise insurance companies seeking land inundation extent and mapping were directed to the QRA website.
- Insurance companies were also advised that they could visit Council chambers and meet with and discuss flood behavior with Council staff.

c. Prospective developers and their representatives

- Council has spent considerable time sharing what flood information Council has with developers - often face-to-face, sometimes meeting with some developers and their registered surveyors to check flood elevations at particular sites.
- Developers have also made use of the maps in the foyer.
- In some instances, maps of land inundation, road centre line heights and flood peaks were provide electronically to developers.

5. **Whether and to what extent Council's infrastructure (for example, sewers, roads, stormwater) was affected by flooding that occurred during the**

period 1 December 2010 to 31 January 2011, citing specific examples where possible;

This section is broken down into details on;

- Urban infrastructure,
- Rural infrastructure, and
- Sport and Recreation Facilities.

This response has been prepared with reference to the statement of Mr William Jeremy Turner, General Manager Civil Operations, Central Highlands Regional Council, who has provided a separate response to the Flood Commission of Inquiry that addresses this question.

Urban Infrastructure

A significant amount of Council infrastructure was affected by the flooding either by inundation or the effects of flowing water. Affected infrastructure included roads, water supply, wastewater, parks and gardens, sports fields, stormwater, bridges, some buildings and public amenities. The urban areas most affected were Emerald and Rolleston although there were roads affected in other townships within the Central Highlands Regional Council area.

<u>Emerald</u>

Flood Spread; The extent of flood spread within Emerald is shown in Attachment 1. This flood spread information was compiled by the Manager Corporate Governance CHRC and was based on site observations, post event water marks, debris deposition and input from private individuals.

It should be noted that this plan shows the extent of water inundation only and gives no indication of water depth, water velocity, direction of flow or duration of inundation. All council infrastructure in the flood spread area was affected to varying degrees.

Sewerage Infrastructure; There are 30 sewer pump stations in Emerald and 19 of these were inundated by flood water. Of these, 7 suffered electrical damage as a result of control panels and/or switchboards being submerged and required repairs before they could be returned to service. The 12 pump stations that were submerged without electrical damage were able to return to service once flood waters had subsided below the level of the pump station lid. Attachment 2 shows the location of the affected pump stations.

The wastewater treatment plants in Emerald, located in Park Avenue and Black Gully (north east of the Airport), were not affected by flooding.

Water Infrastructure; The Opal Street Water Treatment Plant was not greatly affected by flooding although temporary levees were installed to keep flood water out. The water reticulation network is effectively a “closed” system and was not affected.

Roads; Many roads in Emerald were affected by flooding as is evident from the Flood Spread map. The depth of flooding varied as did the duration. Those roads that were subjected to longer periods of submersion have generally deteriorated with time as vehicle loads on the saturated pavements have caused cracking, rutting and deformation. In addition to the road pavement, other infrastructure

such as footpaths, kerbing, street signs and street trees were also affected by the flooding.

Bridges; The John Gay Bridge over the Nogoa River is a low level structure and was closed for a significant period of time. Although the structure itself did not suffer any damage the approaches to the bridge were saturated and required repairs.

Parks & Gardens; Many park and garden areas were flooded but generally sustained no long term damage. Four pumps used to extract irrigation water from the Nogoa River near the Botanic Gardens were all affected by flood debris but were cleared of debris and silt and returned to service once water subsided.

Cemeteries; The Emerald cemetery in Park Avenue was not affected by flooding.

Rolleston

Flood Spread; Attachment 3 shows the extent of the Flood Line with the water level being well above the highest level previously recorded.

Sewerage Infrastructure; Two pump stations located near the Comet River were flooded and suffered electrical damage.

Water Infrastructure; The Rolleston Water Treatment Plant, located alongside the Comet River, was inundated with about 500mm of water on the floor. Water from an emergency bore field was used to maintain the water supply to the township. As part of water supply security, an in line chlorinator had been installed at the bore in anticipation of the need to use the bore field.

Roads; A few roads within the town were affected by flood waters but inundation was not long term and traffic loadings were generally light with little if any permanent damage being caused.

Other Towns

All towns in the council area were affected to some extent by flooding of varying degrees. In some cases, this was surface water only which dissipated quickly after rain eased off or stopped. The towns of Sapphire, Rubyvale and Bluff experienced flood waters that covered low lying areas including sports fields but these recovered as the water receded.
Many towns were isolated for several days by flood waters as rivers and streams rose to high levels resulting in road closures of both Council and State roads. Examples were the Capella Rubyvale Road (Council road) and the Gregory Highway (State road) from Emerald to Capella and Emerald to Springsure.

Rural Infrastructure
Numerous roads throughout the council area were affected by flooding.
In some cases, the effect was inundation with the roads being relatively undamaged and able to carry traffic as soon as water receded.
In cases where the water remained for some time the road pavements became very saturated and suffered damage once reopened. This damage became

noticeable over a period of time as vehicle usage, particularly by heavy vehicles, was unable to be sustained by the road pavements because the saturation resulted in a significant loss of strength.
On many unsealed roads pavement saturation was extreme due to the absence of a water proofing seal coat and usage was either restricted to light vehicles only or the road was closed until conditions improved. A number of roads were so saturated that heavy vehicle usage was not possible for many months. This caused problems in several areas because the cartage of cattle to sale yards, feed lots or slaughter was not possible for up to nine months.
Some roads were so badly damaged by large volumes of flood waters that had sufficient velocity to scour out roads completely that complete rebuild of some sections of road were necessary.

Sport and Recreation Facilities
A total of twenty eight sport and recreation clubs within the council area were affected by flooding. Although most club buildings, facilities and equipment is owned by the clubs themselves the grounds on which they operate are owned by the Central Highlands Regional Council. More details on the extent of damage are contained in the **"Sporting Clubs Flood Damage Report"** prepared by Debbie Hall (Department of Communities) and Mike Priddle (Central Highlands Regional Council) which is included with this statement as Attachment 4.

6. **For 5, details of the reconstruction of this infrastructure including costs and programs;**

<u>Emergent Works</u>
Please note figures as at 31/05/2011 below (figures relate to costs as submitted for the emergent works only):-

Costs to roads (includes parks and gardens) (excludes day labour costs)	$16,494,121
Costs to roads (includes parks and gardens) (day labour only)	$1,505,099
Emerald Transfer station	$1,432
Emerald WTP	$33,370
Emerald Sewer pump stns	$58,770
Emerald showgrounds infrastructure	$70,898
Tourist Info Centre	$65,767
McIndoe Sports Complex	$12,979
Rolleston Sewer pump stn	$25,425
Rolleston WTP	$24,353
Bedford Weir	$26,620

<u>NDRRA/Restoration Works</u>
Please note figures as at 02/09/2011 below (estimates relate to costs for restoration works only):-

Duaringa Area – $38.5 million
Springsure Area – $35 million

Emerald Area - $7.5 million
Capella Area - $5 million

Total = $86 million

7. Funding arrangements for repairs to damaged Council infrastructure;

Funding for repairs to damaged Council infrastructure has been obtained from the following areas:

- NDRRA - For road and appropriate infrastructure, with Council funding day labour for roadworks;
- Insurance for some Council miscellaneous infrastructure (e.g. Showgrounds);
- Miscellaneous grants (small); and
- Council funding all gaps in funding.

8. Any policies or other documents which require property owners to have an evacuation plan and/or route in the case of flooding;

Council does not at the current time have any policies or other documents that require property owners to have an evacuation plan or route in the case of flooding.

What Council is doing to improve evacuation routes in some areas is as follows:-

- Riverview Estate - see copy of attached easement on Lot 7 RP817168 and would be same for Lot 6 RP817168 and Lot 8 RP817168 (Attachment 5).
- Council is in discussions with a landholder of a Lot to see if a new easement about 4m wide could be purchased and extended completely north south along the western boundary of the existing Riverview Estate allotments to assist in allowing access opportunities to Waldby Court, Emerald.
- Council is currently considering a land swap arrangement with a developer and holder of a parcel of land in the south east corner of Blue Gums Estate. This would enable a flood route access to the South East out of Blue Gums estate into Andrew's Road.

9. Describing the results of the collation of base data from the 2008 and 2010/2011 floods as described in Peter Maguire's statement dated 13 May 2011;

KBR was contracted to undertake an audit of all floodplain data held by Council, State and other parties. This data has been collated by KBR digitally into a structured format. Council has not yet received this data but has received an interim report that outlines what data has been obtained, but this remains incomplete as KBR is still awaiting SunWater to provide their data.

C & R Consultants are still collecting field data including stream cross-sections, profiles, photographs and rainfall records from properties in the Nogoa Catchment.

Once both parties supply the data to Council, this data will be used by the successful tenderer once tenders are let for the Flood Plain Management Study and Plan.

10. **Describing the results of the "gap analysis" performed to inform a floodplain management study as descried in Peter Maguire's statement dated 13 May 2011;**

    Council has received the draft Flood Audit and Gap Analysis report that incorporates material from variation one (2010/ 2011 Flood Event Data) from its consultants, KBR Pty Ltd. A set of review comments has been forwarded to KBR Pty Ltd who is holding this document in DRAFT status until such time as that firm completes variation two 'Infrastructure Issues Paper: Impact of Flood Events on Government Infrastructure in Emerald and its Surrounds'. This will allow all of the additional data being generated in variation two to be incorporated into the indexed data sets that are being delivered as a component of the Flood Audit and Gap Analysis.

    The variation 2 'Infrastructure Issues Paper: Impact of Flood Events on Government Infrastructure in Emerald and its Surrounds' is now in the final stages of data collation and KBR is now preparing to commence the analysis phase of this project.

    It is anticipated that the Final report for the Flood Audit and Gap Analysis and the 2 'Infrastructure Issues Paper: Impact of Flood Events on Government Infrastructure in Emerald and its Surrounds' will be delivered in late September 2011.

    A copy of the draft 'Flood Audit and Gap Analysis' report is attached for the Commissions reference (See Attachment 6).

11. **Describing the progress of the floodplain management study commissioned by the Council and described in Peter Maguire's statement dated 13 May 2011;**

    Council commenced an in house audit of material related to flooding and flood plain management in August 2009 in order to ascertain what data was available for a Flood Plain Management Study and Plan. This led to Council making provision in 2010 for the funding of an external consultant to undertake the Flood Audit and Gap Analysis which commenced in February 2011. This is the first stage of the Flood Plain Management Study as per State Planning Policy 1/03. The Council also commissioned two variations to the original contract that had been finalised in November 2010, firstly for collection of additional data from the 2010/2011 flood event and secondly, the preparation of an 'Infrastructure Issues Paper: Impact of Flood Events on Government Infrastructure in Emerald and its Surrounds'.

    Council is now preparing for the commissioning of the Flood Plain Management Study and Plan. It is doing this through the following actions:

    a. The material in the draft Flood Audit and Gap Analysis report has been utilised to prepare tender documentation for the Flood Plain Management Study and Plan by BMT WBM Pty Ltd. This draft report was instrumental in determining the scope and costing for the Flood Plain Management Study and Plan.

    b. Application for funding of the Flood Plain Management Study and Plan through round 3 of the Natural Disaster Resilience Programme through

Emergency Management Queensland. The initial assessment of the proposed projects has been undertaken and it is anticipated that Council will be advised of the outcome in September 2011.

c. The organisation membership of the Flood Plain Management Study and Plan Committee has been determined and approaches are being made to these organisations as to nomination of Committee members. The Terms of Reference for the Committee are being finalised.

d. Council will be undertaking a 'Registration of Interest' for consultants who would like to undertake the Flood Plain Management Study and Plan through September 2011. This will lead to a short listing of consultants to submit a formal tender in October 2011 with a view to the Flood Plain Management Study and Plan commencing in November 2011.

The Flood Plain Management Study and Plan is a significant project that will not be delivered in time for the 2011 / 2012 wet season. So Council has brought forward several smaller studies that would normally be components of the Flood Plain Management Study and which will ultimately be incorporated into the Flood Plain Management Study. These projects have been undertaken to ensure that Council is in an improved position to respond to any flood event in the summer of 2011 / 2012.

1. Flood Audit and Gap Analysis
2. 'Infrastructure Issues Paper: Impact of Flood Events on Government Infrastructure in Emerald and its Surrounds'
3. Economic Impact of 2010 / 2011 Flood on Emerald (through Central Highland Development Corporation)
4. Active acquisition of LIDAR for most frequently affected areas of the Central Highlands Regional Council local government area
5. Additional river gauges to improve forward warning of flood events
6. Assessment of the Upper Nogoa and Fairbairn Dam catchment
7. Urban Flood Plain Analysis from the Fairbairn Dam spillway to downstream Emerald township
8. The commencement of preparation of a Temporary Local Planning Instrument over Emerald Town to regulate future development.

12. Describing the progress of the assessment of the upper Nogoa River and Fairbairn Dam catchment Council engaged C & R Consulting to perform as described in Peter Maguire's statement dated 13 May 2011;

This project is proceeding on schedule and is anticipated to be delivered in late September 2011. The field work for this project has been completed. To date the consultant has provided written updates on 20 June 2011 and 3 August 2011 which are provided for the Commission reference (See Attachment 7).

13. Describing the progress of the Urban Flood Plain Analysis from the Fairbairn spillway to downstream Emerald township at Theresa Creek which Council engaged C & R Consultling to perform as described in Peter Maguire's statement dated 13 May 2011.

This project is proceeding on schedule and is anticipated to be delivered in late September 2011. The preparation of the hydraulic model for Emerald Town will

commence in the week of 30 August 2011. To date the consultant has provided written updates on 20 June 2011 and 3 August 2011 which are provided for the Commission reference (See Attachment 7).

Other information

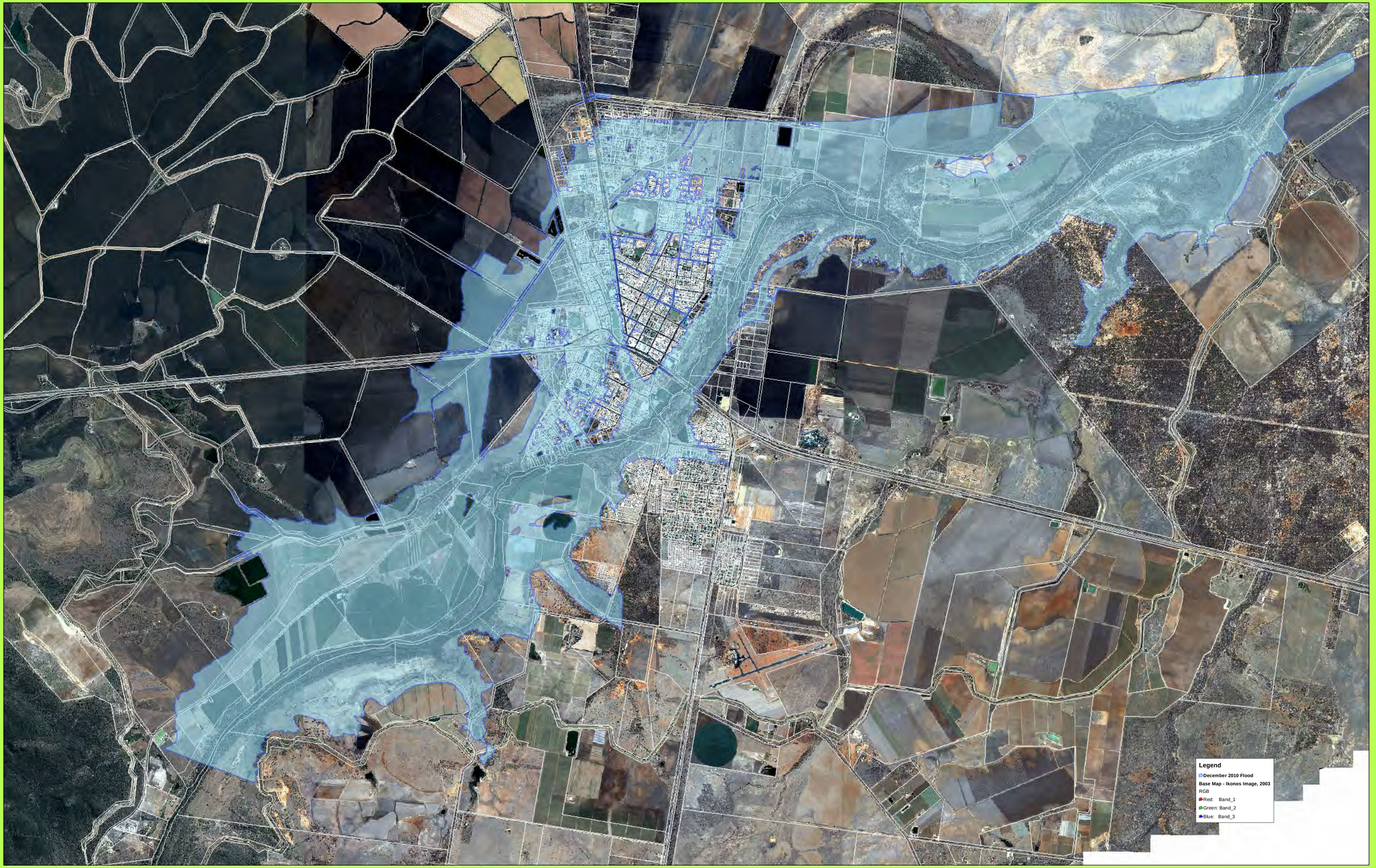
Council has had initial discussions with SunWater about possible mitigation options at Fairbairn Dam such as flood gates. Discussions are currently focused on having a study conducted.

[redacted]

Bryan Alfio Ottone

Declared at **Emerald** this **6th** day of **September 2011**.

Land Inundation - 31 Dec 2010 Flood - Emerald



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Disclaimer:

Central Highlands Regional Council makes no statements, representations or warranties about the accuracy, completeness or reliability of any information contained in this map. Council disclaims all responsibility (including without limitations, liability in negligence) for all expenses, losses, damages and costs you might incur as a result of the information being inaccurate or incomplete in any way and for any reason.

Data capture and map preparation by
Central Highlands Regional Council.
Map prepared 18 August 2011

Datum
Horizontal - Geocentric Datum of Australia 1994 (GDA94).
Vertical - Australian Height Datum (AHD) 1971.
Projection
Horizontal - Map Grid of Australia (MGA94).

Extent of land inundation mapping completed to date at Emerald.
The map depicts water over the land. It does not indicate that water went over the floor of buildings or dwellings.
The map also represents the peak floodwater extent at all locations. It does not represent floodwater at a particluar point in time.

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General Meeting of Council

Excerpt from
MINUTES

Meeting held in the Central Highlands Regional Council Chambers, Emerald Office

Monday 18 October 2010

Commenced at 9.00am

Proposed Ministerial Designation for Community Infrastructure – Emerald Fire & Rescue Station
2A Andrews Road, Emerald Lot 4 on SP166044
Resolution:
Cr Bell moved and Cr Hayes seconded 'That

1. Council notes the content of this report, and

2. A further report is presented to Council advising of the outcome of the Ministerial designation process.

Carried

Council Meeting 18 October 2010 MT	3.3

DEVELOPMENT SERVICES REPORT

Proposed Ministerial Designation for Community Infrastructure Emerald Fire and Rescue Station 2A Andrews Road, Emerald Lot 4 on SP166044.

RECOMMENDATION:

RECOMMENDED that;

1. Council notes the content of this report, and

2. A further report is presented to Council advising of the outcome of the Ministerial designation process.

EXECUTIVE SUMMARY

The purpose of this report is to inform Council of issues associated with the proposed Ministerial Designation of land for Community Infrastructure to establish a Fire and Rescue Station (F&RS) at 2A Andrews Road, Emerald. Council was formally notified as part of the public notification process on 16 September 2010 of the State Governments intention to under take a Ministerial Designation of Land for Community Infrastructure under the Sustainable Planning Act 2009. Council advised the State of its concerns on the 6 October 2010.

If the Ministerial designation is made the development becomes "exempt development", therefore the provisions of the Council's Planning Scheme, Capricorn Municipal Development Guidelines, External Roadworks Contribution Policy and Headworks Policies will not be able to be applied to the proposed development.

Locating the F&RS at 2A Andrews Road, Emerald is not in the public interest due to the following reasons which are discussed in the attached report:

- The site selected is not centrally located;
- The majority of commercial, industrial and residential development is located on the Northern side of the Nogoa River;
- Locating the F&FS on the southern side of the Nogoa River may give rise to delayed response times during periods of flood; and
- Lack of infrastructure to service the development.

The selected site should be reconsidered. The finial location of the F&RS should ensure minimal response times are achieved to the majority of major commercial, industrial and residential nodes as this would benefit the wider community.

It is recommended Council notes this report and, that a further report be presented to advising Council of the outcome of the Ministerial Designation process, once the results of this process are known.

REPORT

PROPOSAL

The Department of Community Safety (Queensland Fire and Rescue Service), has formally advised Council, that it proposes to undertake a Ministerial Designation process under the provisions of the *Sustainable Planning Act 2009* to establish a Fire and Rescue Station (F&RS) at 2A Andrews Road, Emerald. Correspondence from the Department dated 16th September 2010 were received by Council as part of the required public notification and consultation process inviting Council to provide comment regarding the proposal.

The proposal involves the establishment of a new Emerald Fire and Rescue Station. The F&RS will be a standard 24-hour urban station, operating 7 days a week; however the area offices will be open during business hours only.

The proposed Emerald F&RS will produce a 980m² Gross Floor Area (GFA) development including a two (2) bedroom caretakers residence are based on the FS3 standard design for a large auxiliary station. The new station will consist of the following:

- Foyer;
- Data Room;
- Duty Office;
- Mess Room;
- Recreation Room;
- Gym;
- Locker Room;
- Turnout Room with Showers;
- Multi-Purpose/Training Room with Kitchenette;
- Urban and Rural Store;
- Projects Room;
- Urban Area Director Office;
- Administration area;
- Breathing Apparatus Room;
- Equipment Store Room and Workshop;
- Bulk Store;
- 15 car parks; and
- Relieving Quarters (2 bedroom caretakers residence) with Carport.

The Department proposes to service the development by connecting to Council's reticulated water supply and would prefer to utilise an onsite septic system rather than connect to Council's sewerage infrastructure.

External material selection will include colorbond roof sheeting supported on a combination of steel support members and timber trusses. The external materials on the walls will comprise of rendered fiber cement board, colorbond sheeting and brick/veneer which is consistent with the surrounding built form.

The site will be accessed via two crossovers. The crossover along Andrews Road will provide ingress for emergency vehicles and ingress and egress for visitor and staff car parking. The crossover along the Gregory Highway (south) will provide egress for emergency vehicles only. 15 onsite carparks will be provided on site for staff and visitors. Pedestrian and disabled access is available from the car parking area to the station.

Under Part D3.4 of the Building Code of Australia, disabled access by the general public is required from the street boundary and on-site disabled carpark bay to the foyer of the station. The remainder of the station is provided solely for the use of operational staff, whom are required to be able-bodied and ready to respond immediately to emergency calls.

Council has provided a response to Department on the 6th October (see attachment). This response was due by the 8th October.

BACKGROUND

Correspondence was forwarded by the Mayor on the 4th June 2009 to the Honorary Neil Roberts, Minister for Police, Corrective Services and Emergency Services advising that Council had heard of the proposal but had not been consulted with by the Queensland Fire and Rescue Service regarding the location of a future Fire and Rescue Station (F&RS).

The Mayor commended the Department for considering such facility a in the area, however raised concerns regarding the location the F&RS at 2A Andrews Road, as the site is located *"away from the great majority of houses, businesses and industry in town and is separated by the Nogoa River which does flood"*. The Mayor also advised the Minister *"that the need may well arise for a unit to be located on the south side of Emerald but if this is not the intention now as the Mayor I would not support the location of the F& RS"* at Andrews Road if there is to be only one F&RS in Emerald as he does not believe it to be in the best interests of the community.

Council received a response to the Mayors letter dated the 29th July 2009 the correspondence included the following statements:

> *"The Queensland Fire and Rescue Service (QFRS) has identified a future need for a replacement station at Emerald due to the inability of the existing facility to meet future operational and service delivery standards. Over the past 12 months QFRS has conducted a comprehensive review of all properties listed for sale with regard to location, size and major constraints."*
>
> *"Land situated at 2A Andrews Rd, Emerald, was identified as suitable for QFRS purposes, and due diligent searches were carried out in consultation with Central Highlands Regional Council Officers. These included comprehensive investigations regarding flooding, stormwater and sewerage reticulation, and onsite effluent disposal. The Department of Community Safety will undertake the necessary steps for the site to be connected to reticulated sewerage.*
>
> *Plans are now being developed to enable a business case to be prepared for consideration in future capital programs. At this time QFRS has made no commitment to the scheduling of this proposal."*

SITE CHARACTERISTICS

The subject site is presently vacant, has an area 4770m² and is located within the Town Zone: Rural Residential Precinct. The allotment has a frontage of approximately 90m to Gregory Highway and 38m to Andrews Road. Land uses located to the east of the site are of an industrial nature, whilst rural residential development is located to the west and south of site.

COMMUNITY DESIGNATION PROCESS

The *Sustainable Planning Act 2009* (SPA) prescribes the way in which Ministerial designations can be undertaken. The *SPA,* Chapter 5 prescribes that a Minister, before designating land for community infrastructure, must be satisfied that:

- adequate environmental assessment has been carried out;
- in carrying out such environmental assessment there was adequate public consultation; and
- adequate account has been taken of issues raised during the public consultation.

Two (2) rounds of consultation shall occur in accordance with Ministerial designation guidelines. One (1) consultation round shall include relevant public sector entities (including the Council) and the other incorporating public notification to the wider community. However, the guidelines and these statutory processes are not exclusive and the Minister may choose to be satisfied that adequate environmental assessment and public consultation for the designation has been undertaken in an alternate capacity.

Presently the Ministerial designation is undertaking the initial consultation process. Please see the attached flow chart for further details regarding the Ministerial designation process.

If the Ministerial designation is made, the effect is that the use of the site for the designated community infrastructure and service will be exempt from the local government's planning scheme.

ISSUES

Council is concerned regarding the location of the proposed F&RS at the above mentioned address. The subject site is not Council's preferred location, as the site is not centrally located and is not serviced by Council's sewer. Infrastructure in this area is designed to accommodate rural residential development only.

Locating the Fire and Rescue Station south of the Nogoa River on Andrews Road may give rise to delayed response times particularly during flood events of the Nogoa River, due to the closure of the John Gay Bridge. In large scaled events such as those seen in 2008 the Vince Lester Bridge was also inundated, thus preventing road access west and north of the Nogoa River. Severe traffic congestion and time delays occur when only one bridge is in operation.

The majority of residential, commercial and industrial development is presently located north of the Nogoa River. Council is of the opinion that such a facility should be located in a central position to enable short response time to be achieved. Such outcomes would be of benefit to the wider community.

