Final Report of the Deliberations of the

Burnett River Floodplain Action Plan

Community Reference Group

December 2013

Aerial view of North Bundaberg and Bridges January 2013

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Executive Summary

The Burnett River Floodplain Action Plan Community Reference Group (CRG) was formed in September 2013 to engage and consult with the community at large and provide to the Bundaberg Regional Council a report by early December 2013 regarding the results of that consultation. In particular the role of the Group was to attend the Community Consultation Meetings to gather the information required from the attendees. At the conclusion of the community engagement phase, the CRG had received around 243 submissions from members of the community. The Group then was required to discuss and agree on suitable weightings to be used in a Multi Criteria Assessment (MCA) which was being conducted by consulting engineers GHD.

Following agreement of the weightings, the CRG was required to consider all submissions received, filter and group the submissions into options for mitigation and arrive at agreement as to which grouped options would be forwarded for MCA analysis by GHD. At the conclusion of the analysis, GHD returned the options, weighted against the agreed weightings. From those options, the CRG then were in a position to advise Council as to which options the CRG believed were suitable for further detailed analysis including design and costing. The role as contained in the terms of reference required five (5) options to be detailed. However, following lengthy discussion and further consultation with Council and GHD, the CRG grouped several similar options together and arrived at a total of seven (7) options to report to Council. In summary, the options as reported in this document are:

- East Bundaberg Levee and Floodgate Option (Option 2 Weighting 1);
- Regional Bridge Upgrades (Option 38 – Weighting 2);
- Lower level North Bundaberg Levees and Evacuation Route Upgraded (Conjoined Option 10 and 39, Weighting 3 and 7) – This option also includes further discussion regarding combination with channels and other mitigation measures;
- Funding for house raising / restumping (Option 40 Weighting 4);
- (Selective) Dredging of the Town Reach (Option 23 Weighting 6);
- (Selective Dredging and widening of Millaquin Bend (Conjoined Option 25 and 31 – Weighting 8 and 10); and
- Removal of Fairymead levees (Option 26 – Weighting 16).

The Group wishes to make it clear that the options listed above are NOT in any order of priority except listed as they rated in the MCA weighting program. The CRG has purposefully not prioritised the options as there is significant further research and analysis on each option prior to reaching project phase which may alter any priority placed on the option.

During it's engagement phase, the Community Reference Group also received a large number of submissions which were not directly reportable as options. The CRG believed some of the matters to be of significant importance to report to Council in the form of recommendations as diverse as strategic planning for the health of the river, to

negotiation with the Insurance Council and companies to reduce premiums for flood affected areas. The recommendations further reported in the report consist of:

- Development of a 50 Year Plan for a Healthy Burnett River;
- Research the effect the Ben Anderson Barrage and Bingera Weir has on the health of the River;
- Reopen Skyringville Passage (Option 30- Weighting 18);
- Insurance Premium Relief;
- Re-introduction of compulsory flood searches when purchasing real estate;
- Implementation of a system of flood markers;
- Enhancing early warning and response;
- Identify evacuation routes; and
- Paradise Dam issues.

The Community Reference Group recognise that their deliberations will be presented to the Bundaberg Regional Council for consideration once adopted by the Group as per the Terms of Reference. The CRG strongly recommends that the Council release the report to the public as soon as possible to facilitate public comment and debate. It is understood that the contents of the report, together with deliberations of the Technical Working Group, Council and Consulting Engineers GHD will be considered in finality to establish the mitigation projects that will be progressed.

The members of the Community Reference Group commend this report as a record of their deliberations, discussions, options and final recommendations regarding contribution to the Burnett River Floodplain Action Plan.

REPORT OF THE FLOODPLAIN ACTION PLAN COMMUNITY REFERENCE GROUP

1. INTRODUCTION

1.1 In late January 2013, the Burnett River and it's catchment streams were subject to rainfall and weather events caused by Tropical Cyclone Oswald. Whilst the cyclone itself had diminished into reasonable insignificance, the event proved to have significant longevity and caused unprecedented flooding in the North Burnett and Bundaberg Regional Council areas. Many communities were decimated, including large portions of rural and agricultural land and urban areas, particularly North and East Bundaberg. Many rural communities suffered significant loss of dwellings, infrastructure and community disruption. A number of communities were isolated for lengthy periods (weeks in some instances) and were without power, communications, food and fresh water. The privation and disruption was recognised at the time as being the main focus of local, state and federal resources to respond and ultimately move to recover from the disaster.

1.2 The Bundaberg Regional Council (BRC) is responsible for local governance of a significant portion of the Wide Bay-Burnett region, including the Burnett River and catchment streams from Paradise Dam to the river mouth at Burnett Heads. Following the devastating floods of 2010-2011, the BRC commissioned a study of the River to both better understand the impacting factors involved and more importantly to move to mitigate against or at least manage future events to protect life and property. More recent history showed that the river reached higher and clearly unprecedented levels in January 2013, before completion of the study or any substantial mitigation was attempted. Ultimately, the 2013 event set the precedent level to underpin any actions which resulted from the study.

1.3 Following the floods in Bundaberg two flood forums were convened at the Bundaberg TAFE, to discuss the perceived inaction of Council and other government departments to assist the residents particularly of North Bundaberg. These forums were well attended, well publicised and provided a means of venting the communities' frustration regarding perceived inaction. Council also attended to inform the attendees of what was occurring post flood in the recovery process and the future.

1.4 Concurrent with the flood study, the Burnett River Floodplain Action Plan process was commenced to manage the outcomes of the study, identify and understand the risks to the communities associated with the Burnett River flood plain. This included identifying strategies, planning and implementing disaster preparedness, and flood mitigation strategies to protect the community. One of the pillars of the Action Plan was the formation of a Community Reference Group (CRG) *"to liaise between Council and the community to help inform the development of floodplain management options and strategies as part of the Burnett River Floodplain Action Plan project work."* ***(Source: Burnett River Floodplain Action Plan Community Reference Group Terms of Reference)***

2. GROUP COMPOSITION

2.1 The CRG was convened following expressions of interest from members of the community. Selection of the Group was administered by Bundaberg Regional Council and calculated to provide a balanced mix of skills, experience and background amongst participants. The position of an independent Chair of the Group was selected by Council and selection of that position was from those who answered the call for expressions of interest. The members of the group are:-

Kay Amsler	Pine Creek/Givelda/Electra representative
John Bailey	Wallaville and agriculture representative
Rowan Bond	Chair of the Group
Jon Carman	Burnett Catchment Care Group representative
Steve Cooper	Business representative
Helen Dayman	Goodnight Scrub and upper catchment representative
Barry Ehrke	Recreational and Commercial fishing, boating and tourism representative
Christine Hardy	North Bundaberg representative endorsed by Flood Forum
John Lee	North Bundaberg representative
Rob Marshman	Urban Development Institute of Australia (UDIA) representative
John Olsen	Commercial fishing background and endorsed by Flood Forum
Mark Pressler	Canegrowers and agriculture representative

2.2 Member Christine Hardy resigned from the Group after the first meeting however, her position was left vacant to facilitate her return should she wish to do so.

2.3 As Chair of the CRG, it would be remiss not to acknowledge and pay tribute to the positive attitude and passion of the members of the Reference Group. There was a uniquely balanced mix of expertise, experience and local knowledge within the group and all members interacted with sensitivity to the other members whilst still making sometimes controversial points within the discussion. Whilst discussions were sometimes robust, there was a genuine and clearly observable passion for representing their community, group or organisation to the best of their ability.

3. TERMS OF REFERENCE

3.1 The Terms of Reference underpinning the operations of the Group were compiled prior to the inaugural meeting of the CRG and were subsequently adopted at that meeting as being the Terms of Reference of the Community Reference Group. A copy of the full Terms of Reference is contained in Appendix 1 of this document. The role of the CRG as defined in the Terms of Reference is reproduced hereunder for clarity and understanding of the task required and contained in this report:-

1.2 Role

- *Provide input into the development of the Burnett River Floodplain Action Plan;*

- *Gather the collective thoughts and ideas from their respective networks to help to identify and assess a range of suitable Burnett River floodplain management options;*

- *Communicate information and update their respective networks to ensure they are kept informed of the project's progress;*

- *Act as a conduit for community feedback on the plan's development to the consultant (GHD) and Bundaberg Regional Council;*

- *Participate in the project's public consultation program to help encourage the gathering of ideas and feedback from the community, in order to confirm a filtered set of options to test during a Multi-Criteria Assessment (MCA);*

- *Collectively agree to the floodplain management options assessment criteria and weighting used during the Multi-Criteria Assessment (MCA). The MCA will be the primary tool used to confirm the top options to undergo detailed assessment if required and;*

- *Represent the community by submitting a report to Council in early December 2013 detailing the CRG's preferred list of floodplain management options. This will be facilitated by the chairperson and require 70% consensus of the CRG members.*

4. METHODOLOGY

4.1 The methodology used for the CRG was to hold a series of meetings to discuss and consider matters relevant to the above role, in consultation with representatives from the BRC and consulting engineers GHD. Members of the Group also attended all community consultation meetings held in 10 locations in the local government area in September to discuss the project and receive feedback directly from the members of the public attending the consultative meetings. The consultation meetings were held both within Bundaberg City and also outlying rural areas at the following times and locations:

Tuesday, September 24

North Bundaberg Progress Hall – 3pm; 5pm and 7pm. Sessions are 90 minutes.

Wednesday, September 25

North Bundaberg Progress Hall 7am to 9am; East State School Hall 5pm and 7pm

Thursday, September 26

St. George Hall (near South Kolan School) – 5pm to 7pm

Friday, September 27

Wallaville Hall – 5pm to 7pm

Saturday, September 28

Avoca State School Hall – 9am to 11am

Wednesday, October 2

Goodnight Scrub Community Hall

4.2 CRG representatives found the community participants to be positive and willing to share their insight, experiences and views at all community sessions. This feedback was in the form of written questionnaires, direct discussion and invitation to provide feedback at a later date. To facilitate this, the CRG opened and advertised an independent email address pertaining to the Group floodplaincrg@gmail.com, so that the Group could be contacted directly and independently with feedback. Council had also advertised an email address for submissions being floods@bundaberg.qld.gov.au which also received feedback from the community. Ultimately, some 243 submissions were made via the various communication methods. Feedback and submissions from all available sources were collated and made available to the CRG to ensure that the Group had all information available from the community to assist with their deliberations. Collated list of options are contained in Appendix 3.

4.3 As required by the above role, the CRG also met, discussed and agreed on the weightings to be used for the Multi-Criteria Analysis (MCA) being performed by GHD to filter and rank the various proposals. The outcome of those deliberations including the MCA matrix is contained within the minutes of the meeting held on the 8th October 2013 and contained in Appendix 4.

4.4 The Group then met to consider the five (5) project options which would carry the highest merit to place before Council as representative of what the community desired. At the conclusion of the meeting held on the 19th November, the Group actually agreed that seven (7) projects were worthy of taking forward per the Group's role. Additionally, the CRG determined that a number of matters were of sufficient importance to the Group that they should be reported on as recommendations of the Group. These matters were either of a more strategic nature, or were matters that did not fall within the flood specific role of the Group however, members felt it necessary to bring them to the attention of Council. Those recommendations are respectfully outlined later in this report.

5. WHY SOME OPTIONS WERE NOT SELECTED

5.1 As indicated, there were some 243 submissions to the Group which distilled into about 150 options. Deliberations of these options were conducted using rigorous debate, use of expertise and local knowledge, and seeking dialogue with GHD engineers for advice where necessary. Some of the options that reached preliminary short listing or discussion were discounted by the Group following such debate. Whilst it is not the intention of this report to outline in detail why options did not elevate to the final shortlist, it is prudent to outline some of the popular options, and outline reasons why those options were not eventually listed as the

Group's choices.