In addition to the above the Andrews Road intersection with the Gregory Highway is designed to accommodate residential traffic only. Council has advised the State all future costs associated with the upgrade to this intersection required by this development should be funded by the State and have recommended the Department Transport and Main Roads be consulted in relation to this proposal.

If the Ministerial designation proceeds the provisions of the Council's Planning Scheme, Capricorn Municipal Development Guidelines, External Roadworks Contribution Policy and Headworks Policies will not be required to be applied to the proposed development, thus resulting in the Council bearing the burden of any upgrade costs.

As the headworks policy and South East Nogoa External Roadworks contributions are not applicable Council will not receive the required monetary contribution to accommodate the

additional impact the development shall have upon the Local Governments infrastructure. The estimated headwork's contribution for this development is $57,552 and the South East Nogoa Road contribution.

In correspondence issued by the Minister dated 29 July 2009 Council was advised "*the Department of Community Safety will undertake the necessary steps for the site to be connected to reticulated sewerage*". This has not occurred, as the development presented to Council on the 16 September 2010 identifies two (2) options for onsite effluent disposal. Below is an extract from the report the State presented to Council.

> *"Site Effluent Disposal*
> *Due to the level of development required for the site there will not be sufficient area available for disposal of effluent within the lot. Two alternatives are proposed for the disposal of treated effluent;*
>
> *Option 1*
> *To use treated effluent to irrigate the swale drain in the State Controlled Road adjacent to the site. The Department of Main Roads are currently assessing this option.*
>
> *Option 2*
> *To pump treated effluent to Council's existing gravity network in Campbell Ford Drive. This option requires construction of a rising main in the Gregory Highway Road reserve, north from the site to connect to the existing gravity sewer network via a new manhole to be placed over the line in Campbell Ford Drive.*
>
> *This option provides a 'worst case' scenario for expense to service the site with effluent disposal.*
>
> *Budgeting costing for this is as follows:*
>
Onsite treatment plant	*$10,000.00*
Booster pump and storage well (if required)	*$ 6,000.00*
New Manhole (by Central Highlands Regional Council)	*$ 4,000.00*
Rising Main (63mm Poly x 580m)	*$50,000.00*
	$70,000.00 +GST"

Council strongly opposes the utilisation of onsite septic system on this site and the discharge of treated effluent to the Gregory Highway swale. It is standard practice if an onsite septic system is proposed for all of the system to be contained on site. This avoids maintenance issues, neighbourhood disputes and ensures that the system remains under the control and operation of one entity. Council is of the opinion the only practical solution for this site is to connect to the Council infrastructure, which may require the extension and augmentation of existing infrastructure located on the western side of the Gregory Highway

Council envisions infill development to occur within the existing rural residential precinct in the future and to redevelop the area into a low density residential precinct to accommodate Emerald's increasing population, therefore Council would prefer onsite sewerage systems not to be utilised in this instance.

CONCLUSION

Council has responded to the Public Notification of this Ministerial Designation of Land for Community Infrastructure at 2A Andrews Road. Council is not required to undertake any further action in relation to this matter; however Council should be aware of the implications for the Council and the wider community as direct result of this process.

POLICY IMPLICATIONS
In the event the Ministerial Designation proceeds the F&RS will be exempt from the local government's planning scheme. Therefore the provisions of the Council's Planning Scheme, Capricorn Municipal Development Guidelines, External Roadworks Contribution Policy and Headworks Policies will not be required to be applied to the proposed development.

FINANCIAL IMPLICATIONS
Council will not receive $57,552 in headworks contribution and the South East Nogoa Road Works Contribution which would normally be required as part of a determined Development Application. Council will be required to fund upgrades to the water and sewer network which are required to accommodate the additional impact upon public infrastructure generated by this development.

It is acknowledged Council's current headworks policies result in only partial cost recovery for development impact upon public infrastructure.

STATUTORY IMPLICATIONS
There are no statutory implications under the *Local Government Act 1993*, or the *Sustainable Planning Act 2009* with this matter.

[redacted]
Luke Lankowski
ACTING GENERAL MANAGER ENVIRONMENT AND PLANNING

Report prepared by: [redacted]
Senior Town Planner
7 October 2010

central highlands regional council

Map

Map Zoom: 1.671 km
Map Scale: 1:9,039

Selected Properties Address Details

Lot_num	Plan_num	Lot_plan	Tenure	Area_ha
4	SP166044	4SP166044	FH	0.477

Assesment_Number	Parcel_Number	Property_Address	Suburb
5018	9104	2 A Andrews Road	EMERALD

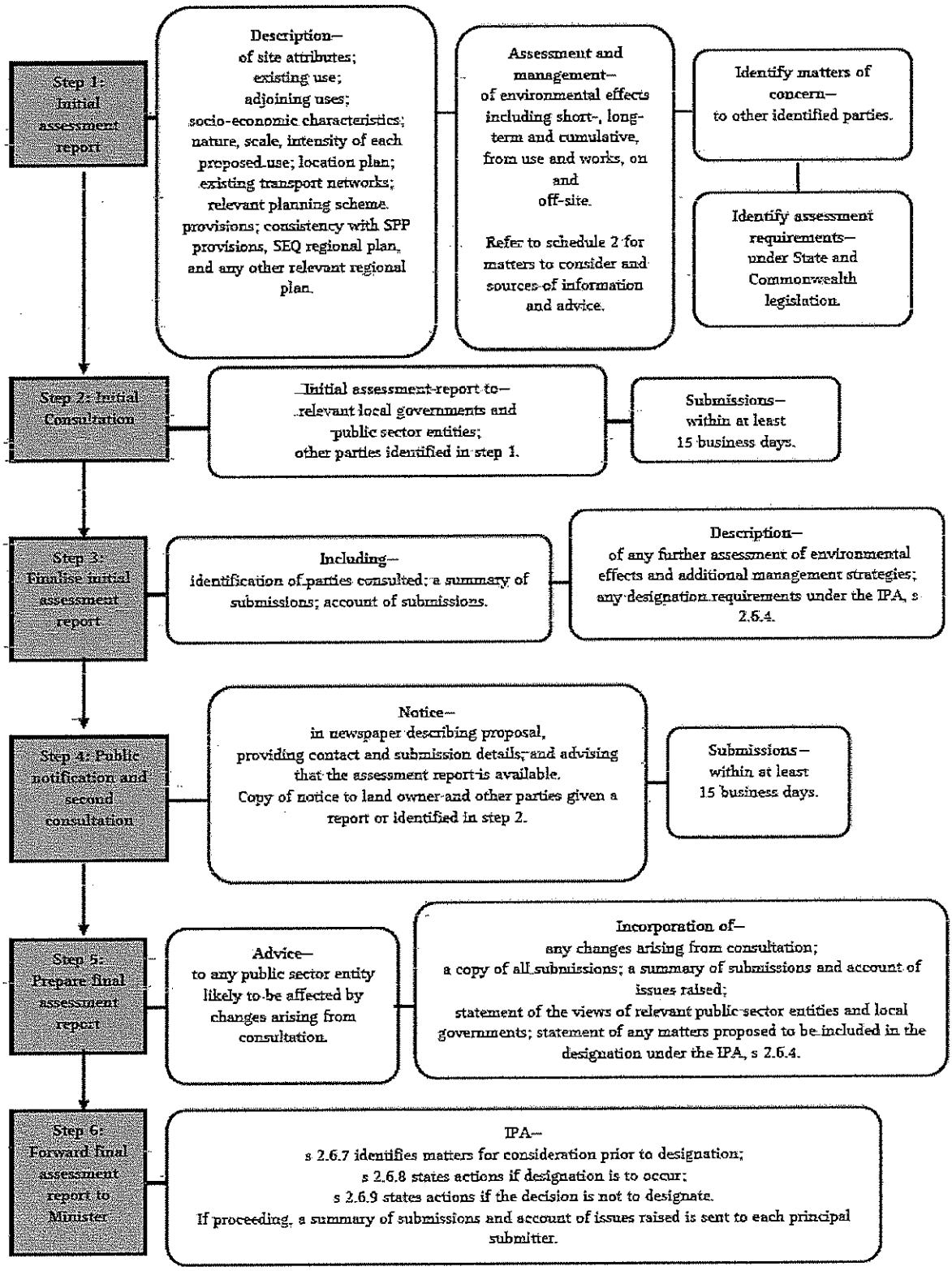
About this Document

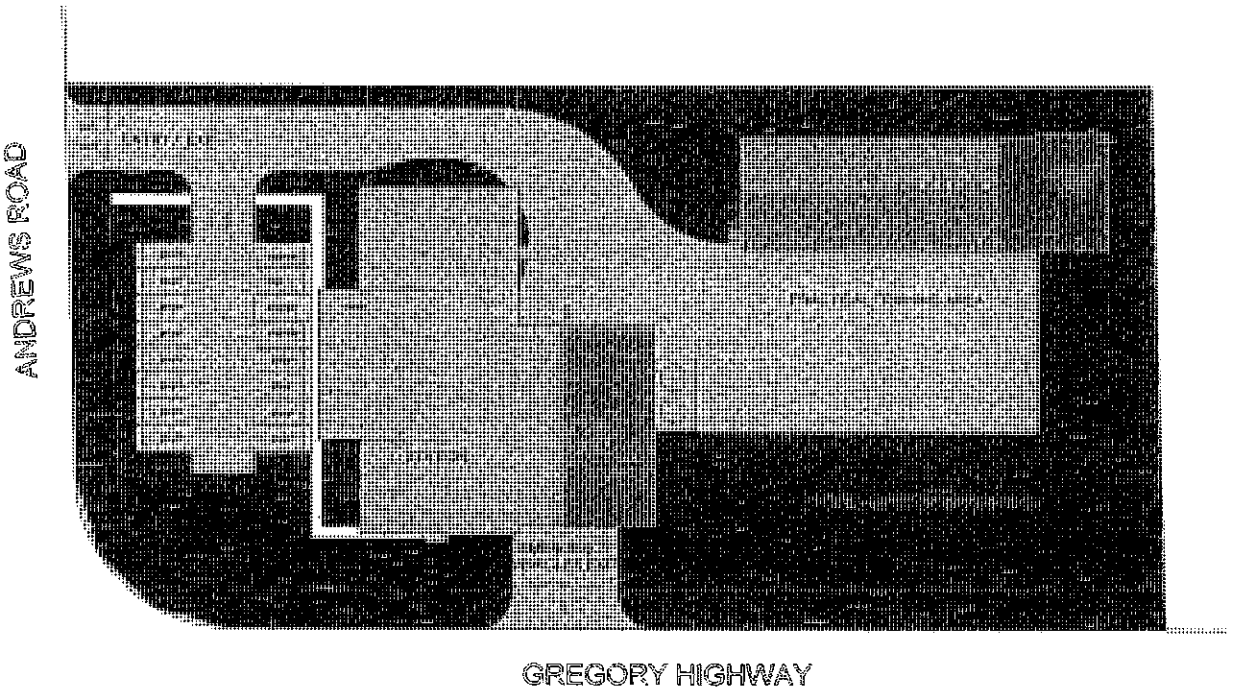
This map has been created for the purpose of showing basic locality information. Property boundary line network data is supplied by State Government. Any error should be reported to the GIS Section.

Disclaimer

This map is a representation of the information currently held. While every effort has been made to ensure the accuracy of the product, we accept no responsibility for any errors or omissions.

FLOWCHART SUMMARISING STEPS FOR ENVIRONMENTAL ASSESSMENT AND CONSULTATION





1 Site
1 : 500

Queensland Government

DEPARTMENT OF COMMUNITY SAFETY
Corporate Suport Division Projects Development

RURAL FIRE SERVICE

No.	Description	Date

QFRS EMERALD

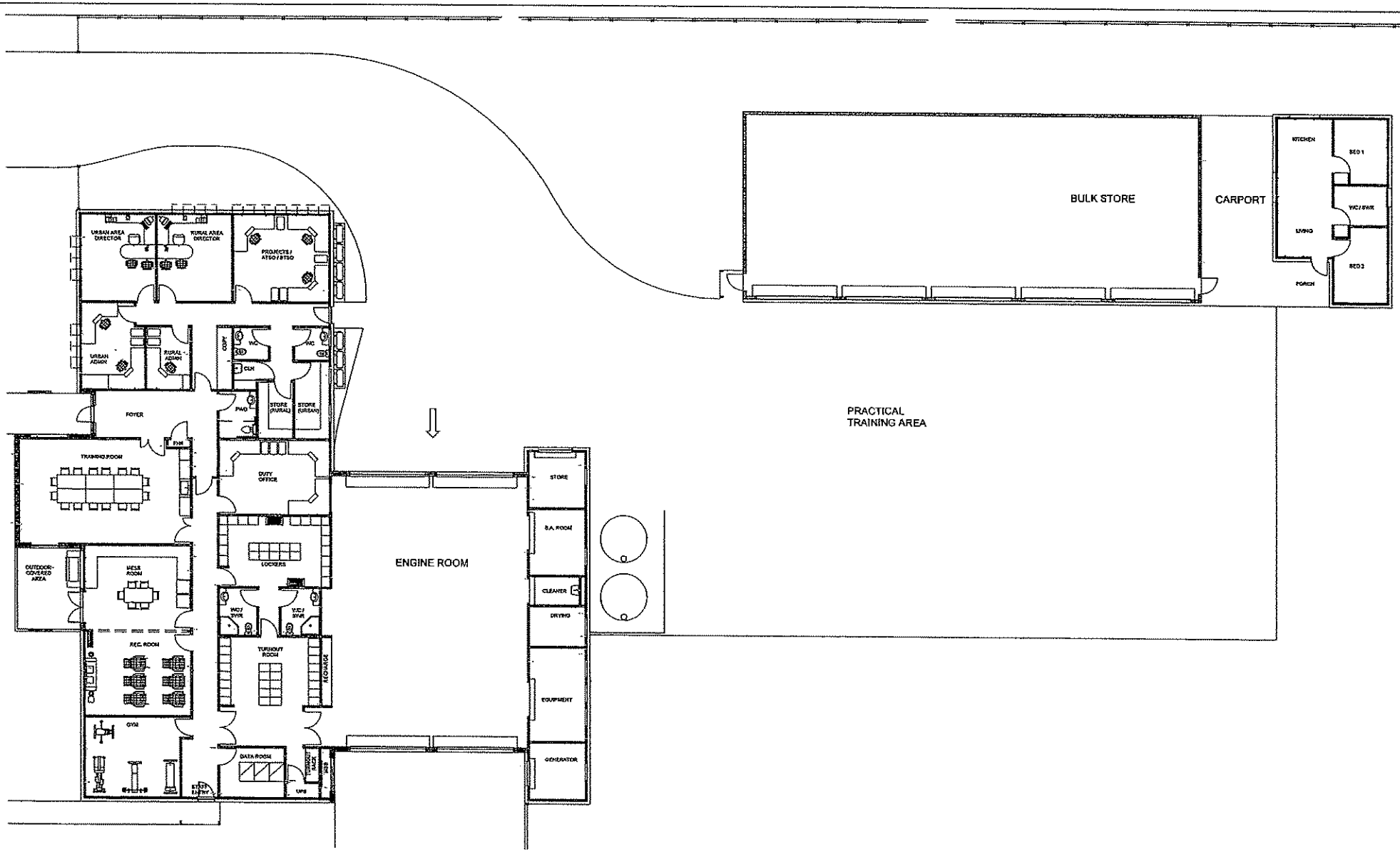
PROPOSED FIRE STATION

Site Plan

Project number	F-2816
Date	2010 / 09 / 07
Design & Drawn by	J. Gonzalez
Checked by	Rob O'Connor
Scale	1 : 500

SD-001

07/09/2010 17:08:14



1 Ground Floor

1 : 200

Queensland Government

RURAL FIRE SERVICE

DEPARTMENT OF COMMUNITY SAFETY

Corporate Suport Division — Projects Development

No.	Description	Date

QFRS EMERALD

PROPOSED FIRE STATION

FLOOR PLAN

Project number	F-2816
Date	2010 / 09 / 07
Design & Drawn by	J. Gonzalez
Checked by	Rob O'Connor

SD-002

Scale 1 : 200

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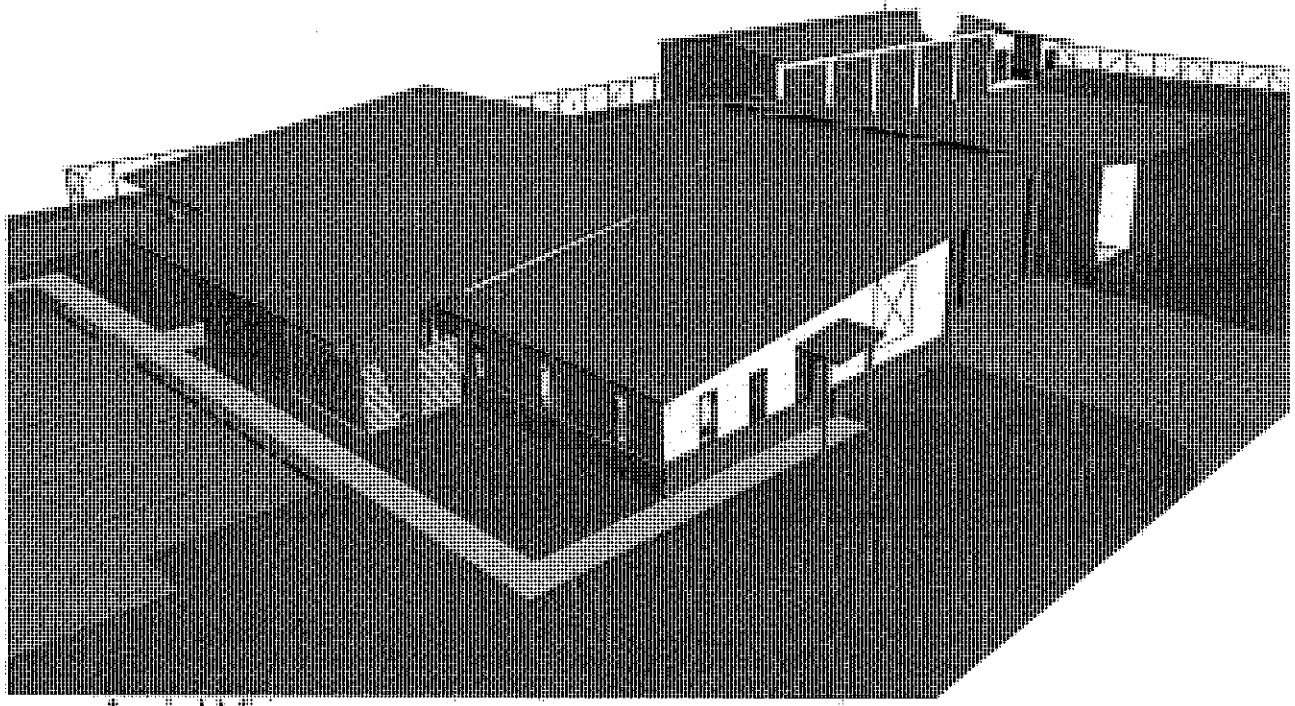
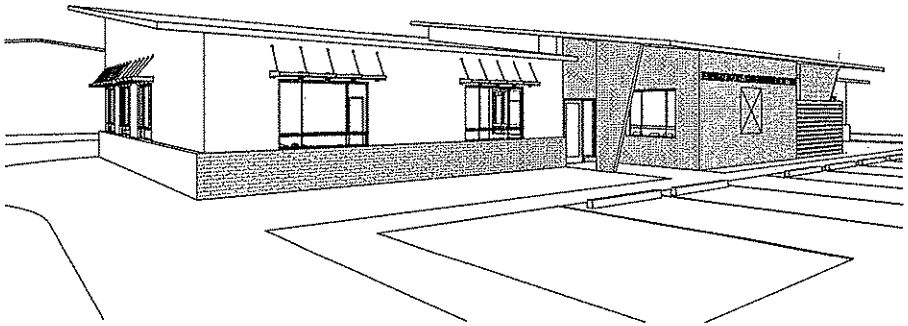
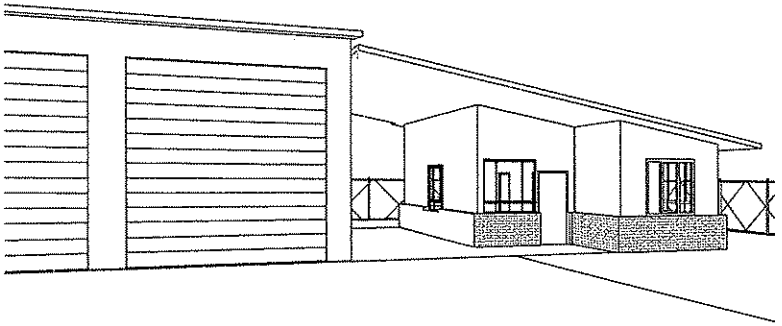


1 Aerial View



2 Access



3 Relief QTS & Bulk Store

Queensland Government

RURAL FIRE SERVICE

DEPARTMENT OF COMMUNITY SAFETY

Corporate Suport Division | Projects Development

No.	Description	Date

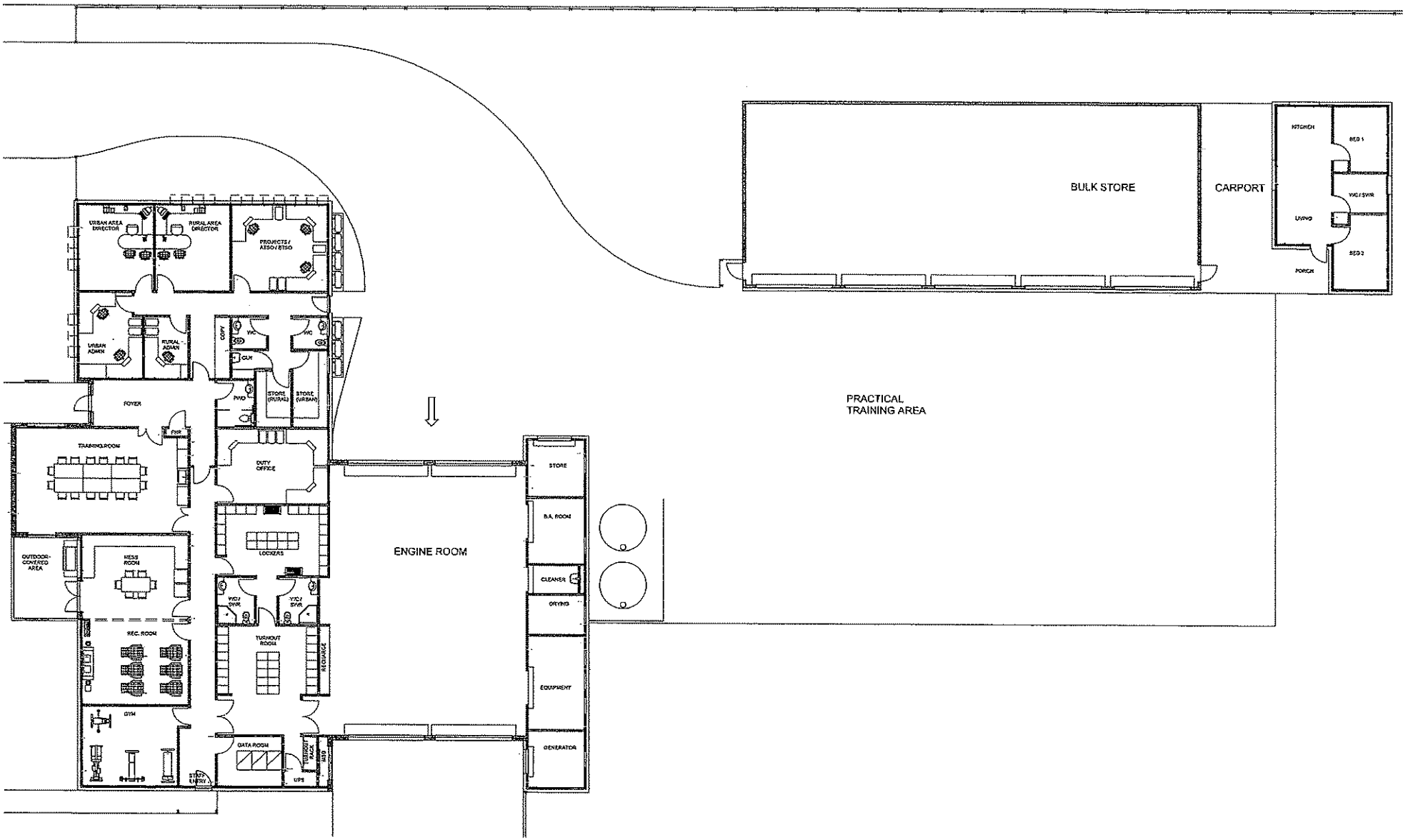
QFRS EMERALD

PROPOSED FIRE STATION

Perspectives

Project number	F-2816	SD-005
Date	2010 / 09 / 07	
Design & Drawn by	J. Gonzalez	
Checked by	Rob O'Connor	Scale

07/09/2010 17:08:40



1 Ground Floor

1 : 200

Queensland Government

RURAL FIRE SERVICE

DEPARTMENT OF COMMUNITY SAFETY

Corporate Suport Division Projects Development

No.	Description	Date

QFRS EMERALD

PROPOSED FIRE STATION

FLOOR PLAN

Project number	F-2816	SD-002	
Date	2010 / 09 / 07		
Design & Drawn by	J. Gonzalez		
Checked by	Rob O'Connor	Scale	1 : 200

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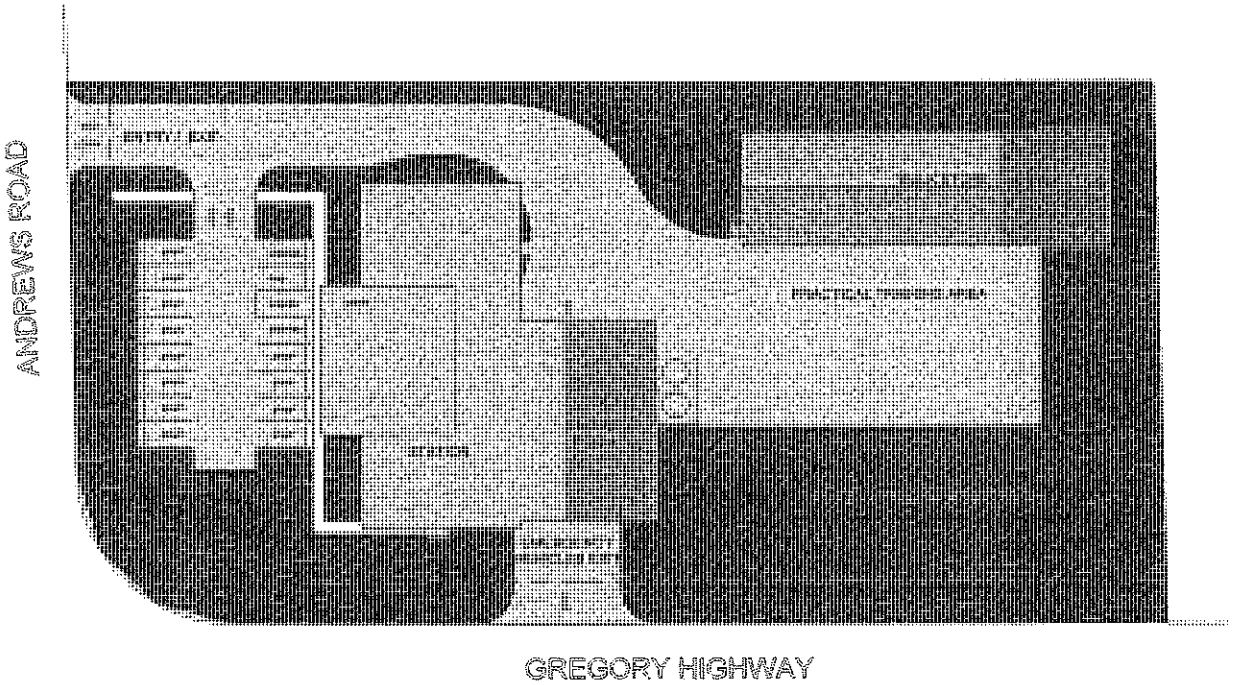


1 Site
1 : 500

Queensland Government

RURAL FIRE SERVICE

DEPARTMENT OF COMMUNITY SAFETY
Corporate Suport Division Projects Development

No.	Description	Date

QFRS EMERALD

PROPOSED FIRE STATION

Site Plan

Project number	F-2816
Date	2010 / 09 / 07
Design & Drawn by	J. Gonzalez
Checked by	Rob O'Connor

SD-001

Scale 1 : 500

07/09/2010 17:08:14

central highlands regional council

CONTACT NAME: Bryan Ottone
TELEPHONE: (07) 4982 8302
FAX: 1300 242 687
EMAIL: bottone@chrc.qld.gov.au

5 October 2010

Housing & Property Portfolio
Project Services
GPO Box 2906
BRISBANE QLD 4001

Doc No: 406759
Date Rec: 6-10-10
Location: TP

Attention: [redacted]

Dear Sir/Madam

Re: **Central Highlands Regional Council response to Public Notification of Proposed Ministerial Designation for Community Infrastructure, Emerald Fire and Rescue Station at 2A Andrews Road, Emerald.**

Reference is made to your letter dated 16 September 2010 regarding a proposed Ministerial Designation of Land for Community Infrastructure at 2A Andrews Road, Emerald for the purposes of establishing the Emerald Fire and Rescue Station.

Please be advised Council is concerned regarding the location of the proposed Fire and Rescue Station at the above mentioned address. The subject site is not the preferred location, as the site is not centrally located and is not serviced by Council's sewer. Infrastructure in this area is designed to accommodate rural residential development only.

The infrastructure is not designed to accommodate the Emerald Fire and Rescue Station and Council strongly objects to the utilisation of an onsite septic system to cater for the use. Such a use should be connected to Council infrastructure which may require the extension and augmentation of existing infrastructure located on the western side of the Gregory Highway and payment of the necessary headworks contributions required for essential upgrades to trunk infrastructure and Councils water supply and sewerage treatment plants.

Council envisions the existing precinct shall be redeveloped in the future into low density residential housing to accommodate Emerald's increasing population, therefore Council would prefer onsite sewerage systems not to be utilised in this instance. It is advised the Andrews Road intersection with the Gregory Highway is designed to accommodate residential traffic only. All future costs associated with the upgrade of this intersection required by this development must therefore be borne by the State. It is recommended that the Department of Transport and Main Roads are consulted in relation to this proposal.

Locating the Fire and Rescue Station on Andrews Road may give rise to delayed response times particularly during flood events of the Nogoa River, due to the closure of the John Gay Bridge. In large scale events such as those seen in 2008 the Vince Lester Bridge was also subject to inundation, thus preventing road access west and north of the Nogoa River. Severe traffic congestion and time delays occur when only one bridge is in operation.

ALL CORRESPONDENCE TO BE ADDRESSED TO THE CHIEF EXECUTIVE OFFICER - ATTN: [CONTACT NAME]
PO BOX 21 / 65 Egerton Street Emerald Qld 4720 General Enquiries: 1300 242 686 Fax: 1300 242 687 Email: enquiries@chrc.qld.gov.au

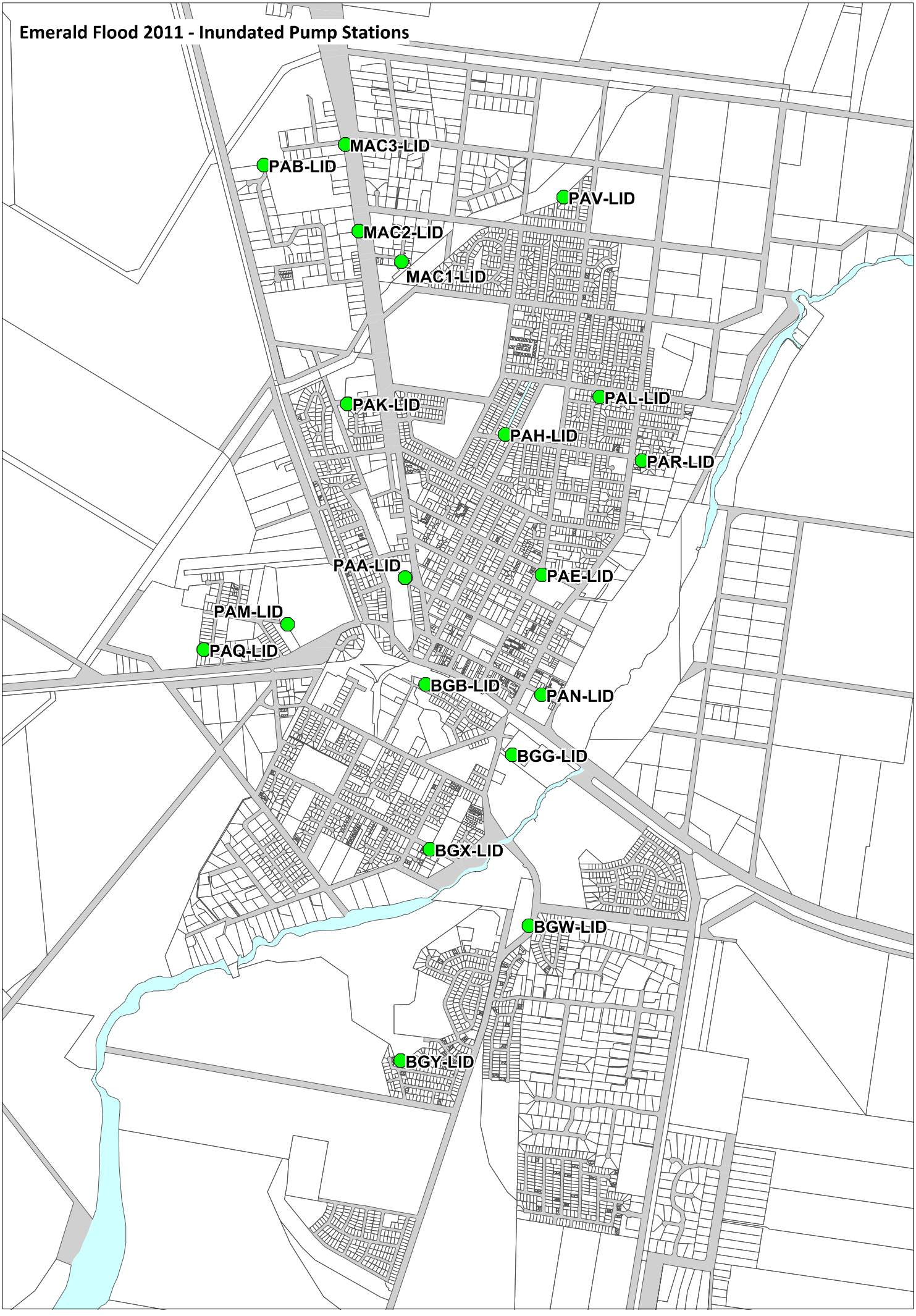
Council is of the opinion that such a facility should be located in a central position to enable short response time to be achieved. Such outcomes would be of benefit to the wider community.

Should you wish to discuss the above response, please do not hesitate to contact the undersigned on the above mentioned telephone number.

Yours faithfully

[redacted]

Bryan Ottone
CHIEF EXECUTIVE OFFICER


Emerald Flood 2011 - Inundated Pump Stations
MAC3-LID
PAB-LID
PAV-LID
MAC2-LID
MAC1-LID
PAK-LID
PAL-LID
PAH-LID
PAR-LID
PAA-LID
PAE-LID
PAM-LID
PAQ-LID
BGB-LID
PAN-LID
BGG-LID
BGX-LID
BGW-LID
BGY-LID

All of the area to the south of the flood line was under flood water - see photo inset.

Legend
Peak Flood Line - 28th Dec 2010
Cadastre
2003 Aerial Photograph
RGB
Red: Band_1
Green: Band_2
Blue: Band_3

0 250 500 Meters

Map produced B Wilkinson

Rolleston - 28 Dec 2010 Flood
Current Extent of Flood Mapping

CHRC central highlands regional council

Central Highlands Regional Council

Sporting Clubs' Flood Damage Report

Prepared by: [redacted]all (Department of Communities)
[redacted] (Central Highlands Regional Council)

Date: January 21, 2011

Overview:

Twenty-eight sport and recreation clubs in the Central Highlands Regional Council area were directly affected and suffered equipment and infrastructure damage as a result of the December 2010/January 2011 flood event.

Effected clubs/organisations were:

Morton Park – Emerald Netball Association, Emerald Junior Soccer Association, Emerald Rams Rugby Union Club

McIndoe Park – Emerald Brothers Cowboys RLFC, Emerald Tigers RLFC, Emerald Brothers Junior Rugby League and Emerald Junior Rugby League

Pioneer Park – Emerald Jockey Club, Emerald Polocrosse Club, Emerald Touch Association

Emerald Showgrounds – Central Highlands Regional Cricket, Emerald Boxing Club, Emerald Rodeo Association

Epic All Sports – Epic All Sports, Magpies Cricket Club

Other facilities - Emerald – Emerald Fighters Inc, Emerald Golf Club, Emerald Horse and Pony Club, Emerald Pistol Club, Maraboon Powerboat and Ski Club

Blackwater – Blackwater Country Club (golf club), Blackwater Junior Motorcycle Club, Blackwater Powerboat & Ski Club, Bluff/Blackwater Amateur Race Club

Comet – Comet River Pony Club

Duaringa – Duaringa Cricket Club

Gemfields – Gemfields Junior Rugby League Club

Springsure – Springsure Pony Club

Interviews were conducted on site with representatives of each of the organisations from January 10 to January 21.

The associations were affected to varying degrees and very few carry flood insurance. At the time of compiling this report, a number of clubs had been unable to assess the full extent of the damage. The organisations were also not in a position put a dollar value to the cost of repairing/replacing damaged infrastructure and equipment at that stage.

Details of the damage experienced by individual organisations are as follows:

Morton Park:

- ## Emerald Junior Soccer Association (Emerald Eagles Football Club)

Located: Morton Park, Emerald

Contact: Mike Featherstone

Description of water inundation – Floodwaters covered all fields to an approximate height of 1.5m. Water also inundated the clubhouse (1.5m), storage shed and Council-owned toilet block. Inundation lasted approximately three days.

Damage sustained – *Infrastructure:* Concrete slab on clubhouse/equipment shed; seven doors in clubhouse and equipment shed; kitchen cupboards and benches; equipment storage cupboard and shed guttering; and possible sinkhole subsidence on fields to be confirmed.

Damage sustained – *Equipment:* Honda mower; 110lpm compressor; 3 fridges (TBC); 1 freezer (TBC); photocopier and fax machine; PA system; line marker; $5000 junior jerseys; balls; bibs; 6 x first aid kits; miscellaneous office supplies; canteen stock; training cones; water bottles; flood lighting bulbs (were in storage); barbecue (TBC); and club records/paperwork.

Effect on ability to operate – Will delay plans for newly formed CQ competition.

- ## Emerald Netball Association

Located: Morton Park, Emerald
Contact: Debbie Hall

Description of water inundation – Floodwaters covered all courts to an approximate height of 1.5m. Water also inundated the clubhouse (.6m), storage shed and toilet block. Inundation lasted approximately three days.

Damage sustained – *Infrastructure:* Possible structural damage to clubhouse to be assessed (including stairs), significant subsidence on court 5 and further subsidence noted to the northern end of court 3 (yet to be confirmed but is covered with a large pool of water). Minor subsidence courts 1, 2 and 4.

Damage sustained – *Equipment:* Fridge and freezer, uniforms/merchandise, balls and misc training equipment, chairs.

Effect on ability to operate – Minor subsidence issues on courts 1, 2 and 4 needed to make them playable to enable season to get underway. Work on court 3 will be required as soon as possible if membership increases this season. Significant subsidence on court 5 poses public safety risk.

- ## Emerald Rams Rugby Union Club

Located: Morton Park, Emerald
Contact: Andrew Erbacher

Description of water inundation – Floodwaters covered the playing field and inundated the clubhouse and storage container to a height of 1.2m for approx 2-3 days.

Damage sustained – *Infrastructure:* Existing kitchen destroyed as was a new modular kitchenette that was being stored in the storage container awaiting installation; shelving under bar; two doors; and possible damage to lighting/electrical wiring.

Damage sustained – *Equipment:* Two gas water heaters; goal post and tackle pads; hit shields; water bottles; fridge/freezer; drinks fridge; line marking machine; padding on scrum machine; trophies; tables and baine marie.

Effect on ability to operate – No effect on ability to stage games/training but catering (source of income) will be affected.

McIndoe Park:

- **Emerald Brothers Cowboys RLFC, Emerald Tigers RLFC, Emerald Brothers Junior Rugby League and Emerald Junior Rugby League**

Located: McIndoe Park, Emerald
Contacts: [redacted] (Emerald Brothers JRL), [redacted] (Emerald JRL), [redacted] (Emerald Tigers RLFC) and [redacted] (Emerald Brothers Cowboys RLFC)

Description of water inundation – Floodwaters in excess of 2m covered the three fields, toilet/changing room facilities and storage donga and inundated the clubhouse/canteen to an approx height of 1.2m for a period of three days.

Damage sustained – *Infrastructure:* Significant damage to the clubhouse/canteen and fittings (doors, floor, lino, bar etc); dressing shed doors; perimeter fencing; clubhouse electrical wiring and storage donga (shared by four clubs). The maintenance shed was destroyed, seating on 13 grandstands, which were displaced by strong water current, will need to be replaced; and the light box for playing fields will need to be checked. Fields also lost recently applied top soil.

Damage sustained – *Equipment:* Shared - speakers; hot water system; signage and goal post.

Emerald Tigers RLFC – 2 x cricket kits; 4-door bar fridge; club memorabilia; and club records/paperwork. May also be faced with the situation where sponsors are now not able to fund jerseys (already ordered) due to their own flood-related issues.

Emerald Brothers JRL – Tackling bags (TBC).

Emerald Junior RL – Nil.

Emerald Brothers Cowboys RLFC – Nil.

Effect on ability to operate – As it is CH-wide, the 2011 season draw will go ahead as scheduled but local clubs' ability to host games (include scheduled rep game) will be affected. Training will be disrupted. Damage to fence will impact on clubs' ability to receive gate takings, which is a significant source of revenue.

Pioneer Park:

- **Emerald Jockey Club**

Located: Pioneer Park, Racecourse Road, Emerald

Contact: [redacted]

Description of water inundation – Floodwaters from the overflowing drain to a height of approximately 1m swept over the racecourse. The fields were inundated for approx 24 hours.

Damage sustained – *Infrastructure:* The road to the stables has been washed out in many places. The perimeter fence along Hospital Road has been flattened and severely damaged along Moody Street. The work track has sustained large washouts and this has made the track unusable. The work track will require a complete re-sanding.

Damage sustained – *Equipment:* Water damage to ride on mower.

Effect on ability to operate – Trainers are currently unable to work horses properly on the work track but the next scheduled race meeting (Feb 12) will go ahead.

- ## Emerald Polocrosse Club

Located: Pioneer Park, Racecourse Road
Contact: [redacted]

Description of water inundation – In the early stages of the flood event, the Club's fields were used for emergency helicopter landings and sustained damage as a result. The four fields were later inundated with floodwater for approx 24 hours.

Damage sustained – *Infrastructure:* Fields have deep wheel ruts from emergency vehicles/trucks and turf has been affected by helicopter fuel/oil in places. Damage to the field also resulted from the helicopter crash on site. There are also wheel ruts in the parking area. The fields are covered in a layer of clay silt, which will become extremely slippery for horses when wet, so facility will require topdressing. A significant amount of sand and crusher dust from the race track has been washed onto one field in large deposits. There are major issues with silt build-up blocking drainage, which will cause significantly more damage should more rainfall occur. Damage to irrigation set-up is possible but still to be determined.

Damage sustained – *Equipment:* Nil

Effect on ability to operate – Drainage problem will have long-term effect on the facilities if not rectified. Grounds will be required for resumption of playing season in April.

- ## Emerald Touch Association

Located: Pioneer Park, Racecourse Road, Emerald
Contact: [redacted]

Description of water inundation – Water inundated playing fields for approx 24 hours.

Damage sustained – *Infrastructure:* TBC

Damage sustained – *Equipment:* TBC

Effect on ability to operate – TBC

Emerald Showgrounds:

- ## Central Highlands Cricket

Located: Various – Emerald
Contact: [redacted]

Yet to confirm interview.

- ## Emerald Boxing Club Inc

Located: Pavilion, Emerald Showgrounds, Capricorn Highway
Contact: [redacted]

Description of water inundation – Inundation to an approx height of .5m through training facility.

Damage sustained – *Infrastructure:* Nil.

Damage sustained – *Equipment:* Punching bags, mits, 2 medicine balls, bench presses (TBC) and ring underlay.

Effect on ability to operate – Ring underlay needs to be replaced in order to hold matches/practice.

- **The Emerald Rodeo Association**

Located: Emerald Showgrounds, Capricorn Highway
Contact: [redacted]

Yet to confirm interview.

Epic All Sports:

- **Epic All Sports Inc**

Located: Cnr Brooks and New Streets, Emerald

Contact: [redacted]

Description of water inundation – Floodwaters to a height of approx 6ft covered the playing fields and inundated the club (800mm) for a period of four days.

Damage sustained – *Infrastructure:* Possible sinking of and damage to artificial cricket pitch; possible damage to concrete in two cricket nets and cricket nets' carpet/pitch destroyed. Playing field may also need top dressing/levelling.

Damage sustained – *Equipment:* Nil (covered by insurance).

Effect on ability to operate – Will impair/delay resumption of cricket fixtures at this site.

- **Magpies Cricket Club**

Located: Epic All Sports, Cnr Brooks and New Streets, Emerald
Contact: [redacted]

Yet to confirm interview.

Other facilities - Emerald:

- **Emerald Fighters Inc**

Located:
Contact: [redacted]

No contact details.

- ## Emerald Golf Club

Located: Opal Street, Emerald
Contact: [redacted]

Description of water inundation – Floodwaters covered all 18 fairways/greens and bunkers for a period of more than three weeks.

Damage sustained – *Infrastructure:* Two greens will need to be replaced and the rest require major repairs (sand, gravel, turf, tree/debris removal etc); pump has been submerged for a significant period (still to be checked) but associated pipes have been damaged; seven satellite receivers for the irrigation system destroyed; irrigation electricity supply damaged; boundary fence damaged; and tee signs and posts will need to be replaced.

Damage sustained – *Equipment:* Maintenance equipment; greenkeeper's office equipment and computer.

Effect on ability to operate – Club may have limited/restricted course established in two weeks.

- ## Emerald Horse and Pony Club

Located: White Street, Emerald
Contact: [redacted]

Description of water inundation – Floodwaters totally submerged stables, 2 equipment/feed sheds and the pony club arena for a number of days.

Damage sustained – *Infrastructure:* Equipment/tack shed; Feed shed; sand/soil washed out of stables.

Damage sustained – *Equipment:* Nil

Effect on ability to operate – Sheds and stable sand required to accommodate horses that are stabled at the club's facility.

- ## Emerald Pistol Club

Located: Selma Road, Emerald
Contact: [redacted]

Description of water inundation – Floodwaters covered the facility to a height of up to 4m (range 1), inundating the toilet block, office and donga/equipment container, and reaching a height of 2.1m in the clubhouse. The facility was inundated for 10 days.

Damage sustained – *Infrastructure:* Damage was sustained to three ranges, clubhouse (including kitchen, workshop and office), toilet block, access road and 5000l tank.

Damage sustained – *Equipment:* Workshop equipment; pump; two compressors (TBC); computer/printer; filing cabinets; fridge/freezer; freezer; bar fridge; canteen stock (meat, condiments etc); stove; $2000 paper targets; electronic range timer; two lounges; stereo; tables and desks.

Effect on ability to operate – Mounds on two ranges need to be fixed to operate at capacity according to Weapons Licensing legislation.

- **Maraboon Power Boat and Ski Club**

Located: Fairbairn Dam
Contact: [redacted]

Description of water inundation – Facilities were damaged by a storm prior to Christmas 2010 and have been submerged by floodwaters for 6-8 weeks.

Damage sustained – *Infrastructure:* The judges' stand was totally submerged and remains partially under water. Possible damage to the stand's stairs and electrical work and possible erosion around concrete slab. The facility's undercover area may also require painting and repairs to benches.

Damage sustained – *Equipment:* Audio cables.

Effect on ability to operate – Repairs will be required to be completed by next major event in August.

Blackwater:

- **Blackwater Country Club (golf club)**

Located: Blackwater
Contact: [redacted]

Description of water inundation –

Damage sustained – *Infrastructure:* Two walk-way bridges destroyed, making one green inaccessible.

Damage sustained – *Equipment:* Nil.

Effect on ability to operate – Limited – one green currently inaccessible.

- **Blackwater Junior Motorcycle Club**

Located: Blackwater
Contact: [redacted]

Description of water inundation – Heavy Christmas rainfall caused overflow from Council water treatment plant, which subsequently surged through club facilities, damaging track and bursting club's dam.

Damage sustained – *Infrastructure:* Dam wall blown out; damage to drainage and jumps; 2000-3000 m3 of sand washed from 1.8km track

Damage sustained – *Equipment:* Freezer.

Effect on ability to operate – Track can be used for practice runs but under licensing requirements, sand is required to be laid on the track for competitions.

- **Blackwater Powerboat & Ski Club**

Located: Bedford Weir, Blackwater
Contact: [redacted]

Description of water inundation – Facilities were submerged by floodwater for approximately 3 weeks

Damage sustained – *Infrastructure:* Significant damage to the ski clubs toilet block/equipment shed (roof, internal walls etc); switchboard, metre boxes and electrical wiring will need to be replaced. The rainwater tank was displaced by strong water current and will need to be repaired if possible or replaced. The shade shelters have sustained significant damage (rooves ripped off or torn) and will need to be replaced.

Damage sustained – *Equipment:* Ski equipment; popup sprinkler system; pressure pump; hot water system

Effect on ability to operate – Facilities are unusable at present

- **Bluff/Blackwater Amateur Race Club**

Located:
Contact: [redacted]

Description of water inundation –

Damage sustained – *Infrastructure:*

Damage sustained – *Equipment:*

Effect on ability to operate –

Comet:

- **Comet River Pony Club**

Located: Comet
Contact: [redacted]

Course remains inaccessible but suspect damage to cross country course and equipment.

Duaringa:

- **Duaringa Cricket Club**

Located: Duaringa
Contact: [redacted]

Description of water inundation – At some point during the Christmas/New Year break, water surged down Ann Street and washed through the cricket facility.

Damage sustained – *Infrastructure:* Possible damage to the storage container.

Damage sustained – *Equipment:* Fridge and freezer; two artificial pitches (roll-up); and miscellaneous cricket gear.

Effect on ability to operate – The Club is unable to conduct any planned matches and events without replacing the artificial pitches.

Gemfields:

- ## Gemfields Junior Rugby League Club

Located: Roy Day Park, Sapphire
Contact: [redacted]

Description of water inundation – Fields were inundated during flooding prior to Christmas 2010 to a height of between 0.5 and 1 metre for two days. Water also inundated the equipment shed and toilet block.

Damage sustained – *Infrastructure:* Toilet doors in amenities block will have to be replaced and the field will require top dressing. A significant amount of sand/gravel from the carpark has been washed onto the area adjacent to the field. There may also be damage to the caretaker's residence.

Damage sustained – *Equipment:* Fridge, lawnmower, tackling bags (TBC), goal post pads (TBC) and miscellaneous training gear and equipment.

Effect on ability to operate – Nil at this stage.

Springsure:

- ## Springsure Pony Club

Located: Pony Club Road, Springsure
Contact: [redacted]

Description of water inundation – Heavy rain prior to Christmas caused breaks in the contour banks and water surged through grounds. The situation deteriorated with each subsequent rainfall event.

Damage sustained – *Infrastructure:* Areas of the contour banks have been destroyed; drainage damaged; deep water gouges through work area/arena; and access to the second area across the creek has further deteriorated.

Damage sustained – *Equipment:* Jumping blocks destroyed (TBC).

Effect on ability to operate – Gouges to work area/arena have rendered area unsafe for use so club cannot function until it is fixed.