5.1.1 *Channel from the vicinity of Woongarra Pumping Station to the vicinity of the Elliott River and outleting into the sea south of Elliott Heads.* This option has merit at first inspection, as it would appear to enable a significant quantity of water to be diverted from the Burnett River, upstream of the city, and take it to sea in a far less populated area. The immediate concern of the CRG was the impact this proposal would have on the Elliott River itself and the communities downstream of the proposed channel. Further, the engineering requirements were estimated for such a venture and outlined to the Group. The channel would be required to be approximately 20 kilometers long, 500 metres wide and an average of 17 metres in depth. This is worked on the channel commencing at 5metres AHD and proceeding downstream to the Elliott River where its contour would be 0 metres AHD to allow sufficient fall to have relevant flows. It is estimated that earthworks would be required to remove a volume of 100 million cubic metres of earth to dig the channel. Even at a very conservative $10.00 per cubic metre, the cost of earthworks alone is one billion dollars ($1B). At the conclusion of such a project, a channel of that magnitude would flow approximately 3000 cubic metres of water per second. Flow in the river during the 2013 flood was estimated at approximately 17,000 cubic metres per second, therefore such a channel would remove significantly less than 20% of the floodwater of a flood of that magnitude, and the small benefit gained would only be felt downstream of the channel diversion. The project has obvious repercussions to communities as large scale resumption of land would be required, and some residents would be isolated in their homes as a result of the project. Faced with the repercussions and the seemingly poor cost benefit ratio to the community, the option was not proceeded with in discussions.

5.1.2 *High levees in North Bundaberg (Options 3, 6, 7, 8, 9).* The Group was desirous of furthering any option that prevented or minimised floodwater ingress into North Bundaberg. Frustratingly, the levels and velocity of the waters during the 2013 flood set a precedent as to the level of difficulty to achieve meaningful remedy to the area. The above options were closely considered in light of protection of the businesses and residences, particularly in those areas most affected. Preliminary design indicated the levees would have to be about 3 metres in height. North Bundaberg is built on a predominately sand based flood plain; therefore levee structures of this height would have poor foundation material to be constructed on. The modeling indicated that such options would increase floodwaters on the southern side of the river (East Bundaberg), increase velocity of water in the river itself, and the velocity of water along the face of any of the levees in the options would be such as to have a high chance of levee failure. This levee failure, and the significant water levels introduced into North Bundaberg should the levees over-top were of great concern to the Members. The existence of levees does also come with an amount of complacency amongst the community who believe the levees will protect them in the event of any disaster. The failure of a high levee will have a catastrophic effect on the community and there is a real risk of significant loss of life as the high velocity waters are released in the event of a failure. Having regard to these matters, the anticipated high risk was unacceptable and the CRG members chose to deliberate on other options which included lower levels, dredging and other combinations of options.

6. LIST OF OPTIONS EMANATING FROM THE CRG DELIBERATIONS

6.1 As requested by Council, the Community Reference Group is pleased to provide their list of options that the Group believes will provide flood mitigation to the various communities of the Bundaberg Regional Council area. One of the great frustrations experienced by the Group, was the inability to advance a significant number of solutions which would protect the residents of North Bundaberg, arguably the most affected community in the 2013 floods. This is mainly because North Bundaberg is built largely on an active flood plain.

6.2 It should be noted that the options as outlined hereunder are NOT in order of priority but do reflect reasonably closely the order that were filtered and ranked by the MCA. No assumptions should be made as to the order of priority or importance placed on these projects by the Group. It should also be noted that the CRG was of the opinion that several options complimented each other and should be conjoined into one project for consideration. A notation has been made where this has occurred. Finally, substantial further work will have to be completed on the options before they would be viable for presentation for funding. Of paramount importance in subsequent reviews is the safety of people and that the utmost is done to protect their property. Any of the options/proposals related to the CRG recommendations should be subjected to a rigorous safety impact assessment related to increased risk for riverside businesses, boating, infrastructure, or increased water velocity or flood height. Risk minimisation strategies must be employed to ensure no collateral disadvantage or unnecessary loss is suffered as a result of the mitigation process. This includes further hydraulic and environmental studies, exact geographic location referencing, risk assessment and appropriately accurate designs and costings of each option.

6.3 East Bundaberg Levee and Floodgate (Option 2 Weighting 1)

6.3.1 Flooding of East Bundaberg and the CBD area consists of back up of water with little flow and suitable for control by levee and exclusion by floodgates. The assessment of this option delivered significant benefit in terms of protection of properties and protecting against economic loss, particularly with businesses. It is further noted that flooding of a significant number of private dwellings also occurred in the area which caused loss and hardship to those residents. This option is also noted to be a very expensive undertaking due to the substantial nature of works including the floodgates required to enclose Bundaberg Creek and the system of levees to protect the CBD and East Bundaberg. However, it would afford protection of a substantial section of the CBD including the entire Hinkler Shopping Centre and a large number of low lying residential areas to the east including an at risk retirement village.

6.3.2 The afflux maps provided are indistinct as to the exact location of the levees at this point in time. The maps appear to indicate that a number of homes and businesses will be on the river side of the levee, a situation which causes some alarm and dissatisfaction to CRG members. It is therefore recommended that considerable care is taken to situate any levee structure to protect as much property as possible and any structures remaining on the river side of the levee of a height subject to flooding, be resumed at commercial value as part of

this option. Safe anchorage can be found in the mouth of Bundaberg Creek for a small number of smaller vessels at present, however this option will remove the last remnants of safe anchorage during flooding in the vicinity. Safe anchorage options are explored in the CRG recommendations pertaining to the reopening of Skyringville Passage.

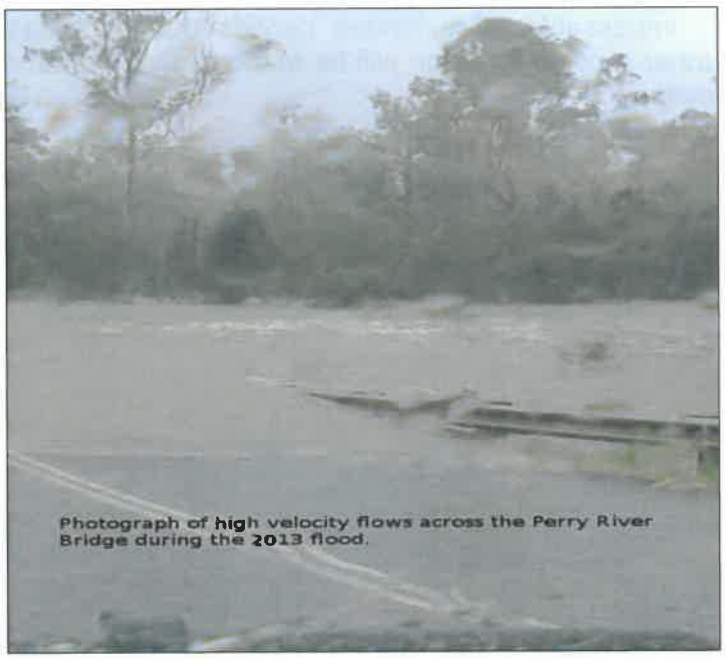
6.3.3 The CRG notes engineers concerns regarding cost, height of levee to contain 2013 levels (3-4 metres) and that infrastructure being roads, electricity supply, water, sewerage and storm water will require modification. It was noted that water displaced as a result of the levees situated at East Bundaberg would not impact on other affected areas including North Bundaberg. It was further noted that the Option regarding work at Millaquin Bend would reduce water levels in East Bundaberg by up to 60 cm. It is therefore critical that this option and Option 25/31 be investigated conjointly, as significant reductions in levee height may be realised by the dredging/widening of the River option.

6.4 Regional Bridge upgrades (Option 38- Weighting 2)

6.4.1 A constant source of frustration for rural communities is the inability to access shops, town, schools or work due to water levels. The reasons are not necessarily associated with flooding and rainfall, as evidence by Booyal Crossing in the Burnett River catchment. This crossing is regularly impassable for extended periods due to releases from the nearby Paradise Dam. A further recommendation will be made regarding that specific problem later in this report. *See Section 7.9.*

6.4.2 Flooding brings with it exceptional hardship for these communities if roads are cut. There are risks to life as people attempt to cross flooded creeks and rivers. Community amenity is reduced because people cannot go to work, resupply or send their children to school. Rural communities in the Burnett Catchment endure months of disruption due to flooding and to the decreased accessibility.

6.4.3 This option seeks redress to communities in the Morganville/Goodnight Scrub area by providing enhanced access to their communities by higher level bridges or other similar engineering solutions. The CRG notes the major issues in that area are Booyal Crossing, Perry River Bridge and St Agnes Creek. The area suffers from both water traveling downstream as a result of rainfall in the catchment, and water backing up the Perry River from the Burnett River and tributaries as a result of more widespread flooding. The communities were isolated for 2 weeks in 2013, 5 weeks in 2010/11 and 2 weeks in 2008. Smaller flood events isolate residents for one to three days in addition to these major flood events. During flood events, residents of the Goodnight Scrub/Morganville community do not have any alternate evacuation routes available once the Perry River Bridge has been inundated. In extreme events such as 2013 and also in 2010/11, the St Agnes Creek Bridge inundation cuts emergency support and access to residents. It is noted that while the majority of residents face isolation, a number of properties near the Perry River were completely inundated in the 2013 flood event. Long term residents consider that the problem of backwater has been exacerbated since the erection of the Walla Weir (Ned Churchwood Weir). Upgrading of the above mentioned bridges, particularly the Perry River Bridge would remedy the situation considerably and allow those communities to return to normality sooner. It was acknowledged that the upgrades would probably not eliminate the risk completely.



Photograph of high velocity flows across the Perry River Bridge during the 2013 flood.

6.4.4 The Pine Creek/Givelda/Electra communities are also included in this option. Those communities have the additional threat of complete inundation of their properties. It was noted in the Council presentations that some of the properties on the Burnett River were inundated to depths of 25 metres. Upgrading of the road network together with early warning systems is critical to facilitation of evacuation of this area should an emergency arise. Long term residents indicate that the major impact is from flood waters of Pine, Cherry and (to a

lesser extent) Log Creeks which can isolate residents for up to two weeks or longer depending upon peaks upstream and for longer depending upon the height of the Burnett River through backup. All three streams become impassible early in a flooding event preventing egress from the area. Upgrading of the bridges of Pine and Cherry Creek and culvert over Log Creek is recommended, however it is noted that this may entail substantial structures across extended flooding areas (it is estimated that Pine Creek would require bridging/embankments for about 500 metres to fully remedy the situation followed by another high level bridge over Cherry Creek less than one kilometre away.

6.4.5 In the event that bridge upgrading is not viable for the Pine Creek/Givelda/Electra area, the CRG discussed and proposes an all weather access road be developed into the area. Locals are aware of forest roads, gazetted roads and private property accesses that could be joined into an all weather road to be used in the event of an emergency like that experience in 2013. A number of CRG members are familiar with the area and the route proposed. It is noted that there may have to be substantial negotiation with property owners to arrange access to those areas and the building of large culvert crossings. It is assumed that such a road would be used relatively heavily during a flood event, however it is proffered that outside such an event the road would be lightly used as it adds substantially to the journey from Pine Creek/Givelda/Electra to the Isis Highway and Bundaberg. All things considered the CRG considers this proposal a viable alternative to the cost of upgrading of the 2 main bridges, which would be required to facilitate similar access during a flood emergency.