Attachment 5

WARNING — PLAN MAY BE ROLLED — A FOLDED OR MUTILATED PLAN WILL NOT BE ACCEPTED

I, [redacted] hereby certify that I have surveyed the land comprised in this plan by Frederick Mark Murray (Surveying Associate) for whose work I accept responsibility and that the plan is accurate, that the said survey was performed in accordance with the Surveyors Act 1977 and the Surveyors Regulation 1992, and that the said survey was completed on 1-8-94

[redacted] Licensed Surveyor

Date 2.6.94

PLAN OF Lots 9–19

Cancelling Part of Lot 2 on RP 613954

ORIGINAL Allot 4 of Sec 55

NO SURVEY RECORDS DEPOSITED

MERIDIAN	MAP REF	SCALE	FILE REF	ENDORSED	REGISTERING DIST
RP 613954	8550-41424	1:750			Central

PARISH SELMA

COUNTY Denison

TOWN/LOCALITY Emerald

LOCAL AUTHORITY Emerald S C

LAND AGENTS/MINING DISTRICT Springsur

MINING FIELD

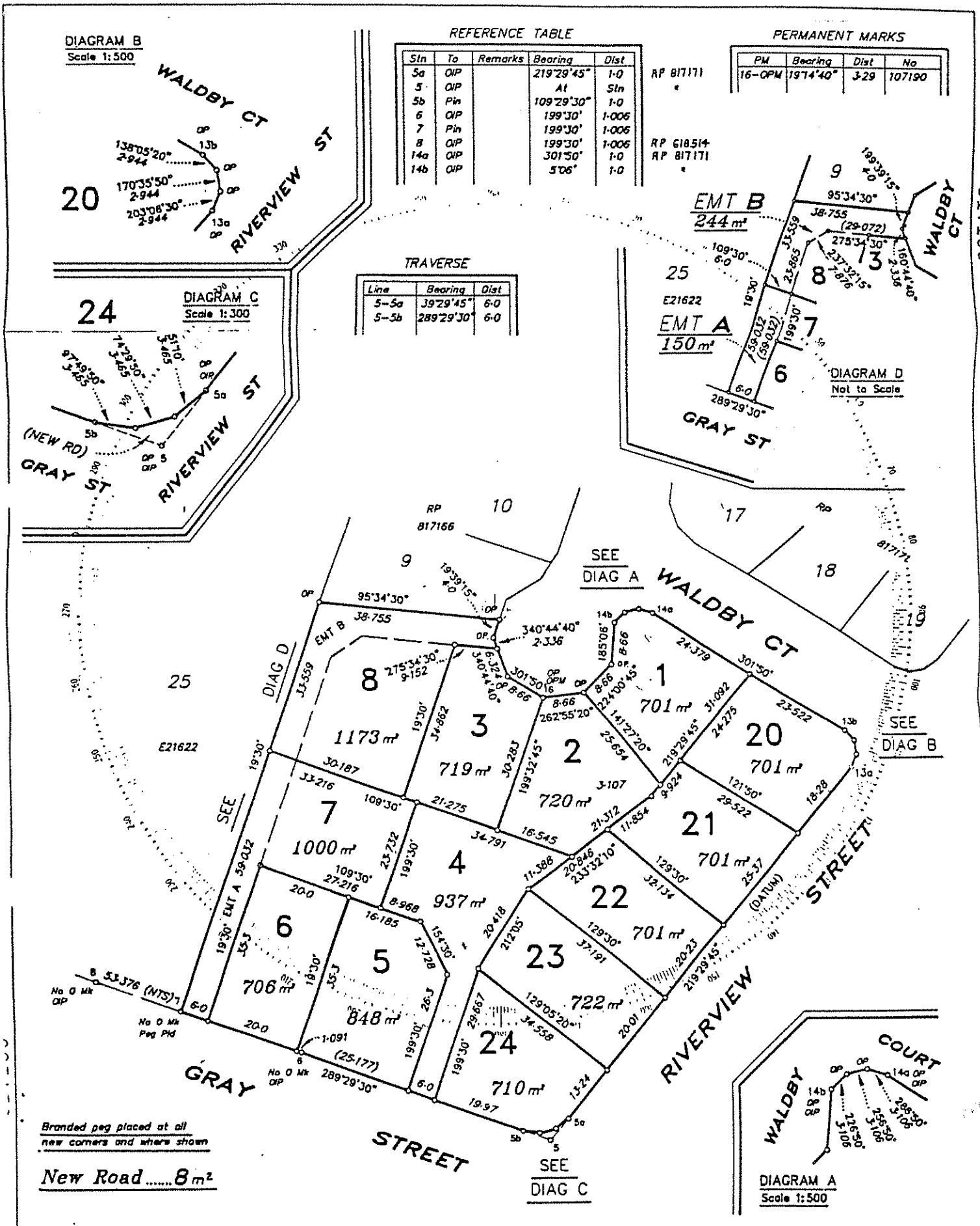
PLAN 81717[illegible]

Attachment 5

WARNING — PLAN MAY BE ROLLED — A FOLDED OR MUTILATED PLAN WILL NOT BE ACCEPTED

817168

PLAN MUST BE DRAWN WITHIN THIS BORDER



I, [redacted] hereby certify that I have surveyed the land comprised in this plan by Frederick Mark Murray (Surveying Associate) for whose work I accept responsibility and that the plan is accurate, that the said survey was performed in accordance with the Surveyors Act 1977 and the Surveyors Regulation 1992, and that the said survey was completed on 2-6-84

[redacted] Licensed Surveyor

PLAN OF

Lots 1–8 & 20–24

& Proposed Emts A & B in Lots 7 & 8
Cancelling Lot 1 on RP 605457
& Bal of Lot 2 on RP 613954

ORIGINAL Allot 4 of Sec 55

MERIDIAN	MAP REF	SCALE	FILE REF	SURVEY RECORDS DEPOSITED ENDORSED	SURVEY RECORDS DEPOSITED REGISTERING DIST
RP 613954	8550-41424	1:750			Central

PARISH ..... SELMA .....
COUNTY ..... Denison .....
TOWN/LOCALITY .... Emerald .....
LOCAL AUTHORITY ... Emerald .....
LAND AGENTS/MINING DISTRICT ..... Springsure .....
MINING FIELD .....

PLAN 817168

CENTRAL HIGHLAND REGIONAL COUNCIL

Flood Audit and Gap Analysis

Prepared for:

CENTRAL HIGHLANDS REGIONAL COUNCIL
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21 June 2011

BEW103-TD-WE-REP-0001 Rev. A

Limitations Statement

The sole purpose of this report and the associated services performed by Kellogg Brown & Root Pty Ltd (KBR) is to collect and audit available data and prepare a gap analysis in accordance with the scope of services set out in the contract between KBR and Central Highlands Regional Council ('the Client'). That scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

KBR derived the data in this report primarily from State Government Organisations and Private Companies. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, KBR has relied upon and presumed accurate certain information (or absence thereof) relative to the study area provided by government officials and authorities, the Client and others identified herein. Except as otherwise stated in the report, KBR has not attempted to verify the accuracy or completeness of any such information.

No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings, observations and conclusions are based solely upon information supplied by the Client, State Government Organisations and Private Companies in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between KBR and the Client. KBR accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

Revision History

Revision	Date	Comment	Signatures		
			Originated by	Checked by	Approved by
A	21/6/2011	Draft Issue for comment			

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Abbreviations

ALS	Airborne Laser Scanning
AR&R	Australian Rainfall & Runoff
ARI	Average Recurrence Interval
BMA	Billiton Mitsubishi Alliance
BOM	Bureau of Meteorology
C&R	C & R Consulting
CAD	Computer-aided Design
CHRC	Central Highlands Regional Council
CHRRUP	Central Highlands Regional Resources Use Planning Cooperative
CRC	C & R Consulting
DCDB	Digital Cadastral Data Base
DEM	Digital Elevation Model
DERM	Department of Environment and Resource Management
DTMR	Department of Transport and Main Roads
FBA	Fitzroy Basin Association
FPMP	Floodplain Management Plan
GIS	Geographical Information Systems
GRP	Gross Regional Product
IAWM	Integrated Area Wide Management
IFD	Intensity Frequency Duration
KBR	Kellogg, Brown & Root Pty Ltd
LGAQ	Local Government Association of Queensland
LiDAR	Light Detection and Ranging
NRFPB	Nogoa River Flood Plain Board
PDF	Portable Document Format
QRN	Queensland Rail National
QRA	Queensland Reconstruction Authority
SRTM	Shuttle Radar Topography Mission
ULDA	Urban Land Development Authority

1 Introduction

1.1 GENERAL

Kellogg Brown & Root Pty Ltd (KBR) was commisioned by the Central Highlands Regional Council (CHRC) to undertake a Flood Data Audit and Gap Analysis for CHRC's area of responsibility.

This project includes gathering, compiling and auditing of hydrological data available from multiple sources and then completion of a comprehensive data gap analysis with the view of determining suitability for the preparation of a new Flood Plain Management Plan for the CHRC area.

1.2 THE STUDY AREA

The study area comprises the Local Government area of the CHRC (Figure 1.1), which contains the former Local Government areas of Bauhinia Shire Council, Duaringa Shire Council, Emerald Shire Council and Peak Downs Shire Council. While the study is focused in the CHRC, this study takes into account its current and potential future relationship with adjacent regions and corridors, for example, the Bowen, Surat, and Galilee Basins, and the surrounding Regional and Shire Councils.

The Local Government areas of CHRC embraces the upper Fitzroy River basin which includes the Nogoa, Comet, Mackenzie and Dawson River catchments. Significant floods in the Fitzroy Basin in 2008 and again in 2010-11 have highlighted the criticality of understanding flooding in the basin and addressing flooding issues through a combination of development controls, flood warning and emergency management planning, structural measures, and increasing community resilience.

The recent 2008 and 2010/11 events, while causing considerable impacts on local communities, provide an excellent opportunity to gather a high quality dataset that together will produce a robust flood plain model, a reliable Flood Plain Management Plan, and a Planning Scheme that minimises the impacts of flooding into the future.

1.3 PROJECT OBJECTIVES

The primary objective of this study is to prepare an audit of the hydrological data available for the CHRC area, and then complete a data gap analysis of this material with a view as to its suitability to underpin a Flood Plain Management Plan for the CHRC area.

This study is the first stage in a larger programme for the preparation of a Flood Plain Management Plan that can provide guidance for the preparation of a planning scheme in accordance with State Planning Policy 1/03 'Mitigating the Adverse Impacts of Flood, Bushfire and Landslide'.

1.4 SCOPE

The scope of the works has been divided in two stages, as follows:

Stage 1.1: The Audit

In the audit stage, relevant flood related information and datasets have been compiled into one central accessible location, including the following tasks:

- Compilation and audit the material gathered from the 2009 Council survey from State Government Agencies and companies. In addition, these companies were recontacted to get any new data relating to the Decemner 2010 flood event which ocurred after the original survey.
- Contact State Government Agencies and companies that did not responded to the 2009 Council survey and gather available hydrological data, including any available information on the December 2010 flooding.
- Source and gather historical flood information in formats that predate computerized data capture techniques.
- Locate material that examines the impact of climate change on the study area.
- Create an indexed central archive for the collected material, with all spatial data to be able to be useable by the 'mapinfo' product.

Stage 1.2: The Gap Analysis

The gap analysis involved addressing the issues set out below:

- Review the content requirements of a Flood Plain Management Study that will deliver the outcomes required in State Planning Policy 1/03 'Mitigating the Adverse Impacts of Flood, Bushfire and Landslide' for the preparation of a Planning Scheme.
- Review the spatial and hydrologic data that has been collected through the audit to identify where suitable hydrological data exists for hydrologic modelling, and what alternative information can be applied in areas that lack this information to identify flood risk.
- Set out the data sets necessary to conduct a community (people) vulnerability assessment and an economic impact assessment.
- Clearly identify where further input data is required for a Flood Plain Management Study of the CHRC area. Where further input data is necessary prior to commencement of a Flood Plain Management Study an estimated costing for any such work is provided.

1.5 ACKNOWLEDGEMENTS

KBR would like to thank the multiple organisations and companies that have responded to the Council survey in 2009 and also this recent data collection exercise. The information provided is very valuable and will assist the development of a new Flood Plain Management Plan for the CHRC area that minimises the impacts of flooding into the future.

The following organisations and companies contributed to this data audit:

State Government Organisations:

- Central Highlands Regional Council (CHRC)
- Bureau of Meterology (BoM)
- Department of Environment and Resource Management (DERM)
- Department of Transport and Main Roads (DTMR)

Private Companies:

- C&R Consulting (C&R)
- Caledon Coal Pty Ltd
- Ensham Resources Pty Ltd
- Rolleston Coal
- QR National (QRN)
- SunWater

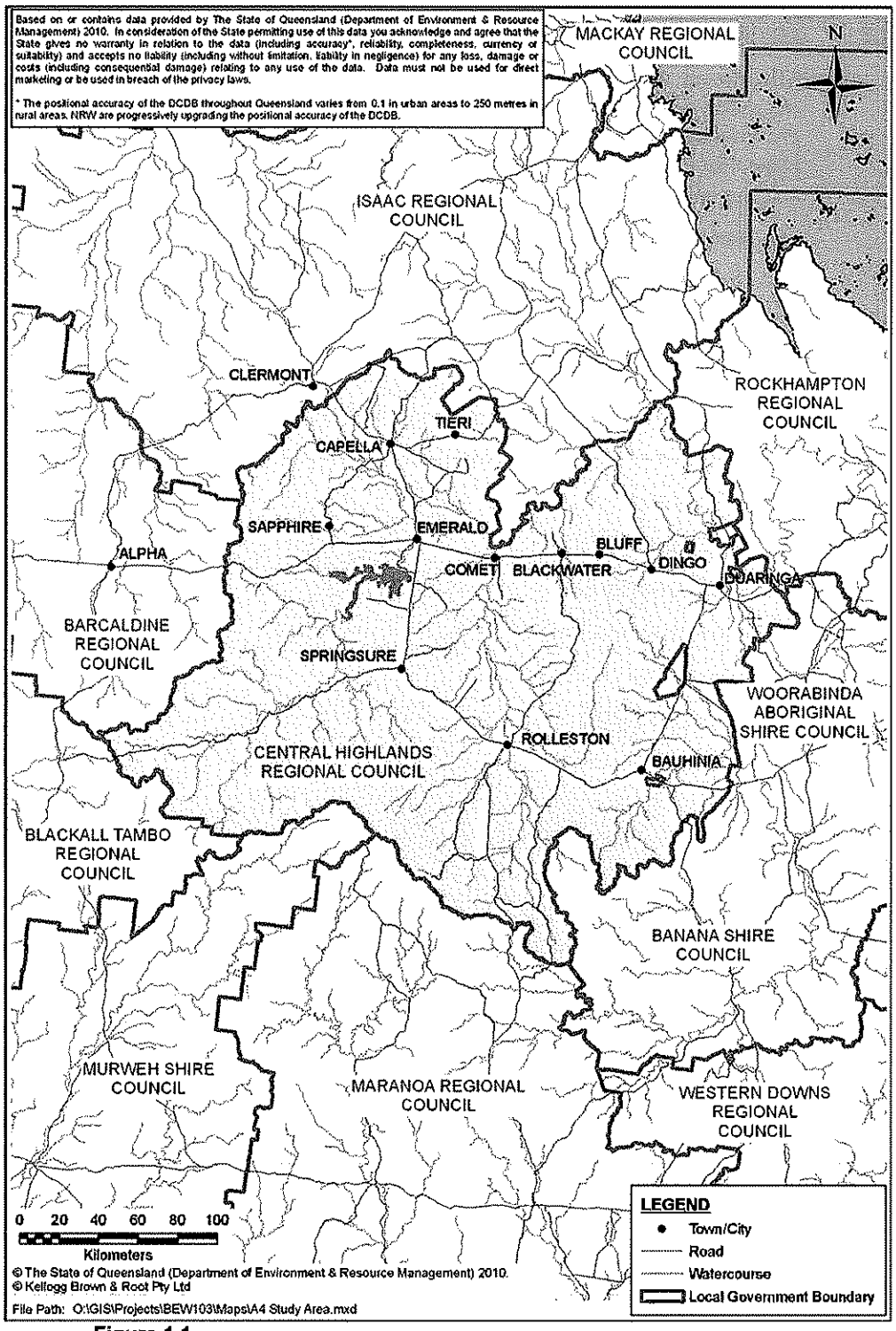

Figure 1.1
CENTRAL HIGHLANDS REGIONAL COUNCIL LOCAL GOVERNMENT AREA

2 Methodology

2.1 DATA COLLECTION

The main objective of this data collection and data audit is to prepare for the development of the new Floodplain Management Plan (FPMP) for the CHRC area that can provide guidance for the preparation of a planning scheme in accordance with the State Planning Policy 1/03 'Mitigating the Adverse Impacts of Flood, Bushfire and Landslide' and the Sustainable Planning Act (2009).

Major components for the preparation of the FPMP are:

- Rainfall-runoff modelling and hydrological assessment
- Hydraulic modelling and flood assessment
- Flood risk assessment and the development of flood management strategies

The broad concepts for model development and assessment within the CHRC area are:

- Hydrologic assessment over all catchments
- 2-dimensional modelling of vulnerable townships
- 1-dimensional modelling of infrastructure outside townships that has the potential to exacerbate the impacts of flooding by, for example, cutting access to the town

The data that is required or desirable to undertake the above tasks are categorised in the following sections.

2.1.1 Selection of flood events

The selection of flood events is one of the important aspects of data collection for the FPMP development. The aim is to calibrate the hydrological and hydraulic models using the latest land use data of the river basins and flood plains that would incorporate up-to-date urban and rural infrastructure.

The large flood event that occurred in the CHRC area is the December 2010 event. This was a wide spread event that affected the entire Fitzroy Basin and will be important for the calibration of hydrological and hydraulic models. There is a substantial amount of data available for this event including rainfall and gauging station information and also mapping of the flood peak and extents which is critical for hydraulic modelling.

The January 2008 flood event was also a very significant event and data collected for this event will be used to validate the hydrologic and hydraulic models accordingly. This flood was not as widespread as the December 2010 event and predominantly affected the Nogoa River catchment, including Retreat Creek. The neighbouring Comet River was largely unaffected by this event.

Other significant flood events include the February 1978 flood and the December 1990 / January 1991 flood. Data collected for these events can also be used to validate the hydrological and hydraulic models.

2.1.2 Selection of vulnerable townships

In order to assess the available data and then complete a data gap analysis with a view as to its suitability to underpin a Flood Plain Management Plan for the CHRC area, an understanding of the areas of interest needs to be established. This is effectively a register of any existing flood prone townships, those areas that may be vulnerable in the future, and areas marked for expansion.

Within the CHRC area the townships of interest have been identified as follows:

- Nogoa River Catchment
  - Emerald
  - Sapphire
  - Rubyvale
  - Capella
- Comet River Catchment
  - Comet
  - Rolleston
  - Springsure
- Mackenzie River Catchment
  - Blackwater is earmarked for expansion under the ULDA
- Dawson River Catchment
  - Baralaba (in conjunction with the Banana Shire Council)
- Fitzroy River Catchment
  - Bluff
  - Dingo

2.1.3 Data for Flood Hydrological Assessment and rainfall-runoff modelling

The hydrological assessment and modelling involves the analysis of recorded stream flow data and the estimation of the design flood peaks and flood hydrographs that will be used as boundary conditions in hydraulic modelling prior to the development of the Floodplain Management Plan (FPMP). The data required to undertake this task includes:

- Topographic data - contours, digital elevation models (if available), SRTM data
- Rainfall data - instantaneous and daily data, particularly for the two most recent flood events.
- Hydrological data - streamflow gauging data, water level data at streamflow gauging stations, instantaneous and daily streamflow data and long-term

instantaneous peak streamflow data. Data for flood events prior to 2008 can be used as verification (for example, 1978, 1990/91).

- Major dam / reservoir data - area-storage curves, historic reservoir levels during flood events; spillway rating curves and reservoir release operation data. Long term dam level simulations may also be useful to assist in evaluating starting water level distributions for flood events.
- Previous studies and models that may provide information and data on flooding (also applicable to hydraulic modelling)
- Relevant standards, guildelines and references. For example, the Nogoa River Flood Plain Board - Interim Flood Plain Management Plan (also applicable to hydraulic modelling)

2.1.4 Data for hydraulic (flood) modelling

The flood assessment and hydraulic modelling involves the analysis and estimation of flood levels in the river systems which are an important component for the preparation of the FPMP. The data required to undertake this task includes:

- Topographic data - LiDAR ALS, river cross-sections
- Aerial photographs - aerial photographs for recent flood events. A set of aerial images in flood free conditions is also useful to set normal conditions for hydraulic roughness
- Hydrological data - streamflow rating curves, observed flood hydrographs at streamflow gauging stations
- Flood mapping data - flood inundation mapping for the two recent flood events of January 2008 and December 2010.
- Observations on flooding events for debris levels, flow paths and breakouts, levee breaches with timing and extent of breach, erosion and sedimentation
- CAD drawings of the existing bridge and culvert crossings and weirs. Additional details are required at times of calibration if there was a difference.

2.1.5 Data for a flood risk assessment and management study

The flood risk management study included the assessment of the flood risks and hazards primarily using the outputs from the hydrologic and hydraulic flood modelling outputs, comparing these with element at risk and then preparing the flood risk management strategies.

The data required are GIS layers of the following:

- Digital cadastre database (DCDB)
- Road network and hierarchy
- Local census data
- Floor level of buildings subject to flooding
- Survey of populations / household subject to flooding

- Current land use zoning
- Planning schemes and development codes
- Details of major planned/approved developments such as subdivions, levees, road/rail embankments and mint pits.
- Location of critical infrastructure
  - Emergency services (police, fire ambulance and hospitals), aged care centres, food storage infrastructure, data repositories and utilities (power supply, water supply, sewage treatment)
  - Critical access points and escape routes
  - Sites that could cause a health hazard in flooded areas (rubbish tips, chemical storage sites)
  - Sites that could be useful during a flood such as an emergency call centres, schools, residential centres
- Local disaster management plan
- Defined geographic extent of the FPMP
- Cost and type of housing affected by flooding which can be used to develop damage curves
- Other natural / anthropogenic issues or hazards that would exacerbate flood impacts or could be worsened if followed by a flood (for example, sensitive wetlands, culturally significant areas).

2.2 DATA REQUESTS

CHRC provided known data sources and personal contacts that would help facilitate the data collection process for the project. During the data collection process KBR contacted government organizations and private companies through telephone calls, letters requesting information and office visits to Emerald, Blackwater and Rockhampton.

Government bodies and organisations that responded to data requests include:

- Central Highlands Regional Council (CHRC)
- Department of Transport and Main Roads (DTMR)
- Department of Environmental Resource Management (DERM)
- Bureau of Meteorology (BOM)

Private companies that respond included:

- Queensland Rail National
- Caledon Coal Cook Mine
- Xstrata Coal Rolleston Mine
- Xstrata Coal Blackwater
- Ensham Resources Pty Ltd
- BMA Blackwater Mine
- C & R Consulting (CRC)
- SunWater

Additionally, datasets for the 2008 and 2010 flood events have been provided by CHRC's [redacted] and include relevant information as summarised below:

- Rainfall data, flood extents and mapping, infrastructure data and releant reports for the January 2008 flood.
- Rainfall data, stream gauge data and mapping of the December 2010 flood.
- Aerial photography (1960 and 1998)
- A selection of historic flood information

Also, in some cases attempts were made to collect data but for various reasons this did not eventuate:

- The Central Highlands Regional Resources Use Planning Cooperative (CHRRUP) were contacted but did not participate in the data audit.
- Queensland Rail National (QRN) responded and KBR made a visit to their Rockhampton office. Some ground and aerial images were provided for the January 2008 flood event at different location along the rainway. Drawings of rail bridges and culverts were not made available.
- BMA [redacted] mine responded to the data request however no informetion was received.
- WesFarmers and Jellinbah Mine were contacted but did not respond.
- Rio Tinto were contacted but were unable to provide information
- At the time of this project representatives of the NFPMB were not available to assist with data collection, however data relating to floodplain development records and prevoius studies can be obtained during the FPMP study.

3 Data audit

The Audit of available data has considered a wide range of data including survey data, rainfall data (daily and instantaneous data), stream gauge data (water levels, discharge gauging data, and discharge rating curves), and peak flood records.

The hydrological data collected by the Council survey in 2009 was provided to KBR during the first site visit to Emerald on 22nd May 2011. This included limited hydrological information and some previous flood study reports.

The data has been compiled and organised and a preliminary review undertaken to identify missing or unclear data, or tasks that might be required to process the data. Where possible, the data has been processed or gaps filled within the constraints of this project. Where the time required processing data or filling gaps was significant we have identify the task required in the gap analysis.

3.1 REVIEW OF AVAILABLE INFORMATION

3.1.1 Topographic data

Hydrologic modelling

Topographic data to undertake the hydrological rainfall-runoff modelling is readily available from Geoscience Australia. This is the SRTM-derived 3 second (roughly 90 m grid) smoothed digital elevation model (DEM-S) Version 1.0 available for all users. While the SRTM-derived 1 second (roughly 30 m grid) smoothed DEM-S Version 1.0 is available for Government organisations.

Therefore the CHRC will be able to request this more accurate data from Geoscience Australia for use in the hydrologic modelling of all catchments within their remit.

Hydraulic modelling

1-dimensional and 2-dimensional hydraulic models require extensive topographic data of the river channel and floodplain. A review of the survey data indicates that high resolution LiDAR ALS is available for parts of Emerald and the entire floodplain downstream to the Mackenzie River. The township of Comet is also available, as is part of Blackwater.

The main contributors for this topographic data are Ensham Resources and SunWater. Additionally, CHRC is investigating several areas for LiDAR acquisition including:

- Emerald up to Fairbairn Dam, including sections of Teresa and Retreat Creeks
- Sapphire and the fossiking area upstream
- Rolleston, and
- Bluff

This data is expected to be available sometime in 2012. Appendix Figure A.1 presents the available topographic data as well as the data to be acquired by Council.

DERM have captured elevation data from the Capricorn Highway to upstream of Theodore covering parts of the Dawson and Fitzroy Rivers. This data is likely to include the township of Baralaba. DERM were also contacted regarding the background studies prepared for the Rolleston Dam which is known to include a large photogrammetric dataset. Attempts were made to acquire this data from DERM but key contacts were not available. This data can be obtained from DERM during the FPMP study.

Some river cross-section data is available through previous studies but has not been collected as part of this study. Updated cross-section data will need to be gathered when the flood studies are commissioned.

3.1.2 Rainfall data

The BOM operates a number of rainfall stations as ALERT and telemetry Stations within the study area, these stations record instantaneous data using tipping bucket data loggers. In addition, BOM also operates daily rainfall stations located in the study area. This data can be used to assess the spatial rainfall distribution over the catchments since the coverage is widespread.

The historic rainfall data will be used as an input to the hydrological rainfall-runoff models to estimate river flows at relevant locations for the historic flood events. The flows generated by the hydrologic model will then be compared against the measured flood hydrographs at river gauging stations.

Historical rainfall data was requested from BOM for the December 1990 / January 1991, January 2008 and December 2010 flood events. This data request comprised all available rainfall stations within the Fitzroy basin.

The instantaneous rainfall records received from BOM are shown in Appendix Figure A.2. The data has been reviewed for the two recent flood events and indicates:

- the December 2010 event has very good spatial coverage over the Nogoa and Comet catchments which comprise the majority of the CHRC area. The data will need to be processed into a format that is suitable for hydrological modelling during the FPMP.
- The 2008 data indicates that the instantaneous data coverage is poor however daily rainfall station data coverage can be used to complement this information. Daily rainfall data for the January 2008 flood has previously been collected by Ensham (BOM daily stations) and by [redacted] of CHRC (daily rainfall totals recorded by landholders). The daily rainfall stations with data for the January 2008 flood are presented in Appendix Figure A.3.
- No data is available for the December 1990 to January 1991 period.
- There are large areas of the Mackenzie, Dawson and Fitzroy catchments where no rainfall data has been received from BOM. It is known that there are many stations within these catchments and KBR are in the process of communicating with BOM to determine why this information has not been provided. Additional rainfall data may need to be collected during the FPMP study.

- Daily rainfall data is held by SunWater for rainfall stations at Fairbairn Dam and Theodore Weir. This is yet to be purchased by CHRC.