6.5 Low level North Bundaberg Levees and Evacuation Route Upgraded (Conjoined Option 10 and 39 Weighting 3 and 7)

6.5.1 The conjoining of the above options was agreed to as the levees proposed in Option 10 could be used to facilitate the evacuation routes discussed in Option 39. Option 10 was raised by a CRG member following consideration of both inflows from the west and back up water from the east, which inundates North Bundaberg. The option was deemed worthy of MCA analysis. The proposed use of low levees would not prevent inundation at levels experienced in 2013, however would provide significant protection to North Bundaberg for lower river level events (arguably more frequent than the unprecedented 2013 event). Due to the velocity of inflow to North Bundaberg, the CRG found that high level levees designed to protect from extreme events would be an unacceptable risk to the safety of people and property in the event of the over-topping of said levee. The proposal of lower level levees was more acceptable as it does provide the necessary protection during more frequent events, but minimises risk to life and property during over-topping.

6.5.2 Engineering of the lower level levees would require further study regarding location and height. It is envisaged that the engineering should include use of the levees to enhance evacuation routes within North Bundaberg. The building of the routes as a feature of the levee would assist in stabilisation of the levee in the event of over-topping and reduce the risk of failure. Consideration of a higher level bridge to replace the low level section of Hinkler Ave is also part of this option. This would allow ingress/egress of North Bundaberg for a much greater period during flood events and probably reduce the need for aerial evacuations

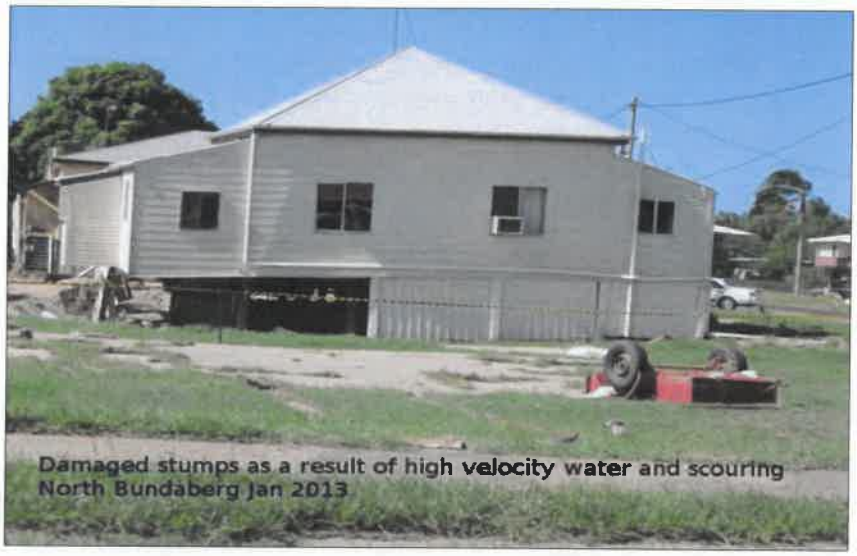
to the extent experienced in 2013. The proposal for a elevated but open bridge between Tallon Bridge and the North School hill is to prevent water backing up behind a road embankment or levee to be used as Hinkler Avenue.

Members took particular note of the passage of floodwater at North Bundaberg adjacent to the northern end of the Tallon Bridge. It appears from the aerial photographs **(left)** taken at near maximum flood height that the northern abutment does form a barrier to free flow of water and consequent water height increases. A conversion to an open span bridge abutment should have a positive effect in allowing the water to flow freely in the area and prevent damming. The above is the opinion of the CRG members based on their observations during the flooding and local knowledge. It is noted that modelling by GHD indicates the abutment has localised impact only (approximately 100 metres radius from the structure) of 10-20cm of water.

6.5.3 The above option has received further consideration within the CRG and discussion with GHD engineer in terms of combination of low levees (option 10), dredging and the Gardens Channel 2 (option 19) or Millaquin Bend (option 31) widening or both. Option 1, the North Levee was also considered in the combination discussion. As stated, it is frustrating that levels and velocities of water does present significant problems for mitigating against floods in North Bundaberg. The suburb has been the subject of considerable out of sessions discussion as to whether combining a number of options will produce meaningful improvement to that community. There is persuasive argument for combination of these options which (in themselves) do not necessarily rate well in the weightings, however when combined, may be more cost effective, manage adverse impacts and provide improved mitigation. Accordingly, discussions with GHD engineers have progressed and they are modeling the combinations in accord with the wishes of the CRG members. Additionally, it was noted in the discussions with GHD that the North Levee (Option 1) is one levee that is not to the detriment of other areas and like East Bundaberg, controls back water buildup. Therefore modeling and initial design is being investigated for this option. The CRG members are thankful for the initiative taken regarding the above progress.

6.6 Funding for house raising / restumping (Option 40 Weighting 4)

6.6.1 This option, whilst also expensive would enable residents to remain in their present location and minimise damage and loss in the event of many flood events. It is acknowledged that a large number of occupants like living in their current location and would be happy to remain in their suburb, if their houses were raised out of flood waters. Preparation for a flood would include removal of items under the house and securing the residence until return in the event of an evacuation. The CRG members have discussed the concerns with this proposal, including complacency or those wishing to remain in their residence during a flood event and that the option is not really viable for elderly residents due to reduced mobility up and down stairs. Additionally, homes built directly on concrete slabs would not have this option available to the owners.



Damaged stumps as a result of high velocity water and scouring North Bundaberg Jan 2013

6.6.2 High velocity water experienced in the 2013 floods caused widespread scouring and building destruction. Using this option in the areas of rapid water movement would necessitate thorough engineering investigation to ensure that foundations would withstand the high velocity water. Some areas, particularly in North Bundaberg may be unsuitable for this option due to the location and water velocity. The CRG does concede that the option will be suitable for a number of locations and therefore has merit as a mitigation strategy.

6.7 (Selective) Dredging of the Town Reach (Option 23 Weighting 6)

6.7.1 Dredging of the Burnett River in various locations will without a doubt improve the River's capacity to carry additional water and therefore reduce the necessity for floodwaters to encroach on habitable land. This Option suggests substantial dredging to lower the river bed by a nominal depth of 3 metres in a large section of the town reach. The CRG has suggested that this dredging be selective depending upon hydraulic studies as complete dredging would impact on significant infrastructure including bridge foundations.

6.7.2 It is noted that a number of options include dredging of the river to various degrees and in various locations. Selective dredging over a reasonably large area as suggested by Option 23 would be less disruptive than some other options. For example, modeling suggests that Option 35 could provide reductions in flood levels in North Bundaberg of 60-70cm. Whilst this would be advantageous and indeed welcomed by that community, the scale of dredging

required would be 3 to 4 times that of Option 23 without comparable benefits. Option 35 would require reconstruction of bridge foundations and significant removal of the north bank of the river which would impact on the amenity of businesses and residences in the vicinity i.e. resumption of land and houses and demolition of a significant part of the foundry – situations that are obviously unpalatable to members of the CRG and the wider community.

6.8 (Selective) Dredging and Widening of Millaquin Bend (Conjoined Option 25 and 31 – Weighting 8 and 10)

6.8.1 Modeling of this option indicates reduction of flood heights by approximately 60cm in East Bundaberg and 30-40cm in North Bundaberg with no apparent detrimental impacts in other areas. Discussions between CRG members, engineers and Council indicate that Option 25 dredging may need to be extended 300 metres upstream from the area indicated on the afflux map to remove infill from adjacent to the Caravan Park. Comparison of siltation buildup over time would also indicate that the widening should include removal of the mud bank opposite Grunskies complex, and downstream of the Foundry. The northern bank aspect of the bend including the emerging mud island should be included in this dredging/widening strategy.

6.8.2 The CRG members discussed several concerns with the Option including the probable necessity of resuming land from some residences in Mariners Way (however not dwellings) and that the option will necessitate river bank stabilisation as part of the project.

6.9 Removal of Fairymead levees (Option 26 - Weighting 16)

6.9.1 The levees were built over 60 years ago to protect the Fairymead Sugar Mill and some vulnerable cane growing land from Burnett River flooding. The CRG agrees that the levees now serve no useful purpose compared with the original intent. The levees were over-topped in both recent flood events. Removal would enable the floodwater to spread across the floodplain and possibly lower depth in the immediate area. The CRG notes concerns of immediate residents and Moore Park residents that believe the levees provide some protection to their community and therefore recommends some further study regarding the efficacy of removal. GHD have conducted preliminary modeling of this option which appears to confirm that the Moore Park area will be subject with higher levels of floodwater.

7 OTHER RECOMMENDATIONS

7.1 The CRG, in consultation with the wider community sought submissions in relation to flood plain management and specifically the action plan. During these consultations, a wide range of topics were robustly discussed. Whilst outside the scope of the role of agreeing and reporting on the 5 options, the matters outlined hereunder in summary were deemed significant enough to report as recommendations of the CRG. The opportunity is taken to outline the results of our discussions to Council and the wider community to promote discussion and action in the areas considered important to community safety and wellbeing, and the healthy future of the Burnett River. Those recommendations are outlined hereunder:-

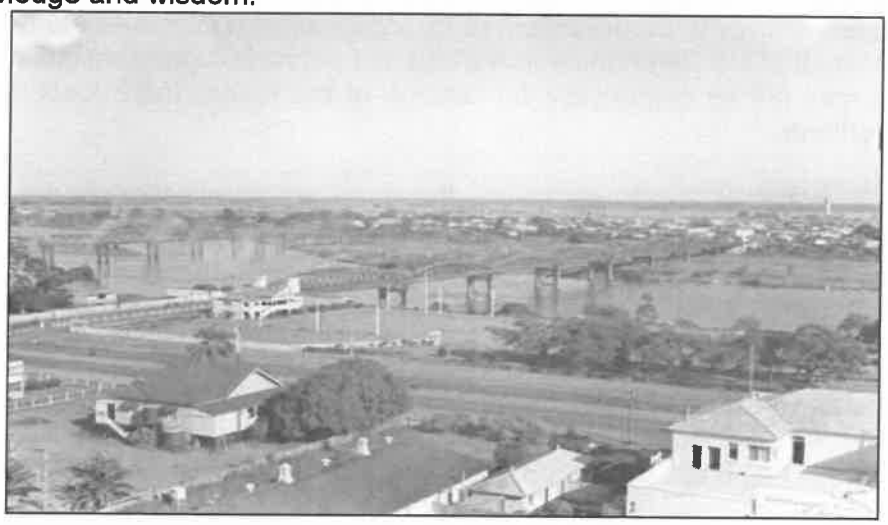
7.1 Development of a 50 Year Plan for a Healthy Burnett River

7.1.1 Much of the discussions relating to the Burnett River Floodplain Management revolved around the poor state of the river itself. This situation has been brought about by well over 100 years of development, changes and neglect that has reduced the River's ability to repair itself. Therefore each subsequent event seems to have had a further negative impact on the River. The CRG strongly recommends that planning commence now to return the Burnett River to a more pristine condition, noting the fact that some changes, whether man made or natural are now irreversible.

7.2.1 The CRG as a group, individual members of that Group and individuals have provided substantial information as part of the Action Plan process regarding concerns with the current state of the River. These include fine siltation and sand deposits, unnatural establishment of stands of mangroves, loss of natural mangrove forests, movement of the river channels and reduction in tidal prism as a result of man made obstructions. The city reach has changed significantly during the time of city development with the main channel moving steadily southward so that the northern channel adjacent to the bridge structures has all but disappeared.

7.1.3 Long term residents and river users are steadfast in their observations that these changes are mostly due to human intervention and definitely do not allow the river to cleanse or repair itself. The CRG therefore believes that further research and action will be required to stop further destruction of the river environment, protect the community and encourage return of desirable marine flora and fauna species.

7.1.4 It has taken almost 150 years to reach the current situation and 50 years to repair the damage would be a conservative estimate. It is therefore the recommendation of the CRG that a 50 year strategic plan be established for reparation of the river from the mouth to Paradise Dam using the finalised flood study, previous and future scientific research, together with practical local knowledge and wisdom.