3.1.3 Stream gauge data

There are numerous stream gauging stations located in the river systems within the CHRC area and most of these stations are operated by DERM. Appendix Figure A.4 presents the locations of stream gauging stations within the study area. These stations measure instantaneous water levels and DERM undertake routine gaugings to update the stream flow rating curves used to convert recorded stream levels to stream flow.

In addition, the BOM also operate several water level recording stations in major river systems of the CHRC area.

In order to achieve a satisfactory hydrological model calibration, concurrent rainfall depth and stream gauge data is required. A review of stream gauge data collected for this study indicates the following:

- Long-term instantaneous / daily maximum streamflows between 1911 and 2006. This data has been downloaded from the DERM website but unfortunately this site is not up-to-date and records from 2007 onwards is missing. This long-term data is important to undertake flood frequency analysis to compare and calibrate the hydrological models.
- Flood event data was then requested from DERM and other organisations for the two major flood events of January 2008 and December 2010. A review of this data indicates that there is reasonable coverage but additional data may need to be collected during the FPMP study.
- SunWater hold data for several gauging stations in the Nogoa, Dawson and Mackenzie Rivers which is available but is yet ot be purchased by CHRC.

3.1.4 Flood mapping

CHRC hold aerial photography of the 2010 flood from downstream of the dam, through Emerald and over parts of the Nogoa River floodplain down to Ensham mine sourced from the Queensland Reconstruction Authority (QRA). The imagery has been used to develop a detailed flood line of the area.

No other township or floodplain within the CHRC area is included in the QRA survey, except for Baralaba which borders with the Banana Shire Council.

The January 2008 flood event flood spot level survey is very comprehensive and directly applicable to the hydraulic model calibration. The peak flood line for this event extends from Fairbairn Dam through Emerald and the Nogoa Floodplain down to the confluence with the Comet River. Flood line information is also available at Comet downstream of the Capricorn Highway, and also a small section covering Sapphire.

For flood events prior to the 2008 flood event this data is incomplete but some information can be extracted from previous studies on a case by case basis. For example, a survey of the December 2004 flood in Rubyvale has been completed by CHRC. Also, a limited amount of aerial imagery is available for the 1978 flood for the Nogoa and Comet Rivers, and Theresa Creek

Some aerial photographs have been collected from multiple sources, predominantly for the Nogoa floodplain and Emerald. These show the extent of flooding at a particular point in time but may not have coincided with the flood peak; however they provide useful insight into flooding characteristics. However peak flood lines can sometimes be estimated by colour changes visible in the photo.

Photos taken from the ground can also be used to record debris or mud lines during flood events which can later be surveyed accurately. There are a large number of photos available from multiple sources which are stored in the database.

3.1.5 Imagery

Aerial photographs and satellite imagery can be used to determine the extent of flooding. Aerial images can also identify the location and extent of breaches in levees and linear infrastructure.

A set of aerial or satellite images in flood free conditions is also useful to determine normal conditions for hydraulic roughness. Ensham Resources captured aerial imagery over a widespread area of the Nogoa floodplain during their LiDAR survey in 2009. Additionally, it is understood that the Fitzroy Basin Authority (FBA) has aerial imagery for the majority of the Fitzroy Basin.

Historic aerial imagery can also help determine the level of development for assessment of historic floods. CHRC hold historic aerial images for Emerald in 1960 and 1998.

3.1.6 Infrastructure

KBR understands that CHRC has collected, and is still collating, pertinent data relating to floor levels and other information regarding significant infrastructure in the Emerald area. This includes the location and floor levels of critical infrastructure, water/sewage infrastructure (floor and switchboard levels) and telecommunications. KBR understand that the following data being complied by CHRC will be made available for this study.

Other infrastructure data includes:

- CHRC have collected road centre line heights for the township of Emerald.
- DTMR have provided data for a number of road bridge and culvert crossings including as constructed drawings. The existing road network is available through GIS layers.
- A PDF map of the existing railway infrastructure network and impacts from the 2010 flood has been provided by Queensland Rail National.
- SunWater hold drawings for major water storage reservoirs including Glebe Weir, Gyranda Weir, Orange Creek Weir, Theodore Weir, Moura Weir, Neville Hewitt Weir, Fairbairn Dam, Selma Weir, Bedford Weir, Bingegang Weir and Tartrus Weir. This data is available but is yet to be purchased by CHRC.

At this stage, the data available for primary infrastructure is incomplete and will need to be extended when the flood studies are commissioned.

3.1.7 Flood risk assessment data

A review of information and data for flood risk assessment and management indicates that the information outlined in Section 2.1.3 is largely available through CHRC. Some of this has been collected in this study and archived in the relevant folders of the data base. However, the majority of this data should be readily available from the Council's database systems.

KBR understands that CHRC has collected, and is still collating, pertinent data relating to building floor levels in the Emerald area. A building floor level survey for properties subject to flooding will be required for the 10 other townships to facilitate the damage assessment.

The Blackwater Urban Development Area was declared on Friday 30 July 2010. Measuring 150 hectares it includes the full extent of the existing town. Blackwater has been selected to help to meet housing pressures expected from growth in the resource sector. The ULDA plan for a mix of housing including some smaller lot sizes and some new housing development is expected to be underway during 2011. The Blackwater UDA Development Scheme will provide more information on this long term project.

3.1.8 Climate Change

There is considerable uncertainty on the effect of climate change on large events such as the 100 year ARI event at present. For mean annual rainfall, global climate models are predicting anywhere from a +20% to -30% change in rainfall. The potential climate change induced sea level rise is much more defined, but sea level rise is unlikely to directly affect the study area. Effects on rare rainfall events are very uncertain.

The Queensland Government Guidelines for preparing a Climate Change Impact Statement includes some quantification of the increase in cyclone intensity, being 20-30% increase in maximum rainfall by 2050. No numbers are provided on the decrease in cyclone occurrence. This document also provides some quantification of potential increases and decreases in general rainfall, being a 20–40% decrease in rainfall or a 10-20% increase in rainfall.

Numerous other government and research bodies are currently investigating climate change. In particular, Engineers Australia is currently managing a project to update the IFD information in AR&R. The update is expected to more seamlessly interface with the CRC-FORGE techniques and deal with issues such as climate change. With 30 plus additional years of rainfall data the estimates of the 100 year ARI event rainfalls are expected to show significant changes in some locations even without climate change being considered. However the results of this update are still some years away.

There is a high degree of uncertainty associated with climate change projections; however the 'Final report on the inland flood study' provides definitive advice on how to plan for more intense flooding under climate change in Queensland. A copy of the final report is included in Appendix B of this report.

Final report on the inland flood study

On 10 November 2010, the Queensland government through the Minister for Climate Change and Sustainability, the Honourable Kate Jones, released the joint Inland Flood Study.

The Inland Flooding Study recommends a new formula for councils when factoring flood risk into their planning decisions. The study provides a benchmark to assess increased flood risk and examples of how to plan for extreme flooding events to ensure a sustainable future for communities.

The study identified that planning for the ARI 100 year flood event is not sufficient to protect inland areas from inundation in the future. Local governments are instead recommended to adopt a climate change factor for increased rainfall intensity of 5 per cent per degree of global warming and incorporate this into local flood studies and planning schemes.

The Inland Flooding Study was undertaken as a partnership between the State Government and the local Government Association of Queensland (LGAQ) to improve Queensland's resilience to extreme flood events caused by climate change. The fact sheet produced by the Queensland Government states:

> *"Flooding causes significant impacts on Queensland communities and the economy-and with our changing climate, extreme flooding events are likely to become more intense. Effective land use planning will ensure our communities are ready for the impacts of climate change by ensuring dwellings, critical infrastructure (such as hospitals) and sensitive land uses (such as storage of fuel) are located where there is a lower risk of flooding, or are built to withstand the impacts of extreme flood events.*
>
> *The Inland Flooding Study recommends options to increase community resilience to extreme flood events by providing:*
>
> - *a recommended climate change factor for incorporation into flood studies*
> - *specific policy options for improved flood risk management in the Gayndah case study area*
> - *recommendations for the review of State Planning Policy 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide.*
>
> *The study provides Queensland's local governments with a recommended climate change factor for increased rainfall intensity for incorporation into their flood studies. It proposes a 5 per cent increase in rainfall intensity per degree of global warming.*
>
> *This 5 per cent increase in rainfall intensity per degree of global warming can be incorporated into the 1-in-100, 1-in-200 and 1-in-500 year flood levels for the location and design of new development in the State Planning Policy 1/03. Local governments are advised to use the following temperature increases and planning timeframes:*
>
> *2°C by 2050; 3°C by 2070; and 4°C by 2100.*

This climate change factor is limited to flood risk management for planning purposes as described by the State Planning Policy 1/03 and does not extend to more frequent events such as a 1-in-50 year flood or more extreme events than a 1-in-500 year flood. The climate change factor applies to floods arising from rainfall events of at least one hour or more. This climate change factor will be reviewed and updated when a national position on how to factor climate change into flood studies is finalised. The outcomes of this national review are not expected to be available before 2014.

The State Government acknowledges the scientific uncertainty associated with projecting climate change and rainfall intensity. However, for the purpose of incorporating climate change impacts into planning regimes, the study also recognises the need for a clear benchmark to provide local councils with the best estimate within an acceptable range of uncertainty. The climate change factors derived for this study fall within the 3-10 per cent range per degree of global warming recognised in the best available scientific literature."

For the CHRC FPMP it is recommended that the Inland Flood Study recommendations be adopted. In addition, consideration mat be given to undertake sensitivity analysis for the following changes potentially caused by climate change:

- drier average climate leading to a lower initial level in Fairbairn Dam
- drier average climate leading to a lower initial rainfall loss
- drier average climate leading to a changed hydraulic roughness from vegetation

3.1.9 Previous studies

A number of hydrological and flood studies have been undertaken in the past, typically part of mining infrastructure development or rural/urban flooding assessments including areas such as Emerald and Ruby Vale. During the study a number of these reports have been collected and archived as listed below:

- Ensham Coal Project Hydrological Study, prepared by Munro, Johnson & Associates Pty Ltd in July 1986. This report is a comprehensive hydrological study for the Nogoa and Comet Rivers.
- Nogoa River Flood Plain Management (NRFPM) Study, Design Flood Estimation Report, prepared by Department of Natural Resources in October 1995. This report is a comprehensive hydrological and hydraulic modelling study of the Upper Mackenzie River basins including the Nogoa River and Comet River. The catchment areas of this basin cover about 90% of the CHRC area. This study comprises four volumes:
  - Runoff routing model calibration Report. This report describes the calibration process that has been undertaken to calibrate the hydrological model for the study.
  - Hydraulic model calibration report. This report describes the calibration of the flood hydraulic model that has been undertaken to calibrate the hydraulic model for the study area.

- Design flood estimation report. This report describes the estimation of the design discharges at relevant locations of the study area.
- Hydraulic Model design flood simulation report. This report describes the hydraulic model design runs.

- Impact Assessment Study for the Comet River Storage Proposal (PPK, Oct 1997). This study includes a hydrological model for the Comet River and a hydraulic model to assess the flooding issues due to the proposed dam. This report is at CHRC library.
- Interim Flood Plain Management Plan prepared by Nogoa River Flood Plain Steering Committee and the Department of Natural Resources (May 1997). This report summarises the hydrological and hydraulic modelling studies that have been undertaken as part of the study and provides rules for assessing development on the floodplain.
- Emerald Town Flood Study, Hydraulic modelling of the Nogoa River Sensitivity Report prepared for Emerald Shire Council by Kinhill Pty Ltd (May 2000). This report was undertaken following the pervious Emerald Town Flood Study undertaken by Kinhill (June 1999) to include sensitivity analysis to determine the potential impacts associated with variations in adopted parameters.
- Developing solutions to flooding in Policeman's Creek, Rubyvale, final report community meeting, undertaken by Integrated Area Wide Management (IAWM) in June 2005. This report analyses major flooding events that have occurred in the area including the December 2004 flood event.
- Ensham Central Project Surface Water Report, prepared by KBR in May 2006. This report includes a comprehensive hydrological and hydraulic modelling of the Nogoa River to Ensham Mine.
- Nogoa River Flood Plain, Ensham Mine Flood Modelling, prepared by SunWater in June 2008. This report covers a comprehensive hydrological modelling undertaken to assess the January 2008 flood event for the upper Mackenzie river basing including the Nogoa and Comet rivers.
- Nogoa River Flood Plain, Hydraulic Impact Assessment of Ensham Resources proposed levee bank extension, prepared by SunWater in February 2008. This report covers flood hydraulic modelling to asses the Ensham proposed levee upgrades after the January 2008 flood event.
- Ensham mine proposed levee banks, January 2008 flood event assessment, prepared by KBR in June 2008. This report incorporates a extensive January 2008 flood event over the Nogoa River at Ensham Mine.
- Economic Impact of January 2008 Floods on Central Highlands Regional Business & Industry, prepared by Lawrence Consulting in August 2008. This study includes an assessment of the existing industry structure and scale of the Central Highlands economy prior to the flood event including contribution to Gross Regional Product (GRP), industry turnover and employment. A survey of businesses and industry in the Central Highlands region following the January 2008 flood identified the scale of businesses affected and quantified the associated direct and indirect impacts.

- Audit of issues related to commercial & industrial activity in the area of the Central Highlands Regional Council, Stage 1, prepared by Foresight Partners Pty Ltd in July 2010 for CHRC. The audit provides a spatial understanding of the location, type, size and scale of commercial and industrial activities in the CHRC, as well as vacancy rates for each urban centre. This report provides an overview of the results. As part of the study a searchable excel database was also established to store and interrogate the data collected from the audit.
- Ensham Central project - Revised Mining Methodology, Flood and river morphology impact assessment, prepared by KBR in August 2010.
- Galilee Basin economic and social impact study, prepared by Economic Associates in August 2010 for the Department of Employment, Economic Development and Innovation - Rockhampton Centre.

3.1.10 Summary

As a result of the data audit at this point of time the collected data is suitable to undertake a FPMP study for the township of Emerald. There is also sufficient information to start the hydrologic and hydraulic modelling for Comet.

The townships of Sapphire and Rolleston have most of the necessary information and a FPMP for these townships can commence once Council's LiDAR acquisition project is completed.

Other areas which are affected by flooding or are susceptible to future flooding are identified in Table 3.1 along with the outstanding data requirements that need resolution prior to starting FPMPs for these townships.

Table 3.1 Summary of data audit

Location	Topographic Data		Historic Data				
	Hydrologic (SRTM)	Hydraulic (e.g. LiDAR)	Rainfall	Stream gauge	Flood mapping	Infrastructure	Building survey
NOGOA RIVER CATCHMENT							
Emerald	Available	Available	Available	Available	Available (2008,2010)	Available	Available
Sapphire		Expected in 2012			Available (2008)	Not currently available	Not currently available
Rubyvale		Not currently available			Available (2004)	Not currently available	Not currently available
Capella		Not currently available			Not currently available	Not currently available	Not currently available
COMET RIVER CATCHMENT							
Comet	Available	Available	Available	Available	Mostly available (2008)	Not currently available	Not currently available
Rolleston		Expected in 2012		Available	Not currently available	Not currently available	Not currently available
Springsure		Not currently available		No gauging data	Not currently available	Not currently available	Not currently available
MACKENZIE RIVER CATCHMENT							
Blackwater	Available	Some additional survey of the town and the downstream creek required.	Only daily recording stations covering Blackwater Creek catchment. It may be possible to interpolate nearby instantaneous station data.	One station downstream from the town	Not currently available	Not currently available	Not currently available
DAWSON RIVER CATCHMENT							
Baralaba	Available	Available through DERM	Some stations in the upper catchment, sparse rainfall data in the lower catchment.	Sufficient gauging data for hydrologic and hydraulic model calibration.	Available (2010)	Not currently available	Not currently available
FITZROY RIVER CATCHMENT							
Bluff	Available	Expected in 2012	Very limited rainfall data	No gauging data	Not currently available	Not currently available	Not currently available
Dingo		Not currently available			Not currently available	Not currently available	Not currently available

3.2 COMPILATION OF CENTRALISED DATABASE

Initially all data collected as part of this study was archived in folders according to the original source. The data was then re-arranged by river catchment to facilitate access and recorded in an MS Excel spreadsheet containing a listing of all data collected during this study. The spreadsheet can be filtered as follows:

- type of data (for example, Rainfall data)
- data source (such as DERM)
- type of information required
- river catchment.

3.2.1 Navigating the database

The hierarchy below explains how the data has been categorised and stored in the centralised database that accompanies this report.

- Level 1 - Catchment
  - Nogoa
  - Comet
  - Mackenzie
  - Dawson
  - Fitzroy
- Level 2 - Data Type
  - Hydrologic and Hydraulic
  - Topographic
  - Infrastructure
  - Imagery
  - Reports (reports relating to the catchment)
  - GIS
- Level 3 - Hydrologic and Hydraulic
  - Models (any available hydrologic or hydraulic models)
  - Rainfall data (rainfall records from organisations and landowners as well as other information such as IFD charts)
  - River Height data (gauging station data)
  - Flood data including peak flood levels and inundation extents
  - Drainage information showing the main channels of watercourses and catchment boundaries
  - Land use mapping

- Level 3 - Topographic
  - LiDAR
  - Photogrammetry
  - Satellite
  - Detailed survey
  - Cross sections
- Level 3 - Infrastructure (including drawings and any records of flood damage)
  - Road and rail alignment and elevation data including drawings of hydraulic structures (culvert and bridge crossings)
  - Building surveys
  - Electricity including substations
  - Water infrastructure including pumping stations
  - Medical facilities including hospitals
  - Farming and mine levee information
  - Reservoirs, lakes and dams
- Level 3 - Imagery
  - Aerial photography
  - Satellite imagery
  - Photos including hydraulic features such as creek or river channels, the floodplain and photos showing recent flood events
- Level 3 - GIS
  - Digital Cadastral Database
  - Any other relevant information

4 Gap analysis

4.1 DATA GAP ANALYSIS

The gap analysis of the collected data indicates that there are some additional data that is available but was not able to be collected during this project. Also, in some cases relevant data may be required for the FPMP but can be collected during the course of the studies.

4.1.1 Topographic data

Principal data gap for the commencement of a FPMP within the CHRC area relates to topographic data for hydraulic modelling.

CHRC is preparing to acquire LiDAR ALS data around Emerald, Sapphire, Bluff, and Rolleston. The area of acquisition at Emerald includes downstream of Fairbairn Dam, the township of Emerald and across to Theresa Creek.

DERM have captured elevation data from the Capricorn Highway to upstream of Theodore covering parts of the Dawson and Fitzroy Rivers. This data is likely to include the township of Baralaba. DERM were also contacted regarding the background studies prepared for the Rolleston Dam which is known to include a large photogrammetric dataset. Attempts were made to acquire this data from DERM but key contacts were not available. This data can be obtained from DERM during the FPMP study.

The remaining topographic data gaps for hydraulic modelling are:

- LiDAR ALS data (Survey) for Capella, Rubyvale, Springsure, Blackwater and Dingo. The capture cost is roughly estimated at $1,000 per square kilometer. The area to be captured is estimated at approximately 30 km^2 per town, therefore an estimated total capture area of 150 km^2 is required.
- An allowance is made for river cross-section survey to be used in 1-dimensional modelling of infrastructure located outside of townships that have the potential to exacerbate flooding impacts. This data may also be desired in areas where river channels are not well defined.

4.1.2 Rainfall data

The December 2010 event has very good spatial coverage over the Nogoa and Comet catchments which comprise the majority of the CHRC area. There are large areas of the Mackenzie, Dawson and Fitzroy catchments where no rainfall data has been received from BOM.

It is known that there are many stations within these catchments and KBR are in the process of communicating with BOM to determine why this information has not been provided.

SunWater hold data for daily rainfall stations at Fairbairn Dam and Theodore Weir which is yet to be purchased by CHRC. The cost associated with this data is reflected in the next section.

A small allowance has been made for the purchase of other rainfall data that may need to be collected during the FPMP study.

4.1.3 Stream gauge data

Flood event data has been provided by DERM and other organisations. Data coverage for the January 2008 and December 2010 flood events is reasonable good.

SunWater hold data for several gauging stations in the Nogoa, Dawson and Mackenzie Rivers which is available but is yet to be purchased by CHRC. The cost associated with this data is reflected in the next section.

A small allowance is made for the purchase of any additional stream gauge data that may need to be collected during the FPMP study.

4.1.4 Flood mapping

Flood mapping for the 2010 event has been completed for Emerald and Baralaba. For the 2008 event the data coverage is more widespread, including Emerald, the downstream part of Comet and Sapphire. Survey of the December 2004 flood in Rubyvale has been completed by CHRC.

Flood line mapping for other townships can be undertaken to capture observed flooding events for debris levels, flow paths, breakouts, levee breaches, erosion and sedimentation. The accuracy would rely mainly on anecdotal information from residents and landowners through memory and photographs.

Key assumptions in the development of an indicative cost estimate for the flood mapping survey are as follows:

- A survey team of two people will be required at an estimated cost of $2,400 per day
- An allowance of 1 day for travel time to and from each township has been estimated from a base in Emerald (for example).
- It is assumed that the average surveying time per town is 1 day
- An additional 1 day is allowed for post processing the data, validation and creating a georeferenced flood mapping data base
- Therefore a total of 3 days at $2,400 per day equates to roughly $7,000 per town

Additionally, Dartmouth University has processed indicative flood extents based on satellite imagery for major flood events. This data can be downloaded from the university web site and used in the absence of other information.

4.1.5 Imagery

The Fitzroy Basin Authority (FBA) has aerial imagery for the majority of the Fitzroy Basin. Attempts have been made to collect this data but no response from FBA has been received. This imagery will need to be collected during the FPMP study.

An allowance is made for the purchase of additional satellite imagery.

4.1.6 Infrastructure

KBR understands that CHRC has collected, and is still collating, pertinent data relating to floor levels and other information regarding significant infrastructure in the Emerald area. At this stage, the data available for infrastructure in other townships is not available and will need to be surveyed when the flood studies are commissioned.

Key assumptions in the development of an indicative cost estimate for the infrastructure survey are as follows:

- A survey team of two people will be required at an estimated cost of $2,400 per day
- An allowance of 1 day for travel time to and from each township has been estimated from a base in Emerald (for example)
- It is assumed that the average surveying time per town is 1 day
- An additional 0.5 day is allowed for post processing the data and creating a georeferenced infrastucture survey data base
- Therefore a total of 2.5 days at $2,400 per day equates to $6,000 per town

SunWater hold infrastructure drawings for major water storage reservoirs which are available but is yet to be purchased by CHRC. The cost associated with this data is reflected in the next section.

4.1.7 Flood risk assessment data

KBR understands that CHRC has collected, and is still collating, pertinent data relating to building floor levels in the Emerald area. However a building floor level survey will be required for the 10 other townships to facilitate the damage assessment.

Key assumptions in the development of an indicative cost estimate for the building flood level survey are as follows:

- A survey team of two people will be required at an estimated cost of $2,400 per day
- An allowance of 1 day for travel time to and from each township has been estimated from a base in Emerald (for example)
- It is assumed that 100 preperties can be surveyed and photographed per day with an average surveying time of 2 days per town
- An additional 1 day is allowed for post processing the data, digitally marking the floor levels on photos and georeferencing into a floor level survey data base
- Therefore a total of 4 days at $2,400 per day equates to roughly $10,000 per town

4.2 ADDITIONAL DATA COLLECTION COST ESTIMATE

The gap analysis indicates that there is some additional data collection that is required before most flood studies can be commissioned. In some cases the data can be collected during the flood studies.

The result of the gap analysis indicates that Emerald and Comet townships have the most comprehensive data coverage within the CHRC area. The LiDAR acquisition planned by CHRC for Sapphire, Rolleston and Bluff will enable FPMPs for these townships to commence. For other town areas susceptible to flooding, the lack of topographic data is a major constraint limiting the commencement of FPMPs around the CHRC area.

The data gaps have been identified after careful review of the existing data that has been collected. Table 4.1 presents indicative cost estimates to fill the data gaps with a total cost estimate of $460,000. This figure is very rough and is intended for preliminary budgeting purposes only.

It is more appropriate to interpret the indicative cost estimate as a range with a margin of error. The indicative cost estimate to fill data gaps with a 25% error margin becomes $350,000 to $580,000.

The cost estimates include the purchasing of data from data providers. Indirect costs, such as the time for CHRC staff to manage data acquisition projects, are not included. Also, the data costs are external to the development of the FPMPs.

Additionally, survey data such as the building flood level, infrastructure and flood mapping surveys for each township could be combined to save time and costs. While this has not been assumed in the indicative cost estimates, it would seem appropriate that a survey team collects all relevant information for an entire town in one stage.

Table 4.1 Indicative cost estimate for data collection

No	Item	Indicative Rate	Estimated Units	Indicative Sub-total ($'000)
TOPOGRAPHIC DATA				
1	LiDAR ALS Data for major town areas susceptible to flooding	$1,000 per km^2	150 km^2	150
2	River cross-section survey data			50
HYDROLOGIC DATA				
3	Data from SunWater as per quote (includes hydraulic structures)			6
4	Additional stream flow data			1
5	Additional rainfall Data			1
FLOOD MAPPING				
6	Flood event spot height survey outside Emerald	$7,000 per town	10	70
IMAGERY				
7	Satellite Imagery for flood events except for Emerald			20
INFRASTRUCTURE DATA				
8	Infrastructure surveys excluding Emerald	$6,000 per town	10	60
FLOOD RISK ASSESSMENT DATA				
9	Building floor level survey for damage assessment excluding Emerald	$10,000 per town	10	100
	Indicative Grand Total			**460**

5 Conclusions

This study has been commisioned by the Central Highlands Regional Council (CHRC) to undertake a Flood Data Audit and Gap Analysis for CHRC's area of responsibility. This included gathering, compiling and auditing of hydrological data available from multiple sources and then completion of a comprehensive data gap analysis with the view of determining suitability for the preparation of a new Flood Plain Management Plan for the CHRC area.

Significant floods in the Fitzroy Basin in 2008 and again in 2010-11 have highlighted the criticality of understanding flooding in the basin and the need to address flooding issues. While causing considerable impacts on local communities, the recent flood events provide very good data for calibration of models for the CHRC area.

A gap analysis following the audit of collected data indicates that there is additional data that is available but was not able to be collected during this project and other relevant data that is required or desirable and can be collected before or during the FPMP study.

The following key data gaps have been identified for most townships:

- Detailed topographic data for hydraulic modelling
- Flood mapping for the recent large flood events
- Survey of infrastructure within the town
- Building flood level survey for flood affected properties

The Emerald township has the most comprehensive data coverage within the CHRC area with essentially all the necessary information available to undertake a FPMP. The data for the townships of Comet and Baralaba is also largely available and only lacks information on the flood mapping and infrastructure and building floor level surveys.