Bundaberg Bridges circa 1907. Note the significantly larger north channel, and the almost complete absence of the sand mass associated with Harriet Island

7.1.5 The plan would seek to address issues such as siltation, natural

and man made course diversion and increasing the tidal prism to a more natural flow. Education of the community with regard to river care and living with flooding and natural events may be included in the overall strategic plan. It is submitted that the education program could accompany actual work on bank stablisation, beautification and erosion prevention by strategic revegetation of the banks of the river. The CRG notes that reference is made to the advantages of revegetation in Attachment 6. It is the view of the CRG that the recommended plan should be commenced as soon as possible to commence reparations before further permanent damage is sustained to the Burnett River.

7.2 Ben Anderson Barrage and Bingera Weir

7.2.1 One of the most controversial discussions conducted by the Reference Group was the relative merits of the Ben Anderson Barrage and Bingera Weir and their effect on the health of the Burnett River. Local knowledge indicates that the Barrage was constructed in the mid 1970's and the Bingera Weir in approximately 1933. Both were constructed for the specific reason to separate salt from fresh water and provide the fresh water for human consumption, industry and agriculture. Prior to both being built, tidal (salt and mixed) water extended past the Bingera Weir in normal flow situations. The split to salt and fresh water caused by the barrage has resulted in a substantial loss of brackish water from the river system. Brackish water, (salt and fresh water mixed), is a highly mobile natural chemistry which is not only displaced, but almost entirely removed from the Burnett River at the Ben Anderson barrage. Far from being mobile, only a static remnant of this exceptionally rich and fertile river water remains from leakage of the barrage. It is so small of dimension that it no longer travels with the tide on most occasions. Both structures do continue to provide the fresh water impoundments per their reason for existence and any discussion regarding removal would spark heated debate regarding efficacy of such decision and substitution of alternative sources of fresh water supplies.

7.2.2 Having regard to this debate, the CRG propose that these structures should be the subject of further significant review as to their long term existence. It is also noted that there is discord within the CRG itself regarding the subject however there is agreement that the Group's concerns be documented for information and further study. Discussions with GHD indicate that the Ben Anderson Barrage did not have significant influence on the 2013 flooding and may not be responsible for siltation of the River. Individuals in the CRG dispute these assertions.

7.2.3 Whilst at its ultimate height, the Barrage was over-topped by a significant depth; aerial photographs of the Barrage clearly show the Barrage continuing to have influence with relatively calm water upstream and displaced and choppy flows immediately downstream of the Barrage, even though the structure had been completely consumed by the floodwaters. This observation would lead a reasonable person to the view that flood waters of a lower height (2010/11 for instance) would be influenced by the obstruction and the river flow patterns would be altered until the Barrage was completely over-topped.

7.2.4 During times of normal water flow the Barrage clearly influences flows and reduces the

tidal prism by 40%. Prior to 1933, tidal penetration extended for approximately 56km from the mouth of the Burnett River. The construction of Bingera Weir reduced this penetration to 42.4km and then to 25.9km when Ben Anderson Barrage was completed ***(Source: Appendix J - Estuarine and Marine Ecosystems: Burnett Basin WAMP Report)***. Fine siltation of the river has increased visibly since the construction of the Barrage and has led to reductions in river channel depth and unnatural growth of mangroves amongst other observable changes. The Bingera Weir construction also altered flows to increase siltation and large sand deposits are clearly visible immediately downstream of what is left of the structure. Environmental damage including disappearance of marine flora species including sea grass was observed following construction of the Weir. After the 2013 floods receded, extremely large deposits of sand and sediment were observed (and remain) in the areas immediately downstream of both structures..These deposits have made the river a dry bed in places. This physical evidence leads the CRG members and the wider community to conclude that both structures are adversely influencing the Rivers ability to naturally cleanse itself.

7.2.5 Of course, removal of the structures in the interest of the environment will have significant impact on fresh water supplies and very substantial investment to replace those supplies. Accompanying photographs clearly show Bingera Weir to be in deplorable condition and it is moot whether the Weir actually performs any significant impoundment function in 2013. Whilst the Bingera Weir is arguably not performing its purpose to a large degree, Ben Anderson Barrage is critical to both Bundaberg water supplies and agricultural water supplies. The Barrage is also used to raise water levels for community enjoyment and recreation. All these factors need to be taken into account to arrive at the relative benefits of the Barrage compared with the ongoing environmental harm the Barrage is suspected of being responsible for. It is recommended that further research be conducted to extract the information necessary to conclusively determine the relative merit or otherwise of both structures remaining. If such information currently exists then it has not been communicated effectively to the community of Bundaberg. Photographs depicting the both the sedimentation deposits and the relevant condition of the structures are contained in Appendix 6

7.3 **Reopen Skyringville Passage** (Option 30 Weighting 18)

7.3.1 It is recommended that Skyringville Passage be reopened. It is noted that hydraulic studies discount the option as having little or no effect on increasing the flow of floodwater to drain the river quicker after an event. Consequently the option did not rank highly in the rankings. The CRG takes note of those observations, and also the dissatisfaction of the Gladstone Ports Corporation with a proposed opening due to the influence on their operations.

7.3.2 However, a reopened Skyringville Passage does have benefits to the community and river health. The Passage would provide some assistance to river drainage following an event. It would also return the river mouth area to a more natural environment and flow. This recommendation, together with others in relation to Ben Anderson Barrage and restoration of areas of the town reach would, in the opinion of the CRG, assist in reducing flood heights at the Port of Bundaberg. Currents and movement associated with the restored tidal prism

would assist with removal of fine sedimentation and sand buildup in the river from the city reach to the mouth of the river.

7.3.3 It is also the view of experienced members of the CRG that the opened passage would assist with moving sand deposits northward from the mouth and has benefits in reinstating the Moore Park Beach area with the displaced sand deposits.

7.3.4 Additionally, the Burnett River does have large numbers of vessels that are all displaced during a flood or cyclone event. The number of creeks and sheltered areas, have been diminished by various natural and human intervention over the years, resulting in the River having no capacity to provide safe anchorage during such events. It is proposed that Skyringville Passage would fulfill the role of a safe and sheltered anchorage for vessels of a number and size that frequent the River (trawlers, yachts, and motor vessels) in times of emergency. The flood flow gauged by modeling does not appear to be significant enough to be of concern and the Skyringville land mass and vegetation provides protection and calming influences on the area in the event of a cyclone.

7.3.5 During the 2013 event, vessels also found calmer waters on the southern bank of the river behind Strathdee. This area is adjacent to the Sailing Club and perhaps marina facilities sited in this area would be a more all weather option than the current position nearer the mouth of the river at Burnett Heads.

7.4 Insurance Premium Relief

7.4.1 Victims of the floods were very concerned with Insurance premiums when speaking to CRG members. Many victims are not able to move or are unwilling, because they like living in their particular neighbourhood. Many are content to remain and face the occasional flood, but are concerned that insurance for their homes and contents would be either unable to be negotiated or unaffordable. The CRG members are very sympathetic to the plight of the victims, and believe that meaningful flood mitigation measures conducted either by government, the community or individuals should have a positive effect in reducing insurance premium levels. It is recommended that negotiations at appropriate level with Insurance Council be instigated to brief them regarding mitigation measures and seek


Destroyed property awaiting collection - North Bundaberg 2013

premium relief for the victims of disaster events and to secure affordable insurance for all householders including those in at risk areas.

7.5 Introduction of Compulsory Flood searches

7.5.1 The CRG recommends that prospective property purchases be accompanied by compulsory flood searches in flood plain areas. Whilst this may deter some buyers, history has demonstrated that prospective purchases can still be found and housing prices stabilise to an appropriate level eventually. Mandating appropriate searches can allow purchasers to still enter contracts having full knowledge and basic disclosure in their decision making process. This initiative can be accompanied by an education program as to what residing in a flood prone area means to the purchaser. In line with this compulsion, CRG members also recommend that Council ensure that further development on flood prone areas (to 2013 levels) be restricted to development proven above inundation levels and not adversely affect flooding in other areas.

7.6 Implement a system of flood markers

7.6.1 Flood height markers in strategic locations in both urban and rural locations are an important education and information tool for the community. The unprecedented nature of the 2013 floods rendered historical information obsolete but is now the precedent for future flood events. One of the greatest concerns of disaster managers in the 2013 floods was the constant comparison by the community with the 2010 levels and the general unwillingness to accept that the 2013 levels could be higher. Even after the projected levels were made public on the 27th January and a self evacuation strategy strongly recommended, people continued to be of the view that they were not effected in 2010 and would not be in 2013.

7.6.2 The result of this complacency was aerial evacuations on an unprecedented scale and serious threat to the well being of the people affected. It is therefore recommended that 2013 flood level markers be placed on permanent and semi permanent landmarks so that residents can compare their situation with recorded history and be in a position to make informed decisions regarding preparation and ultimately timeliness of evacuation depending upon their circumstances.

7.6.3 The CRG discussed relative merits of locations and also possible impacts on the community. Suggestions of buildings, public space and utility poles were discussed as reasonable locations for such information. This is balanced with the issue of possible real estate and valuation issues with such information being readily visible. Having regard to both, the CRG believes it is valuable for such information to be visible and in the public domain to decrease complacency and increase safety. It is suggested that markers are best located adjacent to established evacuation routes and on substantial buildings which may be more permanent, and probably more visible than utility poles and the like.

7.6.4 Tropical Cyclone Tracking Maps are available in the Australian Government Bureau of Meteorology section of the local phone book It is recommended that consideration be given

to provision of a map of the Burnett, Kolan and Gregory Catchment areas showing all flood height and rain fall gauging stations. Members of the community would be able to track river and flood heights noting same on the maps. Information of this nature can be broadcast using ABC and the commercial emergency radio stations on resident's AM/FM radio. This would complement the early warning system that is being developed at present. It is envisaged that the map would only show main rivers or streams with gauge locations and major roads for orientation purposes but not to the extent that it 'clutters' the map.

7.7 Early warnings and response

7.7.1 The CRG received many suggestions regarding concerns with lack of warning to communities (both urban and rural) which resulted in issues ranging from isolation to actual threat to life and property. The CRG considers that early warning systems being in place should be considered Council's first priority and are critical to safety and together with community education, allow people to make informed decisions on what they need to do to protect themselves. It is also acknowledged that the people requiring protection may not be part of the local community (backpackers and tourists for example) and therefore not be familiar with local strategies.

7.7.2 Rural demographics have changed considerably as large landholdings are subdivided into acreage blocks and attracting new residents looking for a "tree change". Authorities at all levels have to consider that those persons do not possess the knowledge or experience to heed appropriate warnings and take appropriate action. Similar situations exist in urban areas as neighbourhood demographics and residents change over time. There are a range of early warning systems available, which can assist in warning residents of impending events. These include such simple devices as warning sirens and signs, to widespread communication through existing telephone networks, the Internet and media. All have their advantages and disadvantages. Failure of technology during events continues to cause concern regarding early warning Initiatives. Nonetheless, the CRG recommends appropriate early warning strategies be put in place using methods appropriate for the different communities.

7.7.3 Some rural communities (example is but not restricted to Pine Creek/Givelda/Electra) require quite a significant lead time for the early warning to enable them to appropriately prepare and possibly evacuate to prevent safety issues. Therefore the timeliness of the warning should be carefully considered and a 'one size fits all' approach be avoided.

7.7.4 The Goodnight Scrub/Morganville communities also suffer greatly from lack of early warning of flooding. The communities unfortunately are close to the Paradise Dam so do not have the convenience or advantage of warning timelines that many other communities enjoy. The local progress association and Council have worked together since the 2013 floods to enhance such warning systems using practical solutions including radio networks, notice boards and other measures which will assist in future events. The community indicates that it requires river and stream levels upstream of the Paradise Dam as far out as Monto to provide a more informed response to river levels affecting their community. The CRG recommends

that Council negotiate with North Burnett Regional Council, Sunwater and any other identities required to facilitate a system whereby this information can be readily available to the general community including specifically the Goodnight Scrub/Morganville community.

7.7.5 Any early warning strategy has to include education of the public to both heed the warning and also what measures have to be taken to compliment the warning. This process also has to consider and include persons who are not permanent residents of the area. Therefore adoption of a relentless and ubiquitous education program together with a public information system is recommended to be developed. A significant amount of work has already been done in this area and the CRG acknowledges the efforts of disaster management personnel for their efforts in preparing the community for response to an emergency situation.

7.7.6 Early warnings can be addressed using available media, particularly AM/FM radio. It is acknowledged that the ABC no longer are the only emergency broadcast provider and commercial radio stations are also providing that valuable service. Nonetheless, the ABC continues to be recognised by the community, particularly rural communities as being the emergency broadcast network and consequently is a popular choice during disasters. The recent floods demonstrated that there are widespread black spots in broadcast communications, particularly when weather events reduce range. Many rural communities were without any form of radio broadcast from either ABC or commercial stations, and consequently could not receive early warning or even updates, so necessary to make informed decisions. The same issues were experienced with mobile telephone communications which also impacts highly on the use of smartphone technology to access Bureau of Meteorology sites, Council emergency instructions or other disaster assistance sites. It is recommended that auditing, particularly of the ABC Radio network range and mobile telephone communication networks be undertaken with a view to enabling great access to these essential services during disaster events.

7.7.7 In a similar vein, members of the community were frustrated with the extended periods of time spent without power due to inundation of supply lines. There are a number of instances brought to the attention of CRG members where electricity supply would have been restored far earlier but power reconnection was prevented due to electricity isolation points being inappropriate. For example, power to Burnett Downs was unavailable due to the supply line across the river being compromised and therefore isolated. There was no ability to reroute power from the South Kolan line which was reasonably available. A number of customers were known to contact Ergon with suggested re-routing, which was attended to very quickly and power restored. Whilst Ergon's efforts were admirable, perhaps an audit of isolation points within the grid would be appropriate to establish alternative supply which may be available. Such an audit would be better conducted outside a period of disaster to enable prioritisation and consultation with the community.

7.8 Identify evacuations routes

7.8.1 Complimenting the above recommendation, evacuation routes need to be identified for

all at risk communities, whether urban or rural. The routes have to be well known, well marketed and in some cases, well marked. As indicated in the options discussions, levees or engineering of high level roadways lend themselves to becoming evacuation routes. Any planning of those structures should therefore include furnishings and necessities to become evacuation routes. Other roads and natural features also are natural evacuation routes. The CRG recommends that these be formalised, mapped and physically marked if necessary to remove uncertainty. At risk rural communities normally only have one route for evacuation, therefore this route should be well known within that community by making simple maps available and local education programs.

7.8.2 Other communities within the State have quite refined evacuation procedures and mapping for their communities and may be able to assist with methodology if necessary. The CRG notes that not all members of the community have access to the internet or confidence in their technological ability so mapping and education should be available in a number of forms.

7.9 Paradise Dam

7.9.1 As indicted in the recommendation regarding early warning systems, the Goodnight Scrub/Morganville communities do not enjoy significant lead time regarding flooding of the Burnett River downstream of the Paradise Dam. The events that isolate the community of Goodnight Scrub are frequent and prolonged and include simple water releases of the Dam and its effect on Booyal Crossing. Such releases are a constant source of frustration for the residents and greatly increase travel time to visit nearby towns, particularly Childers. It is noted that Sunwater have a system in place to advise residents on the river of impending releases. This system utilises the SMS system and has been in place for some time. Residents advise that the effect of releases is felt on a much wider scale than those on the actual river and repeated requests to extend the SMS warning system (or implement some other system) have not been acceded to.

7.9.2 It is the view of the CRG that residents in the area under discussion are disadvantaged unnecessarily by lack of communication. It is recommended that any resident in the Goodnight Scrub/Morganville area should have the ability to be placed on the SMS messaging system not just those residing in proximity of the river. Alternatively, the Group recommends that Sunwater enter discussions and negotiations with the local Progress Association to arrive at a suitable compromise solution.

7.9.3 It is the view of the CRG that general communications between Sunwater and the community are of an unsatisfactory nature and would recommend address of this matter. It is noted that Paradise Dam regularly features in media and predominately in an adverse light. This tends to confirm to members of the community (in the absence of evidence to the contrary) that there is something amiss with the Paradise Dam. This in turn leads to speculation however inaccurate or unconfirmed, that the Dam is not safe and comprises a threat to downstream communities. There is palpable concern within the community that featured in many of the community engagement forums and leads the CRG to conclude that,

at best, the Paradise Dam is a public relations nightmare for its operators.

7.9.4 The Group makes no assumption or comment on the engineering or safety of the Dam, as it possesses neither the expertise nor background to do so. The Group is also aware that Paradise Dam is not a flood mitigation Dam but constructed for water storage. The Group also notes recent independent studies regarding the dam and Sunwater's release of information post 2013 floods. However, in light of the community concerns, the CRG recommends that Sunwater provide more information in a timely fashion regarding its undoubtedly effective efforts in emergency planning, maintenance and general information regarding the dam.

7.9.5 The CRG is confident that this strategy, together with more widespread communication with the immediate communities would address or certainly reduce some of the fears and concerns currently existing in the catchment community.

8. WHERE TO FROM HERE

It was the intention of the CRG to compile a final report to be submitted to the Bundaberg Regional Council for consideration at their meeting to be held on the 17th December 2013. Final discussion and adoption of the report is scheduled for the CRG meeting on the 4 December 2013, and the report will be presented to Council in a timeframe to enable examination prior to the scheduled Council meeting. The timeframes for this project are very contracted, however the CRG is on track to deliver their final report within the timeframes outlined in the Terms of Reference. The CRG will continue to have an open and accountable focus regarding its deliberations and dealings with other groups, and therefore requests the Council release the final report of the CRG to the public as soon as possible to facilitate informed comment and discussion on the findings of the Group.

9. ACKNOWLEDGMENTS

10.1 The Community Reference Group would like to acknowledge the valuable assistance provided to them to assist in their deliberations. This assistance was granted freely by many members of the community particularly during and subsequent to the public consultation phase of the project. Bundaberg Regional Council assisted by providing secretariat staff to the Group most notably Robyn Laing who was tireless in her efforts to ensure that the minutes and other documentation necessary to carry out the business of the Group was recorded and generated in a timely and accurate fashion at all times. When Ms Laing was absent, her duties were performed by Valarie Andrewartha with similar professionalism. The Group particularly wishes to convey their thanks for the performance of this onerous but critically important task.

10.2 The Group met with members of Bundaberg Regional Council Engineers notably Andrew Fulton, Dwayne Honor and Rob Calligaris in order to access required Council records including the results and outcomes of the Burnett Floodplain Study, which were important to underpin the knowledge and learning of the Group. The Group also attended the public

consultation meetings and forums together with those individuals and other Council departments combining to provide a holistic approach to the consultation process. The activities of the Group also generated significant interest and publicity during the course of deliberations which required the assistance of Brodie Bott (BRC) and Brooke Maki (GHD) with regard to some media management and strategy.

10.3 The Group also conferred with a wide range of external organisations to access the expertise required to address concerns and observations. Consulting engineers, Dan Copelin and Ben Regan of GHD assisted the CRG with explanation of engineering matters, including the MCA process and details of preliminary modeling outcomes The Queensland Reconstruction Authority officials, Deputy Commissioner Brett Pointing, Inspector Kev Guteridge, Senior Sergeant Grantley Marcus and Sergeant Meg Owens also made their time freely available to provide background research, information and advice to the Group both at meetings and out of sessions. The Group would like to place on record the appreciation and thanks to all persons, including those mentioned above who assisted the Group to achieve its goals and objectives without seeking to influence or diminish the independence of the CRG during its deliberations.

10. CONCLUSIONS

The Burnett River Floodplain Community Reference Group was formed to facilitate a means of consultation and engagement directly with the community. The role was to gather information and be a liaison between the Bundaberg Regional Council and the community it serves. As a result of the subsequent engagement, together with the knowledge and expertise of the Group Members, the Group has fulfilled its role in terms of providing Council with floodplain management assessment criteria and a list of options to take forward to more thorough assessment and implementation.

The Community Reference Group was of the view that this process afforded a unique opportunity to present other information to the Council as recommendations for consideration. Some of these recommendations were directly flood based, and others were of a more long term nature gauged to enhance the long term viability of the Burnett River system.
On behalf of the members of the Community Reference Group, I am pleased to provide this final report of deliberations for consideration and I commend the contents of this report to the Bundaberg Regional Council as the Group's interpretation of the wishes, concerns and feedback of the community residing in the Bundaberg Region.

Signed

Rowan Bond
Chair
Burnett River Floodplain Action Plan
Community Reference Group
4 December 2013

Attachments

Appendix 1	Terms of Reference
Appendix 2	Media Protocols
Appendix 3	Complete list of submissions resulting from community engagement strategies
Appendix 4	Minutes of Meetings of the CRG
Appendix 5	Afflux Maps associated with options contained in this report
Appendix 6	Revegetation fact sheet
Appendix 7	Photographs of Ben Anderson Barrage and Bingera Weir

APPENDIX 1

Terms of Reference

BURNETT RIVER FLOODPLAIN ACTION PLAN

COMMUNITY REFERENCE GROUP

TERMS OF REFERENCE

1. Background

1.1 Purpose

The Burnett River Floodplain Action Plan Community Reference Group (CRG) is a group of interested, voluntary community members established to liaise between Council and the community to help inform the development of floodplain management options and strategies as part of the Burnett River Floodplain Action Plan project work.

The Burnett River Floodplain Action Plan will confirm the preferred floodplain risk management options and strategies to improve flood resilience and preparedness.

This Action Plan is the next step in the process following the completion of a comprehensive flood modelling and mapping study of the Burnett River floodplain located between Paradise Dam and the river mouth. The flood study provides vital information to underpin the development of the Burnett River Floodplain Action Plan.

The first major phase of work involves identifying the top five floodplain management options by December 2013. Some of these options will undergo detailed engineering assessment in the first half of 2014.

1.2 Role

In summary, the voluntary roles of the CRG are to:

- Provide input into the development of the Burnett River Floodplain Action Plan
- Gather the collective thoughts and ideas from their respective networks to help to identify and assess a range of suitable Burnett River floodplain management options
- Communicate information and update their respective networks to ensure they are kept informed of the project's progress
- Act as a conduit for community feedback on the plan's development to the consultant (GHD) and Bundaberg Regional Council
- Participate in the project's public consultation program to help encourage the gathering of ideas and feedback from the community, in order to confirm a filtered set of options to test during a Multi-Criteria Assessment (MCA)
- Collectively agree to the floodplain management options assessment criteria and weighting used during the Multi-Criteria Assessment (MCA). The MCA will be the primary tool used to confirm the top options to undergo detailed assessment if required.

- Represent the community by submitting a report to Council in early December 2013 detailing the CRG's preferred list of floodplain management options. This will be facilitated by the chairperson and require 70% consensus of the CRG members.

The CRG will report and provide feedback on issues raised in the course of the development of the Burnett River Floodplain Action Plan.

This group will also enable community access to information on the project as well as supporting the opportunity for the community to contribute to, and comment on, the development of the Burnett River Floodplain Action Plan.