For the other town areas susceptible to flooding such as Sapphire, Rolleston and Bluff the CHRC has commissioned to undertake a LiDAR ALS survey. The remaining data outstanding for these towns is flood mapping and the infrastructure and building floor level surveys

The town of Blackwater requires some additional survey data on the downstream side of the Cunningham Highway. This could be included in Council's LiDAR acquisition project.

For other areas such as Capella, Rubyvale, Springsure and Dingo there is no available survey data to enable flood studies of these towns.

Indicative cost estimates to collect data prior to the FPMP have been prepared and between $350,000 and $580,000 should be budgeted for this task.

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Appendix A

DATA MAPS

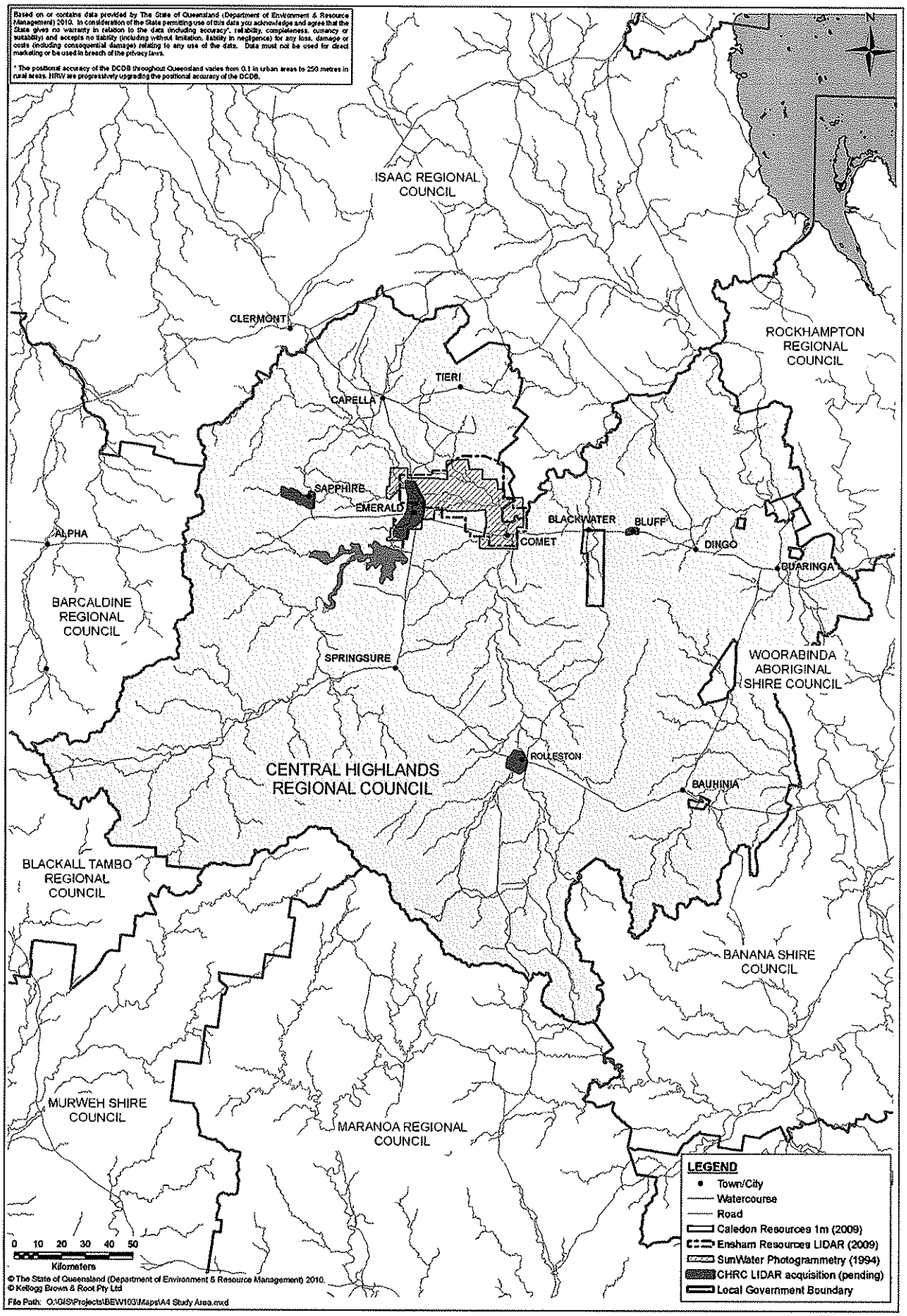

Figure A.1
EXISTING TOPOGRAPHIC DATA

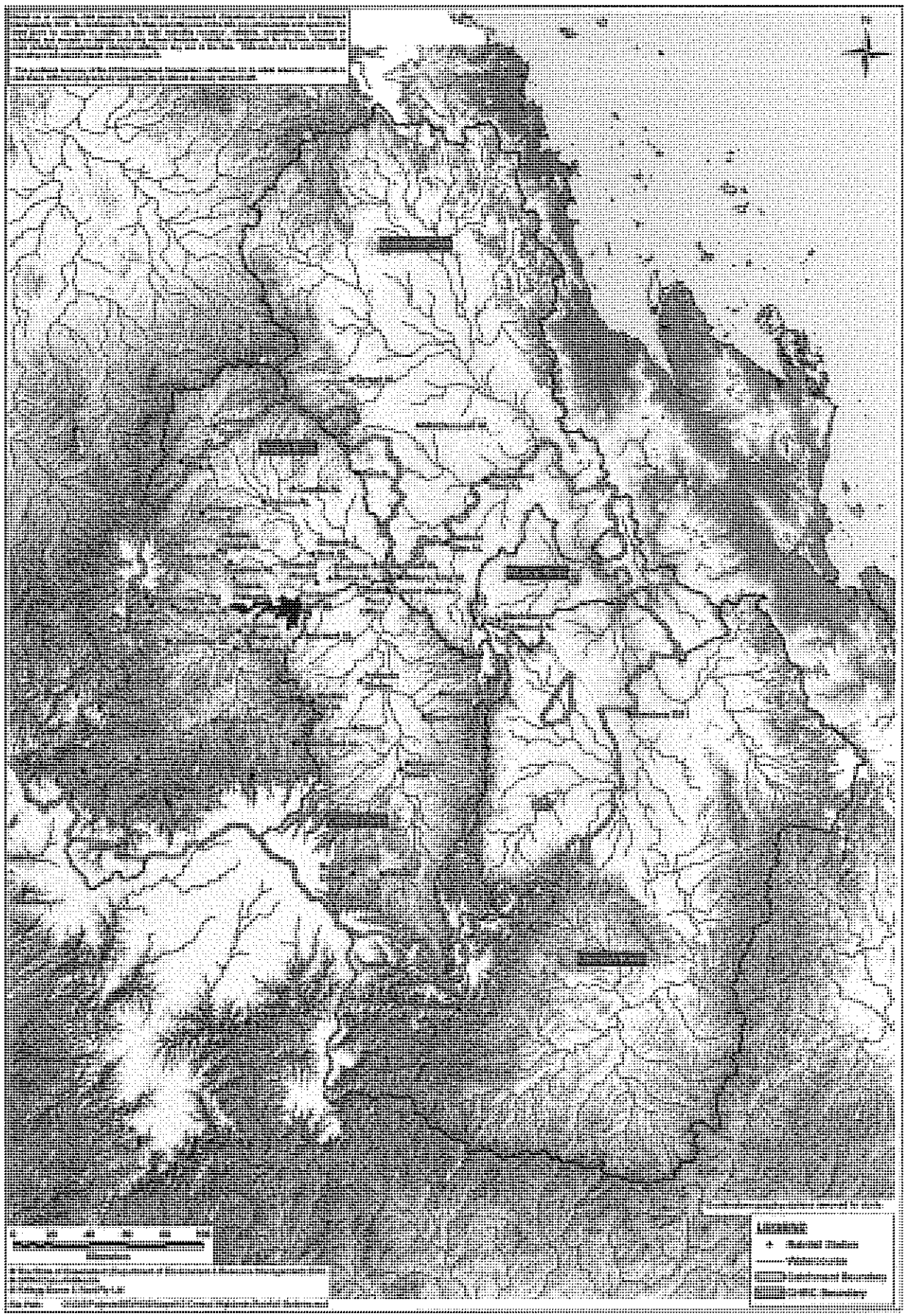

Figure A.2
INSTANTANEOUS RAINFALL STATIONS

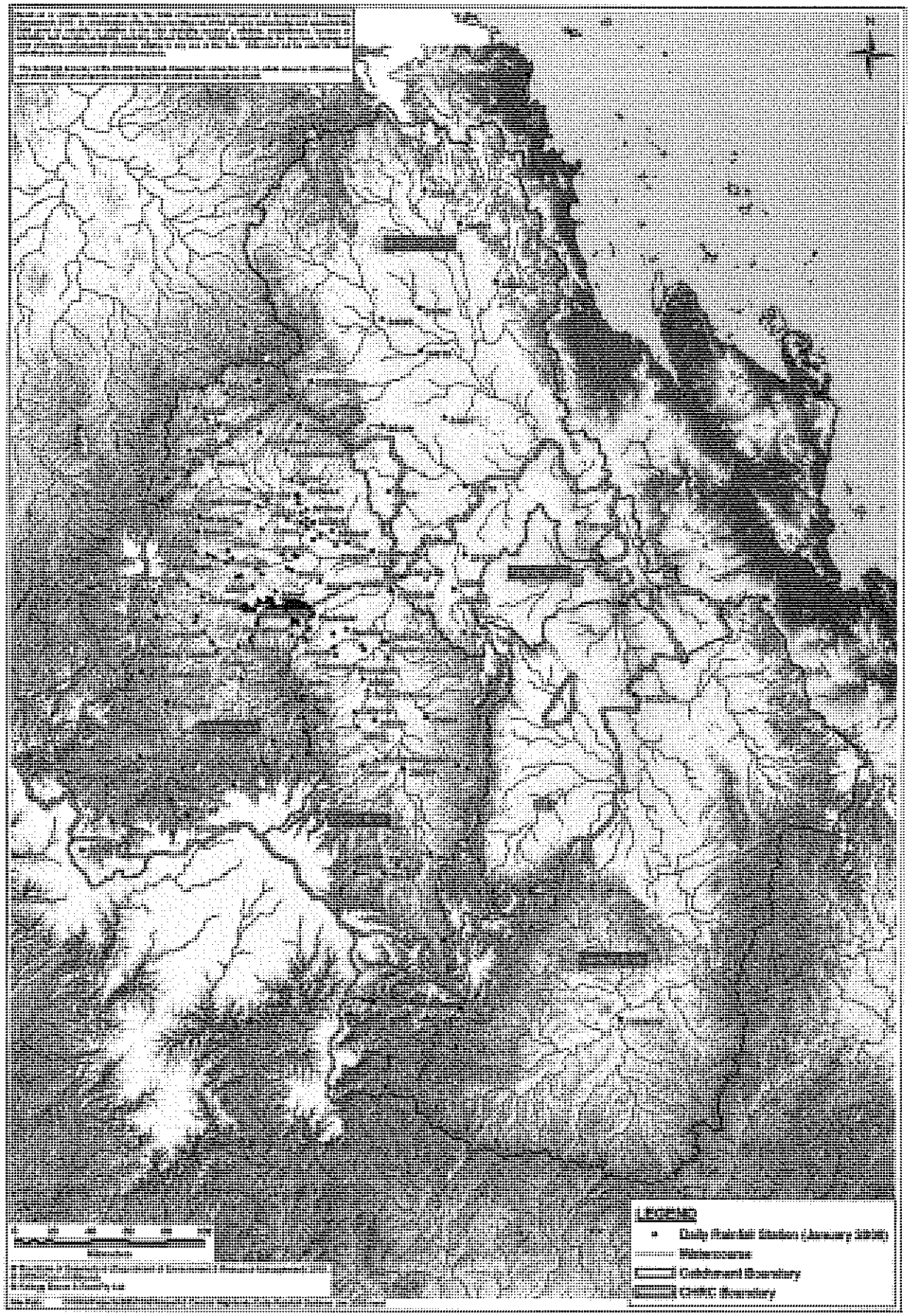

Figure A.3
DAILY RAINFALL STATIONS (JANUARY 2008 DATA)

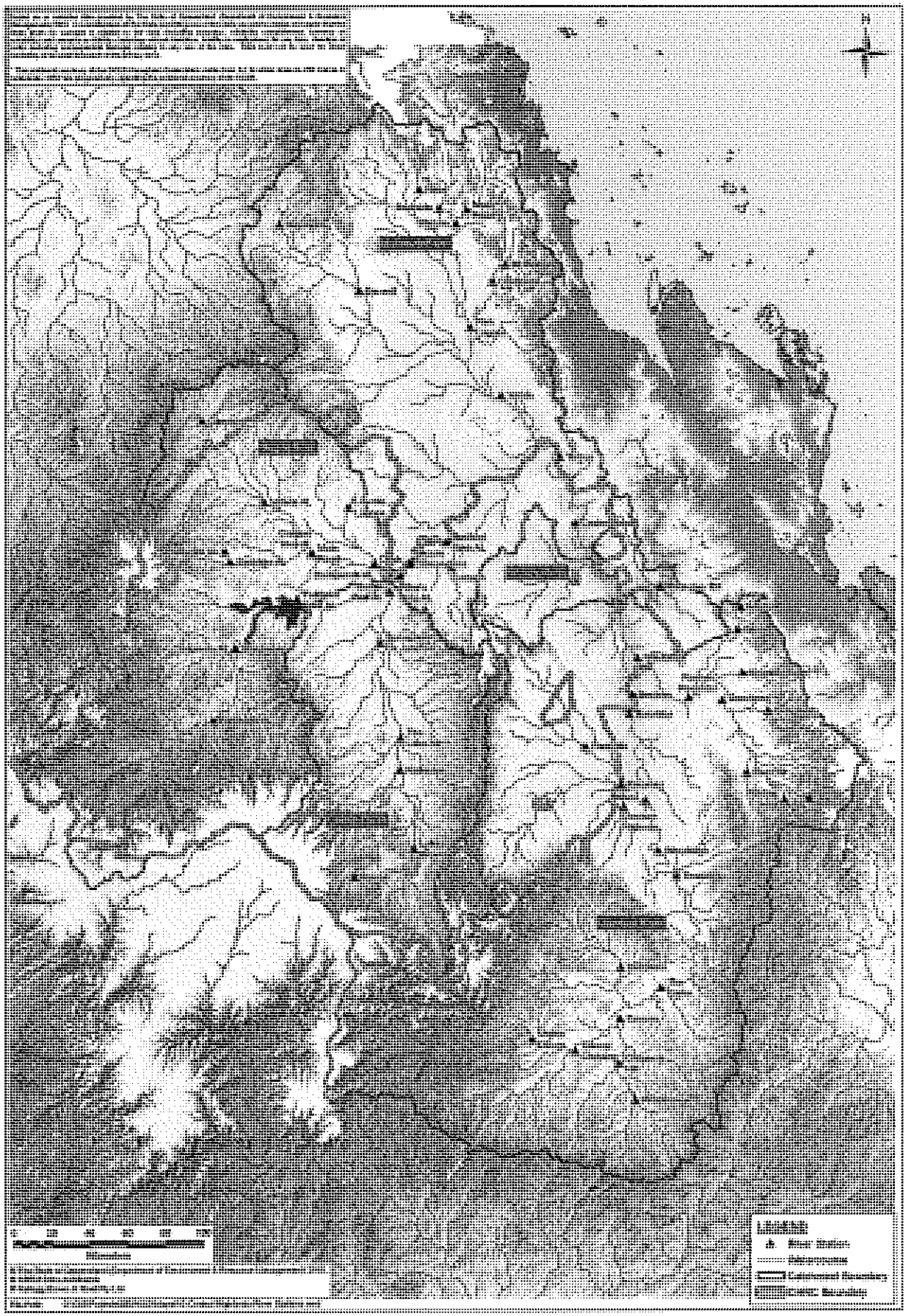

Figure A.4
RIVER GAUGING STATIONS

Appendix B

FINAL REPORT ON THE INLAND FLOODING STUDY

Increasing Queensland's resilience to inland flooding in a changing climate:

Final report on the Inland Flooding Study

A joint project of:
Department of Environment and Resource Management
Department of Infrastructure and Planning
Local Government Association of Queensland

Tomorrow's Queensland: strong, green, smart, healthy and fair

Toward Q Tomorrow's Queensland

Queensland Government

Prepared by:

Office of Climate Change—Department of Environment and Resource Management

Department of Infrastructure and Planning

Local Government Association of Queensland

#29528

Executive summary

Flooding causes significant impacts on Queensland communities and the economy—and with our changing climate, flooding events are likely to become more frequent and more intense. Effective land use planning will ensure our communities are ready for the impacts of climate change.

The Local Government Association of Queensland (LGAQ) approached the Queensland Government to provide a benchmark figure for taking climate change into account when assessing inland flooding risk.

An Inland Flooding Study project was established by the Minister for Climate Change and Sustainability and the Minister for Infrastructure and Planning in partnership with LGAQ to deliver:

1. An improved methodology for assessing inland flooding risk while accounting for climate change.
2. Specific policy options for improved flood risk management in the case study area—Gayndah in the North Burnett Regional Council.
3. General policy options for consideration as part of the review of State Planning Policy 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide (SPP 1/03).

As a result, this Inland Flooding Study combines the best available science and planning options to provide clear guidance and practical tools to enhance flood risk management by local governments.

This study provides Queensland local governments with a climate change factor for increased rainfall intensity for incorporation into flood studies. It proposes a 5 per cent increase in rainfall intensity per degree of global warming.

This 5 per cent increase in rainfall intensity per degree of global warming can be incorporated into the 1 per cent (Q100), 0.5 per cent (Q200) and 0.2 per cent (Q500) Annual Exceedance Probability (AEP)[1] flood events recommended in SPP 1/03. For the purpose of applying this climate change factor local governments should use the following temperature increases and planning horizons: 2°C by 2050, 3°C by 2070 and 4°C by 2100.

This climate change factor will be reviewed and updated when a national position on how to factor climate change into flood studies is finalised as part of the current review of Australian Rainfall and Runoff Engineers Australia Publication (AR&R). The outcomes of this review are not expected to be available before 2014.

In the interim, local governments can use the recommended climate change factor from this project to better identify flood risks. Further technical information on how this climate change factor was derived can be found at ‹www.derm.qld.gov.au›.

Using this climate change factor, the Inland Flooding Study developed recommended policy options to incorporate climate change into the flood risk management framework for Gayndah. These options are included in a draft flood constraint code for assessing development applications, which defines four flood hazard areas linked to the 1 per cent (Q100), 0.5 per cent (Q200) and 0.2 per cent (Q500) AEP flood levels. The draft flood constraint code outlines the appropriate land uses for each of these hazard areas. This is a major step forward in shifting the focus from the 1 per cent AEP (Q100) as the only relevant flood level for residential development to the reality that there are varying levels of flood risk that local governments need to consider.

The recommendations also include two implementation options for addressing the increased flood intensity risk from climate change. These two options allow the North Burnett Regional Council to choose how best to represent this risk in its planning scheme.

The first option uses three new flood maps that include the climate change factor:

- Map 1: 1 per cent (Q100), 0.5 per cent (Q200) and 0.2 per cent (Q500) AEP flood extents projected for 2050.
- Map 2. 1 per cent (Q100), 0.5 per cent (Q200) and 0.2 per cent (Q500) AEP flood extents projected for 2070.
- Map 3: 1 per cent (Q100), 0.5 per cent (Q200) and 0.2 per cent (Q500) AEP flood extents projected for 2100.

These maps are used to apply development constraints based on the asset life and location of a development proposal in relation to the revised flood maps.

1 The Annual Exceedence Probability (AEP) refers to the likelihood of occurrence of a flood of a given size (or larger) in any one year. The 1 per cent AEP flood event is also known as the 1-in-100 year Average Recurrence Interval (ARI) or Q100 event, the 0.5 per cent AEP is also known as the 1-in-200 year ARI or Q200 event, and the 0.2 per cent AEP is also known as the 1-in-500 year (ARI) or Q500 event.

The second option uses Gayndah's existing flood maps and increases the level of constraint on development proposals to account for the climate change factor. In effect this extends the area subject to current 1 per cent AEP (Q100) development constraints to:

- an area equivalent to the present day 0.5 per cent AEP (Q200) flood level for areas subject to a development commitment
- an area equivalent to the present day 0.2 per cent AEP (Q500) flood level for new urban development.

This approach is based on the current 0.5 per cent AEP (Q200) approximating the 1 per cent AEP (Q100) level by 2050 and the current 0.2 per cent AEP (Q500) approximating the 1 per cent AEP (Q100) level by 2100.

The two implementation options apply the same climate change factor of a 5 per cent increase in rainfall intensity per degree Celsius of global warming.

The recommended policy options provide the North Burnett Regional Council with interim guidance on how to better manage flood risk for the Gayndah township area in advance of the review of SPP 1/03. While these options are specific to the issues identified by this project for the Gayndah township, the policy approach underpinning the draft flood constraint code will be of interest to other local governments as an example of how the impact of climate change on flood risk can be addressed in planning schemes. A copy of the recommended policy options paper prepared for Gayndah can be found at <www.derm.qld.gov.au>.

The Inland Flooding Study raised issues that will be considered by the Queensland Government as part of the review of SPP1/03, including:

- the benefits of requiring a standard hydrological methodology for flood studies
- identifying how frequently flood studies should be reviewed and/or updated
- investigating the circumstances in which local governments should be able to have a Defined Flood Event (DFE)[2] that is higher or lower than the 1 per cent AEP (Q100)
- clarifying which components of the SPP, as they relate to flood risk management, are optional or mandatory
- identifying how to better integrate land use planning and disaster management planning, for example making sure there are sufficient evacuation routes to get people to a safe and secure area in an extreme event (e.g. storm, flood or fire).

The key recommendations from the study are:

- **Recommendation 1**—Local governments should factor a 5 per cent increase in rainfall intensity per degree of global warming into the 1 per cent (Q100), 0.5 per cent (Q200) and 0.2 per cent (Q500) AEP flood events recommended in SPP 1/03 for the location and design of new development.
- **Recommendation 2**—The following temperatures and timeframes should be used for the purposes of applying the climate change factor in Recommendation 1:
  - 2°C by 2050
  - 3°C by 2070
  - 4°C by 2100.
- **Recommendation 3**—The Queensland Government will review and update this climate change factor when a national position on how to factor climate change into flood studies is finalised as part of the current review of AR&R.
- **Recommendation 4**—That North Burnett Regional Council consider the two implementation options identified in the paper *Recommended Policy Options for Incorporating Climate Change into the Flood Risk Management Framework in Gayndah* and implement its preferred approach in its planning scheme.
- **Recommendation 5**—The review of SPP 1/03 should consider the benefits of requiring a standard method for undertaking a flood study and determining a DFE.
- **Recommendation 6**—The review of SPP 1/03 should consider whether there is a need to specify how frequently a flood study should be reviewed or updated.
- **Recommendation 7**—The review of SPP 1/03 should develop criteria that outline the circumstances where a DFE higher or lower than the 1 per cent AEP (Q100) is appropriate for residential land use planning.

2 The DFE is the flood event adopted for the management of development in a particular locality. The 1 per cent AEP is the recommended DFE under SPP1/03.

- **Recommendation 8**—The review of SPP 1/03 should clarify what components of the SPP are compulsory and clarify what additional guidance local governments may need to meet those obligations.
- **Recommendation 9**—The review of SPP 1/03 should consider the applicability of the recommended planning response for Gayndah (as per recommendation 4) to other parts of Queensland.
- **Recommendation 10**—The review of SPP 1/03 should consider how to improve the integration of land use planning and disaster management planning.
- **Recommendation 11**—The review of SPP 1/03 should consider issues concerning coincident flooding including: the results of any research into the potential impacts; the extent to which coincident flooding is already covered in flood studies conducted by local governments; and the most appropriate planning instrument to address coincident flooding in the future.
- **Recommendation 12**—Working through the national Building Ministers' Forum (BMF) and the Australian Building Codes Board (ABCB), support the development of a national code for the design and construction of new building work in areas designated as flood prone in local planning schemes.

The Inland Flooding Study has been a joint project of the Queensland Government and the LGAQ. Further information on the project outcomes, including specific recommendations, are set out in the remainder of this report.

Methodology and project governance

Project methodology

The Inland Flooding Study comprised two components:

1. a climate change science component to incorporate climate change into flood studies
2. a planning policy component to recommend policy options for Gayndah and to carry forward to the review of SPP 1/03.

Both components included an analysis of approaches in national and international jurisdictions with a similar propensity for flooding and comparable planning frameworks and governance models.

Various scientific methodologies were examined to identify benchmark figures for planning to take account of the projected impacts of climate change on flood risks. These methods were based on the theory that precipitable water in the atmosphere will increase as global temperature increases. Analysis was undertaken to determine the extent of evidence in the Queensland historical record for this physical relationship. This analysis included both land surface temperatures and sea surface temperatures.

The recent work of Rafter and Abbs (2010)[3] was also considered, which uses extreme value analyses to calculate the percentage increases of intense rainfall from a suite of Global Climate Models. The project also took into account the recently released report from the US National Academy of Sciences (2010) which concludes that: "Extreme precipitation is likely to increase as the atmospheric moisture content increases in a warming climate. Typical magnitudes are 3-10 per cent per degree C warming, with potentially larger values in the tropics, and in the most extreme events globally."

A desktop assessment of relevant planning policy responses in selected national and international jurisdictions identified a number of promising practices to improve Queensland's land use planning response to flood risk management. The most effective practices have informed the planning policy recommendations included in this report.

Gayndah case study

A case study was undertaken in Gayndah in North Burnett Regional Council to trial the increased rainfall intensity climate change factor and consider policy options for improved flood risk management. This was in addition to desktop analyses of relevant science and policy.

3 Rafter T. and Abbs D. (2010). Calculation of Australian extreme rainfall within GCM simulations using Extreme Value Analyses. Unpublished.

In 2008, the former Gayndah Shire Council undertook a flood study to inform its planning and development assessment. The consultant's report recommended that the Council adopt a climate change impact allowance of 20 per cent (i.e. increase river peak flow discharges from the Gayndah catchment by 20 per cent). This increased the area of Gayndah township that would be considered at flood risk for land use planning and development assessment purposes, effectively moving the current 1 per cent AEP (Q100) event up to the current 0.5 per cent AEP (Q200) event.

In January 2009, LGAQ approached the Queensland Government for verification of the advice given to Gayndah Shire Council and to obtain clearer guidance on how to factor climate change into flood studies and land use planning.

As a result, the Queensland Government, in collaboration with LGAQ, undertook this project to deliver a more definitive approach to managing inland flooding risks in a changing climate, based on the best available science and implemented via the Queensland land use planning framework.