2. Community Reference Group

2.1 CRG Chair

An independent Chairperson/Facilitator will be appointed to conduct and manage meeting proceedings with the objective of ensuring the meetings are run fairly and without bias.

The role of the Chairperson includes:

- Ensuring individual CRG members are heard and can contribute to the process. At times the Chairperson may have to mediate the process to ensure all parties in the discussion are heard, actions are summarised and a conducive working relationship is maintained.
- Preparing the CRG agenda in consultation with CRG members and the Bundaberg Regional Council
- Overseeing preparation of the meeting minutes
- Ensuring distribution of the meeting minutes
- Overseeing independent reporting on behalf of the CRG
- Attending the community information sessions as part of the wider public consultation for the project (occurring from mid September to early October 2013); and
- Collating issues raised by the CRG and forwarding to Council for a response.

The Chairperson's reasonable fees and expenses shall be met by Bundaberg Regional Council.

2.2 Representation

Voluntary representation on the CRG will be sought from a range of stakeholder groups via an open Expression of Interest invitation.

The CRG members should be representative of a range of key interests, positions and concerns and who collectively represent a wide cross-section of the community, including people directly impacted by the floods, leaders from the education and community services sector, representatives of groups such as the Human and Social Recovery Sub-committee, environmental groups, and our business and industry leaders.

It is intended that the CRG would include approximately 10 individuals from a wide geographic spread.

The final selection of representatives will be at the discretion of Council.

Other interested stakeholders that may not be selected onto the CRG will be kept updated and informed on project progress through newsletters, factsheets, Council's website and/or copies of meeting minutes or project reports.

2.3 Recruitment and Selection of CRG members

Recruitment and advertising

During late August 2013, the Bundaberg Regional Council invited the general public to:

1. Submit ideas to improve flood resilience; and/or
2. Express interest to join the Community Reference Group (CRG).

This has been advertised in a range of local newspapers throughout September 2013, appeared on the Bundaberg Regional Council website and social media, and was communicated through a variety of other local networks.

Applications were available online at www.bundaberg.qld.gov.au or hard copies of the application form could be collected from Council's Customer Service Centres and submitted by either:

Email: floods@bundaberg.qld.gov.au
Mail: CEO Bundaberg Regional Council
PO Box 3130
BUNDABERG Qld 4670

Applications close at 4.30pm, Friday September 13, 2013.

Selection process

The Council shall select the membership of the CRG giving consideration to their:

- **Locality** (focus areas include North Bundaberg, East/South Bundaberg, Central Bundaberg, Avoca/Branyan/Sandy Hook, South Kolan/Sharon, Pine Creek, Wallaville/Bungadoo, Goodnight Scrub)
- **Representation of stakeholders:** Ability to represent one or more of the above stakeholder groups.
- **Capacity to communicate**: Ability to communicate information from the CRG to other interested stakeholders
- **Constructive participation**: Ability to commit to working constructively and cooperatively as part of the CRG. They should also agree to fulfil their role as laid out in the Community Reference Group Charter (refer section 4 of this document).
- **Interest**: Members should be able to demonstrate interest in one or more issues relevant to the proposed project.
- **Capacity and skills to contribute**: Members should be able and willing to commit to the role and responsibilities of the CRG, and actively participate in the business of the CRG.
- **Availability and flexibility**: Members should be available and willing to meet on the agreed dates during 2013, at a mutually agreed time and venue.

Following an assessment of the individuals based on the above-mentioned considerations, the Bundaberg Regional Council, will select members to collectively represent a wide cross section of our community, including:

- people directly impacted by the floods in various locations along the Burnett River
- representatives of agencies directly involved in flood recovery
- leaders from the education and community services sector; and
- business and industry leaders.

The number of community representatives on the CRG will not exceed 10 or to Council's discretion.

If a member is unable to attend a CRG meeting or activity, a formal apology should be provided to the Chairperson prior to the meeting.

2.4 Bundaberg Regional Council and GHD Project Team

The Bundaberg Regional Council Team for the Floodplain Action Plan involves the following personnel:

- Mayor and Councillors
- General Manager Infrastructure and Planning, Andrew Fulton
- Manager Design, Dwayne Honor
- Media and Marketing Manager, Brodie Bott.

GHD consultancy team assisting with project delivery includes:

- Senior Engineer, Ben Regan
- Stakeholder Engagement Principal Consultant, Brooke Maki
- Manager Waterways and Coastal, John Postlethwaite.

2.5 Meetings

The CRG will meet on at least three occasions before the end of 2013 and more often as determined by Bundaberg Regional Council in close collaboration with the CRG and with the independent Chairperson. If a member sees the need for additional meetings, the member can contact the Chairperson to arrange it.

CRG meeting dates, times and venues will be determined at the first meeting in consultation with all parties.

CRG meetings may involve the Council project support team and GHD technical advisors on an as needs basis or as requested to attend. It is envisaged that the CRG and the project's associated Technical Working Group (the TWG will consist of technical engineering and relevant government agency representatives) will interact throughout the duration of the development of the Burnett River Floodplain Action Plan. **See Addendum on page 9 to view a timeline summary diagram for when the CRG and TWG will meet over the coming months, in relation to the overall project.**

Meetings will be advertised to inform the community of their occurrence and outcomes published. Bundaberg Regional Council is responsible to assist in the coordination of meetings including distributing meeting agendas, minutes and reports.

2.6 Meeting Agendas

A set of standing agenda items will be developed at the first meeting based on the scope and purpose of the CRG.

If any CRG member wishes to discuss an issue at a meeting, it needs to be raised and included on the agenda.

The agenda for each meeting will be prepared by the CRG members at the conclusion of each meeting and finalised by the Chairperson and issued at least one week in advance.

2.7 Reporting and Transparency

CRG meeting agendas and minutes will be open to the public and published on the Bundaberg Regional Council website.

Reporting will be objective and attempt to capture the views of the CRG members and the community.

2.8 Communication with the broader community

CRG members are encouraged to discuss issues and disseminate information about the project with the wider community, including special interest groups.

The CRG may seek to develop content to include in Media Releases to the media, or to adopt other approaches for public dissemination of information, however the Chairperson is to ensure the discussion is balanced and has the final veto on the media/public statement.

Only the Chairperson can act as CRG spokesperson and speak to the media on behalf of the CRG.

3. Bundaberg Regional Council support

Bundaberg Regional Council recognises that support for the CRG is imperative to its success. The Council will provide a project support team to assist the CRG process which will involve:

- Project Manager
- Administration Officer
- Communications expertise; and
- Divisional Councillors.

Council has nominated the CRG Chairperson to be responsible for collating the issues raised by the CRG and for coordinating a formal response.

The Council-employed project staff will commit to supporting the objectives of the CRG through:

- Regular meeting attendance as requested/required
- Recognition of the need to communicate and consult; and
- Appropriately responding to issues raised by the CRG.

Any correspondence and or project information will be provided to CRG members as soon as practicable prior to a meeting. Reports or information will be emailed, printed and posted to members.

Responses to issues raised within the CRG will be provided in a timely manner once the facts are available. Issues raised by the CRG which are of a technical nature will be referred to the project consultants to give advice through Council. Non-technical issues will be referred to Council for consideration and formal response.

4. CRG Charter

All prospective CRG members must agree to abide by the Terms of Reference (TOR) and agree to these terms prior to meeting attendance and participation. This document is not subject to alteration at any point in the future, unless agreed to by all parties (including Council).

A copy of the CRG Terms of Reference is available to any party upon request.

CRG members must ensure they have read and agreed with the below terms in order to be considered or accepted as a CRG member.

CRG members should be willing to and agree to:

- Attend all scheduled meetings. If you are unable to attend a meeting, the independent Chairperson should be notified with a formal apology and any comments or discussion points raised by your local stakeholder/community/group should be tabled via email, phone or letter to the Chairperson prior to the meeting
- Review CRG meeting minutes
- Verbally report to the CRG on communication activities and stakeholder concerns
- Review and comment on correspondence and/or project material
- Provide information to Bundaberg Regional Council on relevant issues concerning their local community and/or stakeholder group in relation to the Burnett River Floodplain Action Plan
- Feed information from Bundaberg Regional Council back to their local community/group; and
- Only make comments to the media or in public forums on behalf of themselves or the stakeholders they represent, not on behalf of the CRG.

Each member of the CRG commits to the following conduct points:

- Ensure any issues raised are directed at the organisations involved (e.g. Council, consultants) and not at an individual or personal level
- Respect and listen to the opinions of others, including during meetings
- Ensure issues are placed on the agenda prior to the meeting to ensure a prepared response/comment can be delivered
- Recognise that active participation in the CRG forum is crucial to the success of the group
- Any complaints regarding the process are raised in the CRG forum to enable the opportunity for resolution and/or in writing to the CEO Bundaberg Regional Council.

5. Exit Process

The Burnett River Floodplain Action Plan Community Reference Group will no longer be required once the Burnett River Floodplain Action Plan (expected to be finalised in May 2014) has been adopted by Bundaberg Regional Council and conveyed to the residents via the CRG community network.

Addendum – further project background

From mid-September 2013, Bundaberg Regional Council will seek ideas and feedback from the community to better understand what options and strategies they would like Council to consider as part of the project. This public ideas collection is supported by the dedicated, independently facilitated Community Reference Group that will be in place for the duration of the project.

In addition to the public ideas collection, technical inputs from key stakeholder organisations will be sought at critical points in the process. The ideas and feedback from the public, Community Reference Group members, and the Technical Working Group representatives will be summarised in a report and will be fed into a Multi-Criteria Assessment process later this year.

The Multi-Criteria Assessment will provide a robust and transparent tool to refine resilience strategies informed by the public consultation by assessing them against a set of agreed weighted criteria. By the end of the year, once the options have gone through the Multi-Criteria Assessment, Council will have the top five floodplain management options and strategies to take forward.

a) Multi-Criteria Assessment process

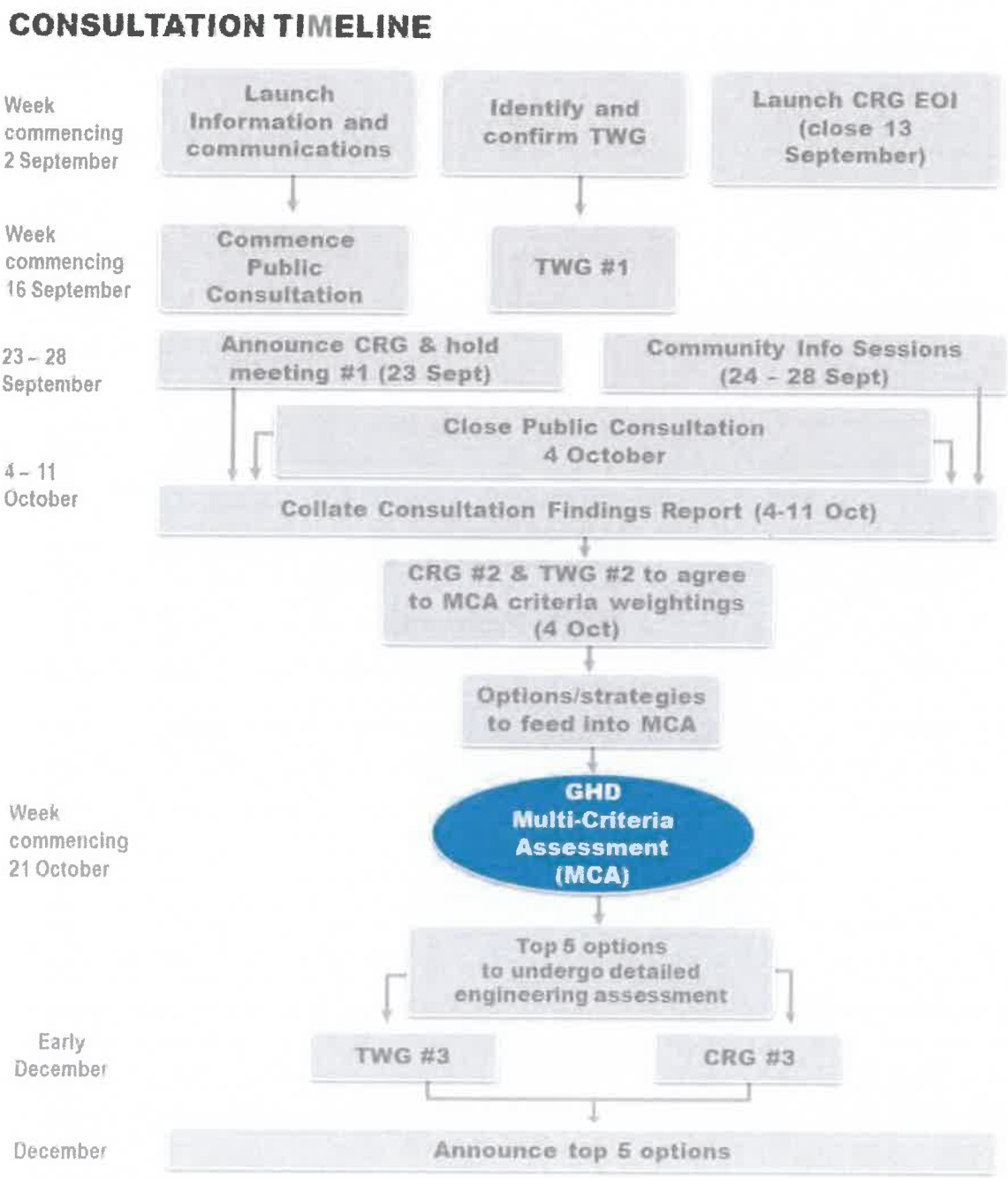
The Multi-Criteria Assessment will determine the top five options that will undergo further engineering assessment before being determined for incorporation into a floodplain management action plan.

The MCA process will objectively consider options based on the feasibility, effectiveness, social, environmental and economic advantages and disadvantages of each. Council will be seeking 70% consensus of all CRG members on the weightings given to each of these criteria before commencement of the MCA process.

The main function and benefit of implementing this approach is that it provides a robust and transparent tool in which options can be measured and if not viable, can be discounted so that Council can explore the more viable options in a more comprehensive and timely manner.

This is an interactive approach which, with input from Council and relevant stakeholders, will provide a holistic understanding of constraints and opportunities.

b) Consultation Timeline



APPENDIX 2

Media Protocols

Media Protocols

Burnett River Floodplain Action Plan

The success of the Burnett River Floodplain Action Plan will be determined through not only high engagement with the community, but also by the amount of accurate, positive coverage by media outlets. Given the technical nature of this project, there is a risk that project information will be confusing and unclear, resulting in inaccurate reporting. This can be minimised by determining a set of media protocols where only approved spokespeople speak with journalists. This protocol is designed to provide Bundaberg Regional Council with guidance in responding to information requests from the media to ensure factual information is disseminated.

Approved spokespeople

Spokesperson	Topic
Mayor*	- Community consultation process (community info sessions, CRG & TWG) - Top 5 options - Project funding - Political information
Deputy Mayor*	- Community consultation process (community info sessions, CRG & TWG) - Top 5 options - Project funding - Political information - General updates on project progress
Dwayne H / Ben	- Technical information about project aspects - Off the record, background briefings about project elements
CRG Chairperson – Rowan Bond	- CRG meetings and outcomes - Development and delivery of CRG report - Promotion of Community Information Sessions

***If the Mayor or Deputy Mayor are unavailable, the BRC media team can speak on their behalf.**

Content management and approvals

- Mayor should officially speak on behalf of the Council about most aspects of the project
- At times the Deputy Mayor or one of the BRC media team may be designated depending on the type of enquiry and the spokesperson's availability
- If a journalist requires technical information that is not covered in the factsheet or FAQ document, the BRC Project Director and/or GHD Project Director can be given approval to background brief a journalist with the BRC spokesperson in attendance.




Media Protocols

- Any technical information provided to journalists should not be quoted – it should be given as background information purely to provide greater understanding about the project.

What to do if ...

... an unapproved spokesperson is approached by a journalist at a community information session or a public consultation event?

- They should decline speaking to the journalist and instead refer them to the Council spokesperson.
- They could say: "I'm sorry, but I'm not the right person to speak about the project, however let me get the number of the person who can help you."

... a journalist doesn't identify themselves and speaks to an unapproved spokesperson and runs their quotes in a news article?

- BRC's media team should contact the media outlet's COS and reiterate the importance of ethical reporting. Depending on how misleading/inaccurate the article is, it would be appropriate to ask for another story to be written to ensure the facts are reported.

... a story is reported inaccurately due to lack of understanding about the project?

- BRC's media team should contact the media outlet and offer another background briefing to ensure the journalist has a full understanding of the project.

Media toolkit

Communications material	Use
Media release/s & Social Media Channels	- New announcements - Reactive statements - Reissuing to journalists asking about project information that's already been released
Key messages / supporting facts	- Inclusion in media responses, media releases, speeches, website content, newsletter content
Factsheets	- Hand out at community information sessions - Uploading to the website
Media Q&As **(internal doc)**	- For media responses and media interviews
Frequently Asked Questions **(external doc)**	- Technical information about project written in plain English for residents, media and other interested parties




APPENDIX 3

Complete List of Submissions

Resulting from

Community Engagement Strategies

APPENDIX 3

Property Modifications	Comment	Development Controls	Comment	Response Modifications	Comment	Flood Modifications	Comment
						1	River modelling to factor Paradise Dam at close to 100% full for several months prior to rain event and consider extent of flood mitigation achieved by holding dam at 90%, 80% or 70% full during wet season (also consider water contained within the off-stream saturation areas.)
						1	Assess the reduced capacity of all dams and weirs in catchment area due to build up of siltation upstream (eg Mundubbera Weir was identified as having lost capacity and unsure if dredging upstream took place)
						1	Consider additional release valves to lower level of Paradise Dam when severe rainfall events are forecasted (if the irrigation release valves and fishway do not have sufficient capacity)
						1	Modelling to consider impact of extreme storm events on Baldwin Swamp system to address the volume of water discharging from Kepnock into Baldwin Swamp (include projected stormwater flows from Residential A subdivision on southern side of Walker St and commercial development which results in higher stormwater runoff.
						1	Flood waters are restricted at mouth due to reclaimed land and rock walls built by Port Authority (including Skyringville rock walls) and dredging/dumping of spoil & rocks in 1958
						1	Sandy Hook Barrage has decreased the run in the river (at Port end) and reduced depth of river around Bundaberg Sailing Club
						1	Spoil from dredging of the old channel some 70 years ago was dumped to the north east and the north winds have brought all the sand ack into the channel.
						1	Dredgng river (not just the Port)
						1	Very large wide table drain (via duct) cut as low as possible to the river line and fall out to sea (lined with road base) - provided 2 suggested routes for these large table drains
				1	Include messages for Pine Creek residents in early flood warning messages on the radio (ABC radio) ie Pine Creek residents will be affected by flooding on Pine and Cherry Creeks. Current messages of low/minor flooding does not supply the required information.	1	Consider the structural integrity of Paradise Dam - possibly remove.
				1	Power and internet outages restricts access to warnings - suggests ringing of landlines with different ring tone to give warning. (Facebook and Texting fails unless the messages are transmitted with earlier warning. Refering to websites is useless as there is usually no interent service and power fails as well.)	1	Incorporate flood gates into Paradise Dam so as water can be released at appropriate times.
				1	Define flooding areas with Flood Zones and mail out information using easy to understand definintions ie "red zone will need to prepare for evacuation asap"	1	Retention basins could be constructed to slow water down in areas where the velocity is great.
				1	Install a series of UHF radios throughout the district in particular - Givelda School and Rural Fire Brigade, Pine Creek Road and Crosswells Road, Back Electra Road.		
				1	Dedicated BRC representitive to inform ABC and local radio.		
				1	Advise residents as to what is protocol for signalling, i.e waiving to helicopters etc.		
				1	Make Givelda School a dedicated evacuation centre - install showers and emergency generator.		
				1	Evacuation route from Lenihan's and Carter's Road area through the Forestry.		
				1	Train SES boat crews to ferry children to school in the Givelda area.		
				1	Have rations card or someone from Emergency Services or the like to co-ordinate food supplies to outlying areas.		
				1	Levy banks where possible.		
				1	Government owned insurance.		
				1	Self built levees on a small scale.		
						1	Dredge the river so as water can flow out to sea.
						1	Dam a section of the river between the concrete bridge and the barrage. Drain the water out of this area via water pump and then using a couple of big excavator machines dig the river out to a depth of lets say 3 metres deep. Dam up again near the Rum Distillery and remove the water once again and dig the area out to 3 metres deep or so. Once this is done then release both lots of water.
						1	Place industrial water pump at the bywash (where the water skiing happens on Burnett river) set at a height of maybe 2 metres or so above normal height. Put the pump up high out of the 10metre water mark and extend a water pickup down to the waters edge. Build a switch of some type so when the water reaches a certain height it will switch on automatically, a bit like a cow feeder and then switch off when water recedes. The water would have to be pumped out of the river possibly to the freshwater end of the Elliot river or somewhere similar.
						1	Improve the flow of the river.
						1	Reinstate the levee bank at Fairymead.
						1	Level Harriot Island ou to the low tide mark.
						1	Also the mouth of Salt Water Creek should be redirected to point down stream and a set of flood gates should be put in place at the mouth of the creek
						1	Fill in sink holes at Marina with rocks.
						1	Put pipes in Bundaberg Creek and remove Kennedy Bridge. And extend the north wall at the river mouth 100 metres.
						1	Queens jar needs pipes.
						1	Hydrologist to do study of River.
						1	Take top off Ben Anderson barrage so that it is 300mm high.
						1	Dredge the river.
						1	Install flood gauges with rainfall monitors.