Gayndah provides a useful case study area for Queensland on the basis that:

- It is an inland catchment that is not influenced by coastal inundation or sea level rise (therefore the impacts associated with potential changes in rainfall intensity can be clearly measured).
- A recent, calibrated flood study had been completed to current standards including consideration of climate change as a basis for assessment.
- Flood conditions in the area are sensitive to changes in peak discharge (with a secondary flow path opening up at a particular threshold) and therefore the potential impacts of climate change are significant.
- It is within a representative inland catchment being medium-large in size (23 350 km^2).

Project governance

A Project Board was established to oversee both components of the project. The Project Board was chaired by the Office of Climate Change (OCC) and comprised senior representatives from:

- LGAQ
- CSIRO Climate Adaptation Flagship
- the National Climate Change Adaptation Research Facility
- Griffith University
- Department of Infrastructure and Planning
- Department of Community Safety
- Department of Environment and Resource Management.

The science component of the project was led by the Queensland Climate Change Centre of Excellence (QCCCE) within the Department of Environment and Resource Management. The science deliverables for the project were reviewed and endorsed by a Scientific Advisory Group (SAG), comprising scientists and flood specialists from leading scientific institutions and stakeholder organisations. Members of the SAG are listed in Appendix 1.

The recommended climate change factor derived through this project was also discussed and reviewed at an end user workshop on 27 September 2010. Organisations represented at the workshop are listed in Appendix 2.

The policy component of the project was led by the Planning Policy and Legislation Branch in the Department of Infrastructure and Planning (DIP). A Planning Policy Advisory Group (PPAG) reviewed and endorsed the deliverables for the policy component of the project. Members of the PPAG are listed in Appendix 3. Consultations with senior officers from North Burnett Regional Council also occurred on 5 August 2010 and 13 October 2010 to seek their feedback and endorsement of the recommended policy options.

Key findings and recommendations

Context

Flooding is number one in the hierarchy of risks from natural hazards in Queensland, and has significant economic impacts on Queensland communities.

In March 2009 floods occurred across North West Queensland and in Mackay, costing state and local governments approximately $234 million in damage to infrastructure. This event saw one million square kilometres, or 62 per cent of the State underwater. In March 2010, serious flooding occurred across large areas of the State including south-west Queensland.

Although flooding is a natural occurrence, climate change science is indicating that despite a projected decrease in rainfall across most of Queensland, a projected increase in rainfall intensity could result in more flooding events[4].

Effective land use planning can help reduce the impact of flood events by ensuring dwellings, critical infrastructure (such as hospitals) and sensitive land uses (such as storage of fuel) are located where there is a lower risk of flooding or are built to withstand the impacts of flood events (for example, building houses on stumps). This report looks at how the planning framework can assist and how it can be better integrated with disaster management.

By combining the best available science and planning options on climate change and flood risk, the Inland Flooding Study has provided clearer guidance and practical tools for local governments to better understand and manage flood risk in a changing climate when conducting flood risk assessments and developing or reviewing local planning schemes.

Scientific recommendations

Recommendation 1—Local governments should factor a 5 per cent increase in rainfall intensity per degree of global warming into the 1 per cent (Q100), 0.5 per cent (Q200) and 0.2 per cent (Q500) AEP flood events recommended in SPP 1/03 for the location and design of new development.

Recommendation 2—The following temperatures and timeframes should be used for the purposes of applying the climate change factor in Recommendation 1:

- 2°C by 2050
- 3°C by 2070
- 4°C by 2100.

Recommendation 3—The Queensland Government will review and update this climate change factor when a national position on how to factor climate change into flood studies is finalised as part of the current review of AR&R.

More detailed information on the rationale for deriving the climate change factor can be found at <www.derm.qld.gov.au>.

In summary, the climate change factor is based on the proposition that as the lower atmosphere warms, the atmospheric water vapour also increases, which increases the risk of more intense rainfall events.

The rate of atmospheric warming over time is derived from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report A1FI (high) greenhouse gas emissions scenario. The A1FI scenario assumes continued dependence on fossil fuels. Global temperatures for the past decade have been the warmest on record and are currently tracking at the upper limits of the A1FI scenario.

Using the A1FI emissions scenario, the best estimate of projected changes in annual global mean temperatures is outlined in Table 1.

4 Climate Change in Queensland: What the Science is Telling Us 2010 p.27

Table 1: Global warming best estimate and representative ranges relative to 1990 for relevant planning horizons for the A1F1 scenario

	2050		2070		2100	
	Best estimate	Representative range	Best estimate	Representative range	Best estimate	Representative range
A1F1	1.8°C	1.08–2.88°C	2.9°C	1.74–4.64°C	4.0°C	2.4–6.4°C

Local governments should use the temperatures and timeframes outlined in Recommendation 2 when producing new flood maps. However, local governments may be able to use their existing flood maps to approximate future flood levels that incorporate the recommended climate change factor for example, in the Gayndah case study area the following approximations were used[5].

Table 2: Approximate change to flood level with climate change

Existing flood level	Temperature change scenario	Changes to a future flood level
0.5 per cent AEP (Q200)	2°c warming by 2050	1 per cent AEP (Q100) by 2050
0.2 per cent AEP (Q500)	2°c warming by 2050	0.5 per cent AEP (Q200) by 2050
0.2 per cent AEP (Q500)	4°c warming by 2100	1 per cent AEP (Q100) by 2100

This project acknowledges that the AR&R publication provides the nationally accepted methodologies for undertaking flood studies. However, the publication has not been updated for 23 years and does not consider the impacts of climate change.

While the Australian Government is supporting a review of the AR&R publication, the outcomes of this review are not expected to be available before 2014. This project was therefore undertaken to meet the needs of local governments on how to consider climate change and better identify flood risks.

In that context, the climate change factor identified by this project for incorporation into flood studies will be reviewed and updated when a national position on how to factor climate change into flood studies is finalised as part of the current review of the AR&R publication.

Issues not explicitly addressed by this project will also be considered by the the AR&R publication review. For example, how antecedent conditions (the wetness or dryness of the catchment) may impact on hydrological models with climate change. For the purposes of this project, the current evidence suggests that maintaining the existing antecedent characteristics of the catchment is reasonable and warranted.

Similarly, the review will consider the implications of revised global emissions scenarios provided in the IPCC's Fifth Assessment Report (AR5) on rainfall intensity and flooding. The AR5 is scheduled for release in 2014.

Advice on how to use the climate change factor in flood studies

To account for the impacts of climate change, the nationally accepted methodologies for undertaking flood studies outlined in the AR&R publication should be followed, with the only change being that design rainfall depths are increased by a climate change factor of 5 per cent per degree Celsius of global warming.

Design rainfall depths should be determined through an appropriate method such as the method in the AR&R publication or CRC-FORGE. Given that the climate change factor of 5 per cent is per degree Celsius of global warming, the actual percentage increase used will depend on the timeframe and temperature outlined in Recommendation 2. For example, there will be a 10 per cent increase in rainfall depth for a timeframe of 2050 (i.e. a 2°C increase in global warming by 2050), a 15 per cent increase for 2070 (i.e. a 3°C increase in global warming by 2070), and a 20 per cent increase for 2100 (i.e. a 4°C increase in global warming by 2100).

5 This is general guidance only and local governments need to check with flood hydrologists whether this is a valid approach for their existing flood studies and particular catchments.

The climate change factor of 5 per cent per degree of global warming should be applied to rainfall depths and not directly to hydrographs (i.e. the quantity of water flowing in the river). The scaled rainfall depths should then be applied to the hydrological model in the same way as the current event-based methods to produce design flood hydrographs for climate change scenarios.

There is currently no requirement to adjust the remaining data inputs (temporal patterns, loss models) or modify the hydrological model parameters. The determined climate change hydrographs should, in turn, be applied to the hydraulic model to calculate the flood level, depth and extents for climate change design events.

Note: This climate change factor is limited to flood risk management for planning purposes as described by the SPP 1/03 and does not extend to more frequent events (i.e. >2 per cent AEP or Q50) or more extreme events (i.e. probable maximum flood). The climate change factor applies to floods arising from rainfall events of at least one hour or more.

Policy recommendations

Recommendation 4—That North Burnett Regional Council consider the two implementation options identified in the paper *Recommended Policy Options for Incorporating Climate Change into the Flood Risk Management Framework in Gayndah* and implement its preferred approach in its planning scheme.

The Inland Flooding Study has identified two policy options for the North Burnett Regional Council to incorporate the effect of climate change on flooding into its planning scheme.

Both options comprise three components:

1. A policy that incorporates different approaches depending on a development commitment being in place or not

For proposals already subject to a development commitment, conditions will ensure that development is subject to stringent design and evacuation standards. To achieve this, development either has to be consistent with appropriate land uses for specific flood hazard areas or development must be designed and constructed to appropriate flood level and height of habitable rooms. In addition, evacuation routes must be maintained to specific flood levels.

For land that is not already subject to a development commitment, the policy directs development to areas of lowest flood hazard based on the proposed land use by requiring that new development is built above specific flood levels and that evacuation routes must also be maintained to specific flood levels.

2. A draft flood constraint code to address development in flood affected areas

A flood constraint code is a requirement within local planning schemes for flood affected areas. The draft flood constraint code developed through this project for Gayndah defines four flood hazard areas based on the three relevant flood levels described in the SPP1/03—the 1 per cent (Q100), 0.5 per cent (Q200) and 0.2 per cent (Q500) AEPs.

A land use table included in the draft flood constraint code outlines the appropriate land uses for each of these hazard areas. This is a major step in shifting the focus from the 1 per cent AEP (Q100) as the most important flood level for residential development to the reality that there are many flood hazard levels and associated risks that local governments need to consider.

3. A choice of flood overlay maps based on different planning horizons

Using the new climate change factor outlined in recommendations 1 and 2, flood overlay maps for different planning horizons were developed for the Gayndah township. These maps will allow North Burnett Regional Council to identify the geographic areas affected by flooding risks over time and will inform application of the draft flood constraint code.

The policy approach proposed for Gayndah is intended to minimise the risk to life and property in flood affected areas, including the accentuated risk from climate change, by:

- reducing the adverse impacts of flooding by encouraging, for example, flood resilient design and layout
- facilitating development in lower probability flooding areas
- maintaining local floodplain processes (water storage and flows; river discharge and capacity; banks of river, streams and water bodies protected from erosion)

- maintaining a network of evacuation routes
- maintaining critical emergency infrastructure and services during flood events
- maintaining functionality of community infrastructure during and immediately following flood events.

These policy options have been developed specifically for the Gayndah township and in response to a request by the North Burnett Regional Council and LGAQ for advice and guidance. While the outcomes of the study have been developed for Gayndah, the findings will be of interest to other local governments in Queensland. Further information can be found in the publication *Recommended Policy Options for Incorporating Climate Change into the Flood Risk Management Framework in Gayndah* available at ‹www.derm.qld.gov.au›.

The policy options provided for Gayndah are transitionary arrangements in advance of the current review of SPP 1/03 (due for completion in 2013). The review of SPP 1/03 will provide all Queensland local governments with definitive policy requirements on how to address flood, bushfire and landslide hazards in their planning schemes. Until this review is complete, any council seeking to amend their planning schemes must continue to reflect the current policy requirements in SPP 1/03.

General recommendations for consideration as part of the review of SPP 1/03

In the context of this review, planners, consultants, engineers and council representatives were consulted on the practical issues associated with implementation of the current SPP 1/03. The Project Board has had regard to all of the issues that were identified during those discussions in formulating the following recommendations for consideration as part of the broader review of SPP 1/03.

Recommendation 5—The review of SPP 1/03 should consider the benefits of requiring a standard method for undertaking a flood study and determining a DFE.

There is currently no requirement on local governments to use a standard calibrated engineering method for undertaking flood studies. Under the current SPP, local governments may elect instead to use, for example, historical flood data (including the lack of data) to determine their DFE. This discretion in how local governments assess their flood risk results in varying degrees of accuracy and predictive value of current and future flood hazards.

Development of a standard method for flood studies which includes advice on the Queensland Government's endorsed climate change factors and takes account of different catchment characteristics (e.g. large rural catchments and highly developed urban catchments) would improve the consistency and accuracy of flood studies in Queensland. On this issue, the Project Board and advisory group members identified that New South Wales appears to have overcome issues of accuracy in the assessment of flood hazards by requiring uniform state-wide application of a standard method for flood studies.

Recommendation 6—The review of SPP 1/03 should consider whether there is a need to specify how frequently a flood study should be reviewed or updated.

While SPP 1/03 requires that a flood study be undertaken for natural hazard management areas, there is currently no guidance on when local governments should review or update those studies. In practice, this means that local governments may be using flood studies that do not reflect recent development in the area and the impact of that development on potential flood risks.

Therefore it is recommended that the review of SPP 1/03 identify appropriate triggers to guide when local governments need to review and/or update their flood studies, taking into consideration the likely cost impacts on local governments of increasing the frequency of undertaking flood studies. Triggers could include undertaking a planning scheme review (review hydraulic components) and updated AR&R advice (update hydrological components).

Recommendation 7—The review of SPP 1/03 should develop criteria that outline the circumstances where a DFE higher or lower than the 1 per cent AEP (Q100) is appropriate for residential land use planning.

SPP 1/03 currently requires local governments to determine a DFE to set limits for land use and development in any floodplain area. SPP 1/03 specifies the 1 per cent AEP (Q100) as the preferred DFE for residential land use planning. SPP 1/03 guidelines indicate that the residual risk (the risk of a flood exceeding the DFE) should be addressed in local government counter disaster plans and emergency procedures.

However, there are currently no criteria to determine when it may be appropriate for a council to use another DFE (i.e. above or below the 1 per cent AEP or Q100). In practice this has led to local governments adopting varying flood levels to constrain development without reference to any consistent criteria. The review of SPP 1/03 should develop clear and transparent criteria for use by local governments and referral agencies on the circumstances where a DFE above or below the 1 per cent AEP (Q100) is appropriate.

Recommendation 8—The review of SPP 1/03 should clarify what components of the SPP are compulsory and clarify what additional guidance local governments may need to meet those obligations.

The review provides a useful opportunity to clarify the core components of what local governments must do to assess and manage their flood risk, as well as provide more detailed guidance on how local governments should meet those obligations (as per recommendations 1 and 2). This would help to address current inconsistencies in how local governments interpret and implement the SPP. More generally, the review provides an opportunity to provide clearer guidance to local governments on core requirements and standards, as well as those matters on which they continue to have discretion. This could include guidance on how the revised SPP should be reflected in statutory regional plans.

Recommendation 9—The review of SPP 1/03 should consider the applicability of the recommended planning response for Gayndah (as per Recommendation 4) to other parts of Queensland.

The recommended planning responses for Gayndah township should be considered for applicability in other local government areas and to establish if the policy options provide an appropriate planning response to direct new development to areas with lower levels of flood risk now and in the future under climate change.

This should include consideration of the utility of incorporating draft flood overlay codes (modelled on the draft flood constraint code developed for Gayndah) in the Queensland Planning Provisions (QPPs).

An assessment of the useability of the draft flood constraint code developed for Gayndah should form part of this broader consideration of state-wide applicability.

Recommendation 10—The review of SPP 1/03 should consider how to improve the integration of land use planning and disaster management planning.

The SPP 1/03 guidelines currently outline how residual risk can be addressed in disaster management plans and emergency procedures developed by local governments.

The review provides an opportunity to consider what changes need to be made to improve the integration of land use planning and disaster management planning, including whether any additional guidance is required and what, if any, elements of that guidance should become mandatory provisions under a revised SPP (for example, ensuring land use planning takes account of population growth and its impact on the efficient evacuation of people to a safe and secure area in an extreme event).

Recommendation 11—The review of SPP 1/03 should consider issues concerning coincident flooding including: the results of any research into the potential impacts; the extent to which coincident flooding is already covered in flood studies conducted by local governments; and the most appropriate planning instrument to address coincident flooding in the future.

The AR&R publication provides national guidance for undertaking flood studies. The publication is currently being reviewed to include consideration of climate change and incorporate new data and technological advances in rainfall/runoff assessment. This review is due for completion in 2014.

One component of the AR&R review includes examining the interaction of coastal processes and severe weather events and should result in guidelines for incorporating the joint effects of flood flows from storm rainfall and elevated ocean levels into flooding predictions (coincident flooding). Elevated ocean levels caused by the storm (storm surge) as well as those caused by climate change (sea level rise) will be considered.

The Department of Environment and Resource Management has been allocated National Disaster Resilience Program funding to examine the impacts of coincident flooding in Queensland.

The results of this research should be considered as part of the review of SPP 1/03 to determine how this issue should be addressed in Queensland's land use and disaster planning frameworks.

National guidance on coincident flooding is expected to be provided from the AR&R review in 2014.

Recommendation 12—Working through the national Building Ministers' Forum (BMF) and the Australian Building Codes Board (ABCB) to support the development of a national code for the design and construction of new building work in areas designated as flood prone in local planning schemes

Queensland is represented at the BMF by the Minister for Infrastructure and Planning. In 2009, the Minister sought recognition at the forum of the significant impact of flooding on buildings in Australia, the current lack of national building codes to address this issue, and for the ABCB to develop a national code for building in flood prone areas for regulatory adoption by individual States and Territories.

Subsequently, the ABCB has drafted a proposal to develop national design and construction requirements under the Building Code of Australia for new building work in designated areas vulnerable to flooding. Minimum requirements under the Building Code of Australia would include performance requirements and deemed-to-satisfy provisions to minimise damage to buildings and building materials from flooding.

The ABCB is expected to develop this new code by the end of 2012. This code would be referenced in Queensland under the *Building Act 1975* and, once developed, will specify the design and construction requirements that apply in Queensland for new building work in designated flood prone areas.

Conclusion

The outcomes from this project provide guidance to local governments on how to better manage their flood risks and land use planning responses in a changing climate. This has been done by providing a climate change factor for incorporation into flood studies, developing specific land use policy options to improve the flood risk management framework in Gayndah, and identifying a series of recommendations for consideration in the SPP 1/03 review.

The project provides all Queensland local governments with a climate change factor for incorporation into the 1 per cent (Q100), 0.5 per cent (Q200) and 0.2 per cent (Q500) AEP flood events recommended in SPP 1/03 for the location of new development. This approach will be reviewed and updated when a national position on how to factor climate change into flood studies is finalised as part of the current review of the AR&R publication. In the interim, Queensland local governments can use the approach from this project to better identify flood risks.

A progressive policy approach for the Gayndah township has also been developed that incorporates multiple flood hazard zones and reduces reliance on one flood level in local government planning. The broader applicability of this approach will be considered as part of the review of SPP 1/03.

The project also makes recommendations to address challenges in the planning framework and its consistent implementation through the review of SPP 1/03. These recommendations are designed to address challenges and gaps in the current planning framework and improve the connectivity between disaster management and land use planning.

By integrating the best available science and innovative planning options through multiple flood hazard zones and reducing reliance on one flood level in local government planning, this joint project between the Queensland Government and the LGAQ has delivered clearer guidance and practical tools for local governments so they are better positioned to manage flood risk for Queensland communities.

Appendix 1: Membership of the Inland Flooding Study Scientific Advisory Group

Name	Organisation
Prof Colin Apelt	University of Queensland (retired)
Prof Nigel Arnell	Director, Walker Institute for Climate System Research
Peter Baddiley	Queensland Hydrology Manager, Bureau of Meteorology
Helen Fairweather	Chief Scientist, Coastal Impacts Unit, Queensland Climate Change Centre of Excellence
Dr Ryan McAllister	Research Scientist, CSIRO
Ken Morris	Principal Engineer, Water and Environment, Brisbane City Council
Prof Jean Palutikof	Director, NCCARF (National Climate Change Adaptation Research Facility)
Jeff Perkins	Hydrologist, Bureau of Meteorology
Richard Priman	Director, Regional Water Supplies, Department of Environment and Resource Management
David Robinson	Director, Coastal Impacts Unit, Queensland Climate Change Centre of Excellence
John Ruffini	Director, Water Science, Department of Environment and Resource Management
Dr Bill Weeks	Director (Hydraulics), Department of Transport and Main Roads

Appendix 2: Organisations represented at the Inland Flooding Study Workshop

The following organisations were represented at the Inland Flooding Study Workshop held in Brisbane on 27 September 2010:

- Department of Environment and Resource Management
- Department of Infrastructure and Planning
- Office of Climate Change
- Queensland Climate Change Centre of Excellence
- Bureau of Meteorology
- Local Government Association of Queensland
- SEQ Water
- Brisbane City Council
- Ipswich City Council
- Redland City Council
- Moreton Bay Regional Council
- Cardno Associates
- BMT WBM
- Sinclair Knight Merz
- Kellogg Brown and Root.

Appendix 3: Membership of the Inland Flooding Study Policy and Planning Advisory Group

Name	Organisation
Michael Allen	Project Manager, Industry Projects Facilitation, Department of Infrastructure and Planning
Megan Bayntun	Director, Planning Policy and Legislation, Growth Management Queensland
Helen Fairweather	Chief Scientist, Coastal Impacts Unit, Queensland Climate Change Centre of Excellence
Christophe Manchon	Senior Project Officer, Office of Climate Change
Tracy Haynes	Senior Advisor, Local Government Association of Queensland
Deborah Mangu	Principal Planner, Planning Services, Department of Infrastructure and Planning
Amy Marsden	Director, Planning Services, Department of Infrastructure and Planning
Shane O'Brien	Principal Advisor, Building Codes Queensland
Tom Orr	Principal Advisor, Planning Policy and Major Development, Department of Transport and Main Roads
Mark Piorkowski	Manager, Environment and Planning, Local Government Association of Queensland
Robert Preston	Manager, Climate Change, Planning Policy and Legislation, Growth Management Queensland
Christina Sinnemann	Senior Project Officer, Climate Change, Planning Policy and Legislation, Growth Management Queensland
Carol Wall	Principal Policy Officer, Office of Climate Change
Graham Wiltshire	Director, Strategic Policy, Department of Community Safety

C&R CONSULTING

Geochemical & Hydrobiological Solutions Pty Ltd

ABN 72 077 518 784

Marine and Coastal Processes and Dynamics
Groundwater and Environmental Specialists
Environmental Compliance and Monitoring
Contaminated Site and Soil Assessment
HydroGeomorphic Evaluations
Chemical & Water Modelling
Spatial Analysis
GIS Services

PO Box 1777
Thuringowa Qld, 4817, AUSTRALIA

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Mob: [redacted]

info@candrconsulting.com.au
www.candrconsulting.com.au

COMMERCIAL IN CONFIDENCE

DATE: 01 MARCH 2011 **PROPOSAL NO. 1107**

Proposal For

CENTRAL HIGHLANDS REGIONAL COUNCIL

For services in

FLOOD MANAGEMENT

(A) UPPER NOGOA RIVER - FAIRBAIRN DAM CATCHMENT: ASSESSMENT AND EVALUATION

(B) FAIRBAIRN DAM SPILLWAY TO DOWNSTREAM OF EMERALD: URBAN FLOOD PLAIN ANALYSIS

PROPOSAL:

C&R Consulting have considered the above project in detail and for ease of discussion, the project has been divided into two (2) sections according to the geographical positioning of the two catchments:

Section A: Upper Nogoa River - Fairbairn Dam Catchment Assessment and Evaluation, and

Section B: Fairbairn Dam spillway to downstream of Emerald (above junction with Theresa Creek) - Urban Flood Plain Analysis.

The tasks required for the two studies have been developed in response to discussions with the Central Highlands Regional Council. Again, for ease of understanding, the two tasks are detailed separately.

It should be noted that this quotation is not intended as a whole-of-catchment study. This study is specifically directed to the streams and rivers directly impacting on the town of Emerald. Therefore, the Nogoa River catchment referred to in this study extends from the top of the system shown on official maps as the Nogoa River to the Fairbairn Dam, and from the Fairbairn Dam spillway to upstream of the junction with Theresa Creek.

SECTION A: UPPER NOGOA RIVER - FAIRBAIRN DAM CATCHMENT: ASSESSMENT AND EVALUATION

TASKS:

- Determination of gaps in present and historical information in regards to stream flow and rainfall data (i.e. gaining a better understanding of the size of the event in all sections of the catchment).
- Compilation, analysis and mapping of rainfall data during the months of September, October, November and December 2010 prior to, and during the event ending January 20 2011.

- Definition of catchment boundaries.
- Detailed geological, geomorphological, soil, vegetation and surface hydrological mapping of the upper, middle, and lower catchments, including all sub-catchments.
- Identification of stream flows in all sections of the catchments with a focus on volumes, velocities and timing.
- Identification and validation of flow transport processes through the catchments.
- In-field assessment of soil permeability, runoff coefficients, and infiltration capacities. Need to do this on a wet and dry season basis.
- Discussions with Landholders to ascertain anecdotal information and possibly further define gaps in current knowledge.
- Model calibration using all data collected from the 2008 and the 2010/2011 flood events.
- Forensic geomorphic and hydrological analysis to establish historical evidence of extreme flow events within sections of the catchment.
- Analysis of climate and weather patterns throughout the catchment using all available data.

A breakdown of these tasks has been included in the attached Table of Works. C&R Consulting will provide highly qualified and experienced staff to perform the required tasks.

SECTION B: FAIRBAIRN DAM SPILLWAY TO DOWNSTREAM OF EMERALD: URBAN FLOOD PLAIN ANALYSIS

TASKS:

- Collection of historical data (e.g. the 2008 & 2010/11 floods and earlier floods) in regards to river heights and flows through the town of Emerald. This would also include information and assessment of other features such as rate of rise and fall, the shape of the rise and fall curves from the Emerald gauging station in relation to Fairbairn Dam discharge.
- Discussions with households and business owners to validate the actual heights and timing of water levels in all sections of the flood plain.
- Collection of all design information in regards to major infrastructure (e.g. Vince Lester Bridge, railway line and associated infrastructure, SunWater Drainage System, Council Drainage Structures).
- Detailed assessment of the impacts caused by infrastructure, including affluxes and concentrations of flows from Fairbairn Dam to downstream of Emerald.
- Detailed Model calibration using suitable flood models which more adequately replicate infrastructure as flow impediments ("levees") across the flow pathways and attempts to calculate flow heights and velocities induced by the impediments and flow constrictions to achieve a more accurate replication of the past two (2) events (2008 and 2010).
- Undertake detailed model scenario runs across the flood plain at different flow volumes through the Fairbairn Dam
- Define geomorphic behaviour of critical sections of the river system that may affect flood capacity and preferred flow pathways. Stream migration and aggrading stream reaches can drastically affect flood behaviour.
- Deliver recommendations on the ability of current infrastructure and future planning programmes to achieve better outcomes for the movement of water through and across the flood plain.

A breakdown of these tasks has been included in the attached Table of Works. C&R Consulting will provide highly qualified and experienced staff to perform the required tasks.

OUTCOMES

1. **Catchment Understanding:**
   - Knowledge of the climatic and weather patterns likely to trigger similar events.
   - In-depth understanding of the 2008 and 2010/2011 events.
   - Increased ability to assess the probability of future events.
   - Formulation of the prediction of downstream flows.
   - Recalibration of current models to gain a better understanding of the Average Recurrence Interval and Annual Exceedance Probability (ARI and AEP) relevant to the area, and the inherent uncertainties in these values caused by statistical assumptions and short data sets.
   - The potential ability to establish a risk based management plan to minimise the impacts of future events on downflow receptors (i.e. Emerald).

2. **Urban Flood Plain Understanding**
   - A greater understanding of flow pathways, heights, flow velocities etc. through the urban area of the flood plain to provide a better understanding of the risk to life and property.
   - A greater understanding of the stability of the current flow pathways and the likelihood of sudden changes in preferred flow pathways.
   - Ability to adequately identify evacuation requirements and evacuation points.
   - Increased notification and evacuation period before the event hits the urban areas.
   - Provision of information to assist individuals in making their own decisions in regards to protection of property and evacuation.
   - Production of flood preventative plans for present and future development.
   - A better understanding of the probable failure of service infrastructure for the town (e.g. water treatment plant, major power installations, sewage, rail and road).
   - Provision of quantifiable information to assist in improvements to present and future major infrastructure to improve water flow through the flood plain.
   - Provision of suitable information to better assess future development and probable impacts within urban areas.
   - Ability to identify inundation areas at certain volumes of spill from the dam.
   - Reduced impact of down-time costs for redundant infrastructure.
   - Recommendations to improve the flow performance of the flood plain.
   - Ability to answer queries and concerns posed on variability of the impact across the flood plain.
   - A community that is more sustainable within its flood plain and therefore better able to achieve a superior degree of risk management towards both the physical and social infrastructures of the town.
   - Provide residents with a greater degree of comfort that they are relatively safe
   - Provide council with an improved ability to direct specific development types to defined areas.

3. **Infrastructure Assessment and Evaluation:**
   - Ability to assess infrastructure that will benefit from replacement with more appropriate designs.
   - Ability to assess the need to modify new and existing infrastructure to improve sustainability within the current regime of catchment dynamics.
   - Ability to evaluate location and design of future sustainable infrastructure downstream of the upper catchment.
   - Ability to design and implement sustainable planned building programmes and infrastructure expansion projects within the catchment.
   - A thorough understanding of the catchment and the consequent ability to reduce down-time costs for redundant infrastructure.

4. **Improved assistance prior to, and during, an Event:**
   - Delivery of rapid information to ensure risk management within both towns and catchment areas is maximised.
   - Extrapolation of the principles found in this investigation to the boundaries of the Central Highlands.

This project relies on the intrinsic knowledge of C&R staff of the flooding processes operating in the Nogoa River Floodplain. This knowledge has been gained from previous works and a long history of working in the area. This report will be targeted towards using real and interpolated data to allow the Central Highlands Regional Council to gain an appreciable understanding of flooding processes within the study area. Whilst multiple models will be used in this assessment, they will be used to inform the knowledge of C&R Consulting to provide the deliverables, rather than being the aspect described in final reports. This allows C&R Consulting to provide:

- An assessment that can be easily interpreted by a wide variety of individuals.
- Processes and results of flooding assessments being actively described in the final reports in a manner that is easily understood.
- Final reports reflecting on-ground conditions that can be quickly evaluated by Council's local knowledge of the area.

PAYMENT FOR SERVICES:

Our costs for undertaking the above tasks are provided as part of the attached Table of Works and Cost Structure detailed on Page 7(p7).

The following services and resources are included in this payment:

- Project Management
- Project Supervision
- Administration and Associated Costs
- Vehicle Hire, Fuel, Travel Costs and Subsistence
- One (1) electronic Draft copy of the report
- Three (3) hard copies and one electronic (CD) copy of all reports

Note: In the event the report is more than 200 pages in total, C&R reserve the right to charge for more than one hard copy. If there are multiple reports combined to make up the overall report, only one hard copy will be provided. Additional copies will be charged at the applicable printing rate.

C&R Consulting reserve the right to impose a surcharge on any outstanding payments.

Our Terms:

C&R Consulting, through discussions with the Central Highlands Regional Council, will establish a payment scheme based on completion of specific milestones as set out below and in accordance with the Table of Works and Cost Structure detailed on Page 7.

Milestone 1: (Contract Awarded)	25% of payment upon signing of contract for each Section
Milestone 2: (Section A):	Invoices will be raised on completion of each task,
Milestone 3: (Section B):	Invoices will be raised on completion of each task.

Time for completion will be approximately nine (9) months from receipt of commission notice. C&R would prefer to complete the project prior to the commencement of the 2011 wet season (end of September). However, this may be delayed in the event that commission is delayed and existing commitments, unforeseen weather, or the inability to access required data, impede the initiation or completion of the investigation).

In the event the Scope of works is changed by the Central Highlands Regional Council, C&R reserve the right to submit an amended proposal.

Data Requirements

In order to complete this request for quotation, C&R Consulting require the following data from the Central Highlands Regional Council:

Required:

- All catchment data and relevant information currently held by Council.
    - Topographic data.
    - Design drawings for relevant infrastructure, where available.
    - Soil mapping, where available.
    - Current and historical aerial photography, where available.
    - Discharge and rainfall data held by Council, where available.
    - Previous flooding investigations for the area under consideration.
    - History of land use change and inputs into the study area, where available.
    - Current zoning / precinct maps.
    - All aerial photography, landsat and other satellite imagery as available, soils maps, geology maps, historic rainfall and river discharge data, local recordings, etc, held by Council.
    - Landholder contact information along the studied streams.
    - KBR infrastructure data.

It is our understanding that KBR have been engaged by the Central Highlands Regional Council to provide adequate data relating to this project. Should C&R be unable to obtain this data from KBR via Council, we reserve the right to charge an hourly rate for any data collection obtained by our staff specifically for this project in order to complete the project within the nominated timeframe (as per our Terms above).

Agreement

To accept this proposal, please complete the attached 'Authorisation and Agreement' form with the relevant contact details and signature, and return it to C&R Consulting.

Contact Details

Geoff Kavanagh
CQ Office Manager / Hydrologist
Ph [redacted]
[redacted]

Dr Cecily Rasmussen
Company Director / Geomorphologist
[redacted]

If you have any queries regarding this quote, please feel free to contact me at any time.

Kind Regards,

Geoffrey Kavanagh
Office Manager / Hydrologist
Central Queensland Office

TABLE OF WORKS AND COST STRUCTURE FOR UPPER NOGOA RIVER – FAIRBAIRN DAM CATCHMENT ASSESSMENT AND EVALUATION

TASK	TIME (Hours)	RATE/ HOUR $	COST $
SECTION A: Upper Nogoa River - Fairbairn Dam Catchment: Assessment and Evaluation			
• Compilation and analysis of climatic data	60	185	11,100.00
• Terrain Evaluation	100	180	18,000.00
• Historic and Forensic Terrain Evaluation	60	185	11,100.00
• Stakeholder Consultations	80	150	12,000.00
• Modeling and Calibration of Models	200	250	50,000.00
• Detailed Catchment Mapping	120	185	22,200.00
• Report Compilation and Presentation	80	150	12,000.00
		Sub Total Section A	$136,400.00
• Consumables (Transportation, Accommodation, Administration, etc) @ 15%			$20,910.00
		Total Section A	**$157310.00**
SECTION B: Fairbairn Dam Spillway to Downstream of Emerald: Urban Flood Plain Analysis			
• Collection and compilation of historical data	60	185	11,100.00
• Terrain Evaluation	80	185	14,800.00
• Historic and Forensic Terrain Evaluation	60	185	11,100.00
• Stakeholder Consultations	70	150	10,500.00
• Modeling and Calibration of Models. • Detailed Model Scenario Runs across Catchment	120	250	30,000.00
• Detailed Catchment Mapping	60	185	11,100.00
• Report Compilation and Presentation	80	150	12,000.00
		Sub Total Section B	$106,100.00
• Consumables (Transportation, Accommodation, Administration, etc) @ 15%	16215		16,350.00
		Total Section B	**$116950.00**
		Total Section A	**$157310.00**
		Total Section B	**$116950.00**
		Totals Sections A and B (excluding GST)	**$274260.00**
		GST @ 10%	**$27,426.00**
		TOTAL (GST Inclusive)	**$301,686.00**

C&R Consulting (Geochemical and Hydrobiological Solutions) Pty Ltd

Facsimile Cover Sheet	
To: C&R Consulting	[redacted]
From:	Date:
Subject: Authorisation and Agreement	No. of Pages (Including this one): 1

Authorisation and Agreement

C&R Consulting and the Client, Central Highlands Regional Council, hereby understand and agree to all terms and conditions as set out in the above proposal (**Proposal No. 1107**) for the delivery of services and have executed this Agreement on the dates given below.

Upon acceptance of this proposal, a contact manager will be appointed to the project. Your contact officer is named in the Contact Details section of the proposal. Please provide your contact details below and add details of any other person who will act as your organisations contact person for this proposal.

SIGNED for and on behalf of

C&R Consulting (Geochemical and Hydrobiological Solutions) Pty Ltd

By Mr Geoffrey Kavanagh
Name

[redacted]

Signature

Central Queensland Manager
Position

Date

SIGNED for and on behalf of

Central Highlands Regional Council
Name of organisation

By
Name

Signature

Position

Date

PAYING CLIENT (if different from Authorising Client)

Organisation

Contact Name:

Position:

Postal Address:

Phone:

Email:

Organisation's contact person/s for this proposal

Name

Position:

Phone:

Fax:

Mobile:

Email:

Attachment 7

C&R CONSULTING

Geochemical & Hydrobiological Solutions Pty Ltd

ABN 72 077 518 784

Central Queensland

HydroGeomorphic Terrain Evaluations
Water Planning and Management
UCG and CSG Assessments
Groundwater Management
Clay/Soil/Water Reactvity
Geochemical Modelling
Water Flow Modelling
Mine Water Disposal
Petrography

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Emerald Qld, 4720, AUSTRALIA

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Mob: +61

info@candrconsulting.com.au
www.candrconsulting.com.au

Nogoa Catchment Flood Management Interim Report

C&R Consulting Pty Ltd

20th June 2011

IMPORTANT NOTE

[redacted]

Cecily Rasmussen
Director

20/06/2011
Date

[redacted]

Christopher Cuff
Director

20/06/2011
Date

[redacted]

Geoffrey Kavanagh
Water Management/Mine Site Specialist

20/06/2011
Date

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LIST OF FIGURES

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Figure 2: Emerald Nogoa Catchment Location in Queensland 6

1. INTRODUCTION

C&R Consulting were commissioned by the Central Highland Regional Council (CHRC) to undertake a detailed Flood Management Analysis and Evaluation study of the Upper Nogoa River catchment above the Fairbairn Dam and including the Fairbairn Dam Spillway to downstream of the Emerald: Urban Flood Plain. The commission was in response to the re-occurrence of flooding in the Emerald area (i.e. January 2008 and December/June 2010).

The tasks required for the two studies have been developed in response to discussions with the Central Highlands Regional Council and is specifically directed towards the streams and rivers directly impacting on the town of Emerald. Therefore, the Nogoa River catchment referred to in this study extends from the top of the system shown on official maps as the Nogoa River to the Fairbairn Dam, and from the Fairbairn Dam spillway to upstream of the junction with Theresa Creek.

The studies have been undertaken to increase the range of knowledge of the area and ultimately to understand how it functions as a catchment. Once an understanding is gained, management approaches in relation to sufficient notification & evacuation, prevention and reduced damages can be developed accordingly.

1.1 SCOPE OF THE PROJECT

This Interim Report has been constructed to brief the CHRC on the progress of the Flood Management Analysis and Evaluation study; Upper Nogoa River – Fairbairn Dam Catchment: Assessment and Evaluation.

The study will investigate the formation, magnitude, periodicity, and history of events similar to the 2008 and 2010/2011 flood events. The investigation will require site assessments, information sessions with local residents and historical groups, fluvial characteristics of the catchment and the river systems, climatological assessment of the region, forensic geomorphic and hydrological analysis and a determination of any gaps in present and historical information in regards to all components of the Upper Nogoa Catchment. Compilation of this soft data has allowed many gaps to be filled and a clearer understanding of the size of the event in all sections of the catchment.

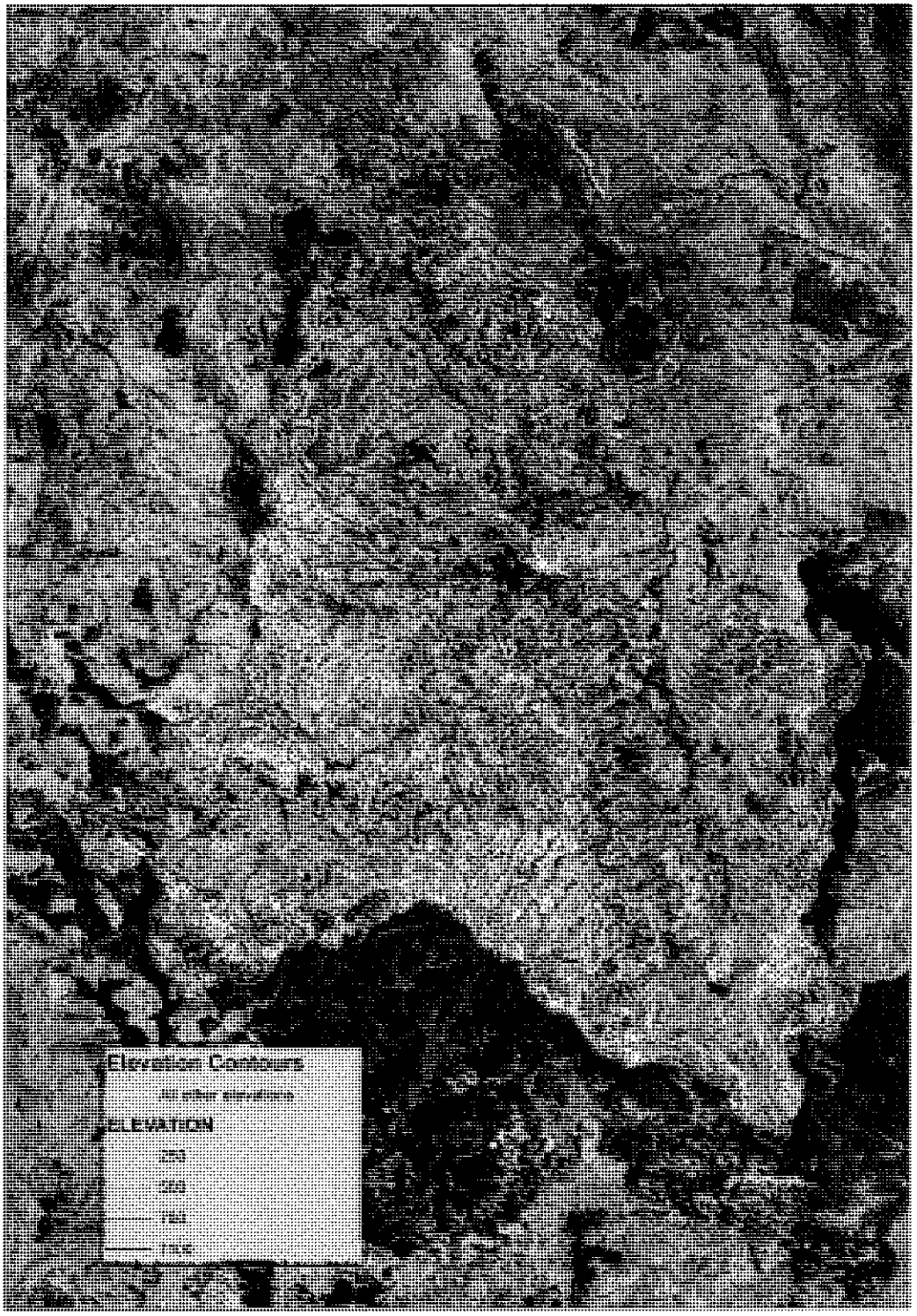
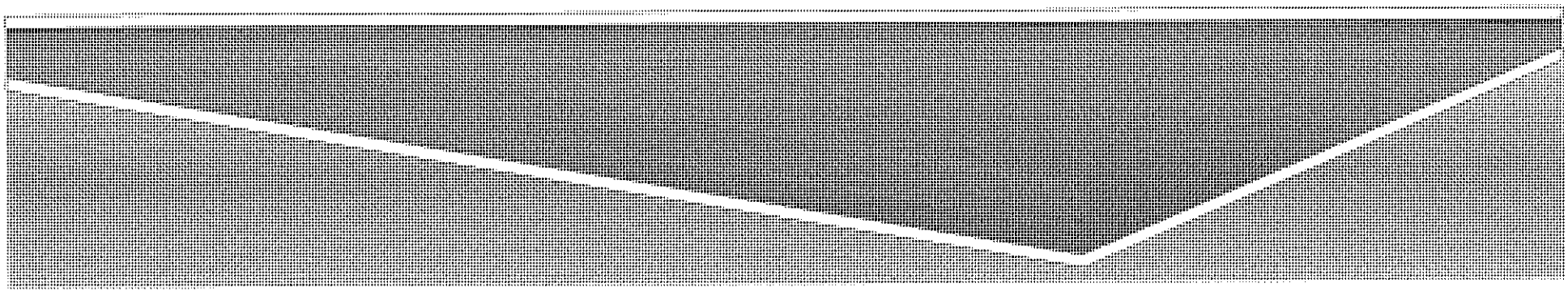


Figure 1: Nogoa River Catchment

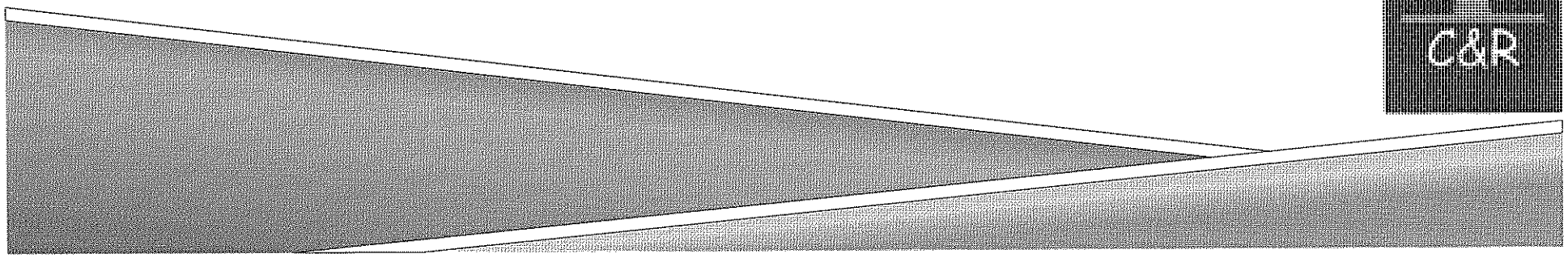
EMERALD FLOOD EVENTS NOGOA CATCHMENT

Geoffrey Kavanagh
C&R Consulting Pty Ltd



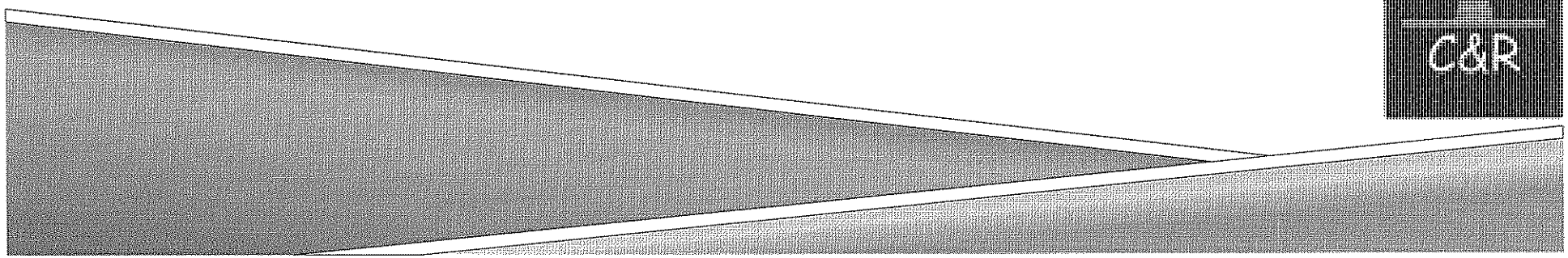
COLLECTED – NOGOA CATCHMENT

- Rainfall data from landholders, householders, CHRC, BoM and DERM.
- Photos from landholders and householders during flood events
- Reencounters (stories) of peaks and stream movements
- Measured water through river beds and across flood plains
- Measured and recorded extremities along the streams/rivers
- Establishing a database available for use off Google earth – includes images, notes, rainfall data and locations of 2008 and 2010 floods in the area
- GRV mapping of flood plains and cross sections
- Geomorphology of the upper catchment



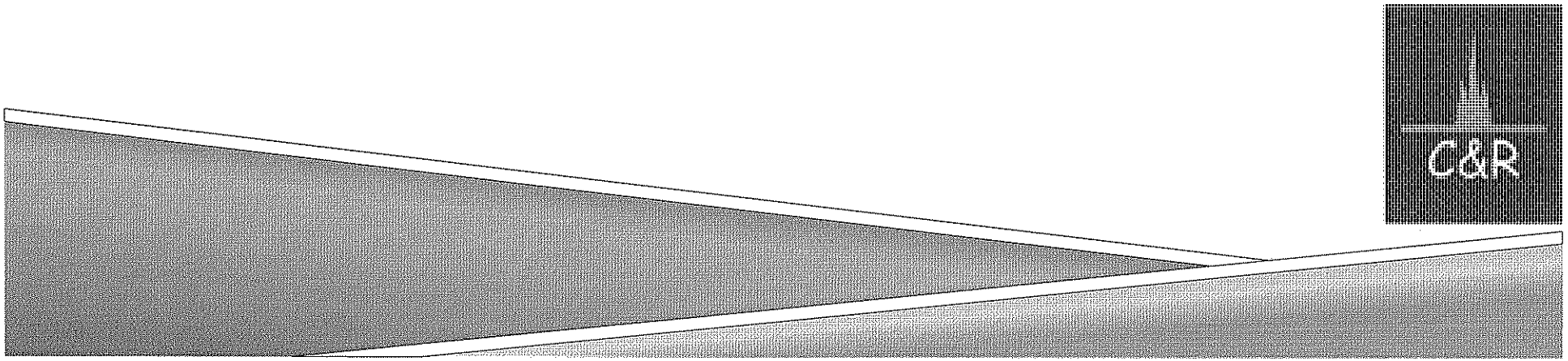
CATCHMENT STUDY OUTCOMES

- Probability status of the 2010/11 event. E.g. ARI or AEP Was it bigger or smaller than a 1 in a 100 or 1% chance.
- With all the current available data what is the 1:100 or 1% probability for Nogoa catchment and the town of Emerald.
- The understanding of worst case flooding outcomes for Emerald E.g. A 1 : 1000 year event.
- The construction of a rainfall run off model to be used by council and agencies leading up to and during a event.
- Detailed model runs through the town of Emerald using the flood height data from 2008 and 2010/11 to establish any flow impediments caused by infrastructure.
- The establishment of a data base that can be added to and utilized by all.



WHERE TO FROM HERE?

- Data collection almost complete
- Collection of data from Council in the next 5 days
- Modelling to start in the next 2 weeks
- Still on target for the 30th September



Attachment 7 _ [redacted]

YOUR REF: 6BW032-M-S110121
OUR REF: Flood Plain Management Project
CONTACT NAME: [redacted]
FAX: [redacted]
EMAI[redacted]
Central Office, PO Box 21 Emerald Qld 4720

21 April 2011

KBR
GPO Box 633
Brisbane QLD 4001

Attention: [redacted]

Dear Sir,

Variation Two – 2010 Flood Event Data
CHRC Flood Audit and Gap Analysis

KBR have commenced conducting an audit of flood information and a gap analysis of this data on behalf of Council. The Emerald area and its surrounds recently experienced a flood event at the end of 2010 that impacted on existing government infrastructure and will affect future planning associated with government infrastructure.

To enable Council to be in an informed position we are requesting the preparation of a Policy Paper to identify and investigate impact of recent floods on existing and proposed significant government infrastructure at Emerald and its surrounds to enable an examination of how best to manage the future provision of infrastructure by all levels of government

This variation has previously been discussed with your firm at the inception meeting on the 22 February 2011 and later teleconference on 23 March 2011. It is now confirmed that Council would like to proceed with this variation and forwards the following specifications for a quote for this work to be undertaken.

Original Scope of Work

Audit Phase

The sourcing of information is the first phase of Floodplain Management Study (FMPS) and is embedded in the original project in the Flood Audit component.

- The company is already gathering pertinent data during the audit phase as it liaises with Council and State Government agencies follows:

i Locate existing significant Local, State and Federal Infrastructure in Emerald and surrounds.
ii Ascertain impact of flood of operation of infrastructure and extent of damage. (vulnerability and economic assessment)
iii Locate existing risk assessments, hydraulic analysis and as constructed details of government infrastructure
iv Locate studies and risk assessments for proposed government infrastructure.

The inclusion of this variation may result in more targeted and detailed requests in regard to government infrastructure than would otherwise have been the case.

Variation 2: Scope of Work

The State Planning Policy 1/03 'Mitigating the Adverse Impacts of Flood, Bushfire and Landslide' contains a brief for carrying out a FMPS that includes the affect of flooding on government infrastructure and proposed mitigation strategies for existing and proposed infrastructure, including relocation of infrastructure. A part of this task will be brought forward in the form of a policy paper that will be an input into the later FPMS.

The Policy Paper is to identify existing government infrastructure that was negatively impacted by flooding and any existing or proposed government infrastructure that is being considered for relocation post the flood event. The Policy Paper is to consider the following ramifications:

i Does the location of the infrastructure address existing and future flood problems.
ii Flow on impacts on the infrastructure network if one or more elements is relocated.
iii Indicative cost / benefit in terms of social, economic and environmental impacts.
iv Implications for Council forward programmes and Emerald's settlement pattern.

Deliverables

Audit phase

The information sourced in relation to government infrastructure will be incorporated in the indexed central archive, and where required, material converted into a common digitised database system.

Analysis phase

Draft Issue Paper	17 June 2011
Final Issue Paper	30 June 2011

Timing and Fees

In undertaking this variation, as described in the above scope of work, it is proposed that same project team be utilised for the variation as are currently assigned to the ongoing flood audit. The quote should contain an estimation of hours for this variation. The fee should be based on an estimation of the proposed pay rate of the project team members and the number of hours required for the tasks to create a comprehensive audit database.

The quote should clearly state the fee for professional services and GST components.

It is envisaged that KBR will invoice Council for the full variation fee amount upon satisfactory delivery of the Policy Paper and that the terms of payment would be 30 days.

Documentation of Variation

It is requested that you prepare a quote for Council's consideration.

If you have any questions about our proposed scope of work or other matters, please do not hesitate to telephone and we can discuss any aspects that require clarification.

Yours faithfully,

[redacted]
Manager Environment and Planning