APPENDIX 3

Property Modifications	Comment	Development Controls	Comment	Response Modifications	Comment	Flood Modifications	Comment
				1	Install sirens on top of old Burnett traffic bridge and all water towers, and in parks and open space rather than at residents.		
				1	Different volume of siren depending on seriousness of emergency. Should be digital and the standard emergency sound and also be accompanied by a voice direction.		
				1	Test signal only to be voice recording and not emergency tone.		
				1	The local council should be responsible for the administration of the siren system but the BOM should be responsible for the operation of the system.	1	Dredge the Burnett River.
				1	The sirens need to be designed to work before, during and after an event. The sirens would need to be located above the DFE and have solar panels on top.		
				1	Give out tents and sleeping bags at evacuation centres.		
				1	Co-ordinate a united health care disaster protocol that includes GPs, pharmacists and other healthcare workers etc to minimise confusion and maintain vital health care services during crisis times.		
				1	Community to control of our emergency warning systems.		
		1	Implement planning controls which stop developers from converting flood plane into housing lots.	1	A noise warning alert should be reinstated on radio and television before any weather warnings are given.	1	Incorporate Aboriginal learnings into the Floodplain Management Action Plan.
		1	Rezone flood constrained land to become open space and recreation.	1	People in the Moore Park area need an early warning system in the event of a cyclone as the flooding and road closures that may occur in that area will not necessarily come from water coming from the Burnett river catchment area due to flash flooding.		
				1	Improve early flood warning devices/systems for residents along Splitters Creek.		
				1	Map of Burnett catchment area with all the river systems and locations of all river gauging station marked on the map with emergency numbers down the side and stress that ABC radio is the emergency channel to listen to for up to date weather and flood height warnings, you will only get this on a transistor radio when all power is gone.	1	Removal of both Bingara & Ben Anderson Barrages.
				1	Through the wet season Sunwater needs to put in the local paper weekly what percentage water levels in all dams and weirs are at.	1	A pipe line could be run to Walla Weir or Paradise Dam to supply water for the town and for irrigation, due to costs this can be done over time.
				1	Farmers should be contacted through the catchment area during a rain event as a manual backup for automatic rain gauge and river height reporting.	1	Water from Monduran Dam could also be channelled to a point for irrigation supply on the Northern side of the Burnett River.
				1	Council to have database and contingency plan for the elderly and disabled.	1	Governments to provide money for the establishment of riparian areas along river bank and also for the removal of pest and noxious weeds.
				1	Bunnings to be used as an evacuation centre.	1	Do not place any levee banks at Technology Park.
				1	Better advice should be given to SES workers when helping out in area's unfamiliar to them during floods or other disasters so that they don't become the victims of the people they are trying to help.	1	No more infrastructure on the northside of the town bridges or on flood prone land.
						1	Work needs to be done in Waterview Road to Mariners Way to stop the build-up of water in Mariners Way.
						1	Remove debris from the Burnett River and creeks which restrict the flow of water.
							Remove all levies and tram tracks in the Ferrymead area as they are restricting flow of water to the flood delta and Skyringville Passage.
						1	No infrastructure built along River Road.
						1	No cane bins should be stored in area 21 at Ferrymead during the wet season at they act as a levee restricting flow.
						1	North Skyringville Passage should be reopened as this was a major outlet for flood waters before being closed off.
						1	Tantitha ridge needs protection from sand mining as it is the only area that may protect Bundaberg from a Tsunami
						1	Investigate affects of flooding due to infrastructure near Round Scrub and Kirby's Wall.
						1	Polluted drains which run from near Bundy mill effluent pond to Rubyanna Creek need attention and the effluent pond needs moving out of the flood plain.
						1	Stacked up sand along river bank on River Farm down from Kirby's Wall between Gills Road and Rubyanna Creek should be removed as they are forming a levee and will stop the river flow in the event of future flooding, and the head land along the river that has been degraded by farm machinery and tractors using rippers in this area should be reinstated with vegetation and suitable riparian works should be done along not only this area but all rivers and creeks.
						1	In order to reduce the flood height in our City of Bundaberg and the surroundings areas by say 5 metres all that is needed is a "Distributary Channel" or "Diversion Channel" cut into the side of the Burnett River at a height of 15 metres This "Distributary Channel" would channel damaging flood waters into the upper reaches of the Elliott River only in extreme flood events such as 2011 and 2013. The Channel would need to be wide and long enough to accommodate the volume of water to reach the other side of Goodwood road crossing where the height of the Elliott River is 5 mt.
				1	Make provision for adequate and accurate warnings and updates and provision of effective evacuation routes (eg. Hinkler Av & Tallon Bridge)		
				1	Maintenance of power for as long as possible (may require review of where isolation points are located within the network & ability to switch to alternative substations)		
				1	Provision of a fuel dumps for communities that may be isolated and will need fuel for generators,		
				1	A more reliable communications system	1	Review of the impacts of man-made structures on run-off in areas away from and in the main stream in past and future floods
				1	The identification of evacuation centres with infrastructure (water, cooking and toilet facilities) that is able to cope with much-increased numbers.		

APPENDIX 3

Property Modifications	Comment	Development Controls	Comment	Response Modifications	Comment	Flood Modifications	Comment
				1	Allow locals as well as SES staff to participate in evacuation procedures.		
						1	Dredging of river from Foundry to Rum Factory with spoil put on low lying areas (eg Kendalls Flats)
				1	Evacuation centres - Toilets and Showers -The in-house residents, that is everyone on site, should be made aware of what facilities are available in the way of toilets and showers. These facilities need to be supervised from the outset to ensure they are clean and stocks of toilet paper, hand towel and handwash are not wasted, preventing mess and blockages in the sewage system. To have a written roster, with a dedicated person in attendance supervising the situation. A time sheet that is ticked off to indicate the facility has been checked would go a long way in managing the toilets, as done in the airports.		
				1	Evacuation centres - Hand washing – A health professional to give a physical demonstration on just how to wash hands and the use of chemical sanitizers. This is supported with posters in a number of locations.		
				1	Evacuation centres - Signage indicating that fruit has not been washed and that individuals should wash before consuming to prevent the spread of disease. Possibly some water/lemon dipping stations.		
				1	Evacuation Centres - To alleviate wastage allow individuals to refill water bottles at designated stations.		
				1	Evacuation Centres - Supervise recycling in relation to separation of food waste from plastic/paper/glass recyclables.		
				1	Evacuation centres - Have public notice boards to share communications.		
				1	Evacuation centres - Allow unaffected residents to provide help in relation to providing accomodation, food etc.		
				1	Evacuation centres - Have phone recharge stations which provide an array of charges and multiple charging points.		
				1	Evacuation centres - Include facilities and provision for pets. the Council could tag dogs as they do when they are lost.		
				1	Where residents provide accomodation for displaced individuals/families, enter into a simple residential tenancy agreement so as both parties are protected.		
1	Build below ground homes with watertight marine lids so the flood water can't get in, act as "storm cellars"						
				1	Purchase hovercraft for evacuation of up to 200 people at a time		
				1	Purchase Army Ducks to evacuate 200 people at a time		
						1	Apply modern temporary barrier systems in key locations
		1	Land north of Airport Drive rezoned for land use such as recreation, this would also allow land to be use as water retention basin.			1	Build weir or gates around land north of Airport Drive.
						1	Determine where appropriate to locate sea walls, levies and flood gates.
						1	Install large screw pumps at appropriate locations.
						1	Remove dangerous trees that may fall during storm.
						1	Water filled pvc tubing which act as water barrier - alternative to sand bagging.
						1	Dreadge the river 10 metres deep at Fairymead and as wide as possible.
						1	Use the dredged material to build a 10 metre levee around the river.
						1	Dig a new channel from Fairymead to the sea 20 metres deep with a swing for ships and a rock batter on both walls.
1	Council cover expense to raise homes.					1	Remove island at Don Tallon Bridge.
						1	Widen the river and build levee banks.
						1	Flood by-pass channels in the Fairymead precint and downstream flood plain.
						1	Repair Bundaberg Sugar Levee
				1	Improve evacuation warnings and procedure, especially for those in Fairymead as it is believed they did not get appropriate warning times.		
						1	Use mining gear to provide new drainage channels away from and around low-lying areas, and for more efficient drainage systems along footpaths.
		1	Council to provide DERM with data relating to the construction of levees in the BRC area to inform DERM's future regulatory framework				
						1	Install levees and valved drainage to exclude backwater and protect CBD, fund through Special rates and Charges provision of Local Government regulation Sections 28 to 32
		1	Cease Development Approvals in low-lying floodplain and wetland areas.			1	Restore mangroves along riverbank and plant rows of native trees behind the mangrove forests.
						1	Dredge and widen the river from the town reach to the river head.
						1	Remove the Ben Anderson Barrage and Bingera Weir.
						1	Fit Paradise Dam with water release floodgates
						1	Install larger pipes and back flow valves or flood gates at McCoy's Creek in Branyan.
						1	Install larger pipes at the creek intersecting Kirbyn Road.
						1	Flood mitigation work at Colonial Cove, Winfield.
						1	Provide State Government with flood mitigation options.
		1	Establish early warning system.			1	Employ engineering company to gather flood hydraulic maps and data.
		1	Buy-back and relocate flood affected residents.			1	Create mitigation plan for Bundaberg North and East.
						1	Obtain funding from State and Fedral Government.
						1	Dredge the river between the old road bridge and a point where the river again has capacity to accept flood water.
						1	Clean out Saltwater Creek and realign the mouth of the Creek to flow downstream.
						1	Remove mangroves that have formed as a result of the construction of the Ben Anderson Barrage.

APPENDIX 3

Property Modifications	Comment	Development Controls	Comment	Response Modifications	Comment	Flood Modifications	Comment
						1	Remove the island that is forming north of Quat Street (east) and School Lane.
						1	Investigate testing and purchasing Flood Barrier Technology.
						1	Erect footbridge and floodgate at Bundaberg Creek.
						1	Construct levee banks at Mcrdys Creek.
						1	Dredge the Burnett River.
				1	Use the UHF radio repeater at Mt Perry (Channel 1) to distribute flood related warnings for upstream areas, messages could be relayed each hour to update people with what is happing. Upgrade the repeater so its reliable during a disaster, at present its not. Many people can't get ABC radio coverage and only access is UHF radio network.		
				1	Evacuation plans are required around Pine Creek and need to be very clear, legible and easily printed from councils website. For example, State Government Property maps of assessable vegetation (PMAVs) can be completed online by landowners but when you print them they are unreadable. Maps must show cadastral parcels and roads. Local flooding over roads should also be considered in the maps (not just riverine). The routes need to determine whether you can retreat by foot, car or by tractor. Some residents were trying to escape on their tractors but the flood water was too deep.		
				1	Flood warning forecasts should be made at predetermined times over ABC radio during an event for key gauge locations. For example, people can be out preparing for the floods and aren't able to constantly listen to the radio .As an example, if they knew that warnings would be broadcast on the hour (every hour) they could come back to their radios to listen for critical data. Gauges include Paradise Dam, Walla and Bundaberg predictions.		
				1	ABC local radio has very poor reception and in some cases non existent coverage for upstream areas including Goodnight Scrub, Morganville, Wallaville and even areas such as Sandy Hook. People often have no electricity or telephones and would like to rely on ABC radio through transistor radio but they can't access the signal.		
				1	Totem poles or flood markers should be established at key road crossings and locations that were flooded in January between Paradise Dam and the river mouth. Zillman Road at wallaville and the Perry River bridge were specifically recommended and allows the community to keep a watch on river rise. This includes totem poles in North and East Bundaberg that give not only historical flood heights at that location, but also the estimated levels that could be expected based on Walla and Paradise Dam gauges upstream.		
				1	Pine Creek area request for designated fuel drop off points for resupply of generators, residents can only keep a couple days storage but a meeting point would be advantageous for resupply.		
						1	Dredge and reopen Paddys Creek (Western side of Paddy's Island) to see if this will drop flood waters in North Bundaberg.
				1	Need to know bridge closure times in North Bundaberg for the old Burnett Traffic Bridge and the Talion Bridge. This could be at a specific Bundaberg Gauge Level and would allow people to prepare themselves and evacuate prior to their close. Sufficient warning time is needed prior to their close.		
				1	Break north Bundaberg into difference zones, could be based on street blocks and stagger the evacuations so that not everyone is trying to leave at once. Properties could be colour coded so red zone goes at different time to green zone and could be different evacuation route for each.		
				1	If incremental gauge maps are used as part of evacuation maps, then they should be a little consertive to ensure people have enough time to pack their essentials and go. E.G. 0.5m increment prior to them getting wet with sufficient time between.		
		1	Councils flood search database should also include a lot specific level of the Paradise Dam break analysis so when I build my home I can make sure its above that level.				
				1	The dam break inundation map for Paradise Dam should be publically available so everybody downstream can understand the impact to them.		
		1	People struggle to understand how high their properties are above the river bed level. Simple informaiton should be provided to clearly show the depth and river levels that can expected across their property, this should also include their ground contours. People do not know how to access this.				
1	Funding assistance needs to be made available for landowners to repair bank stabilisation that is threatening their homes. Currently only farmers and rural properties can access this, but not if you just have a house that's at risk of falling into the river.						
		1	Planning scheme should give consideration to river bank desabilisation and risks of building homes close to them. Some houses are close to falling into the river as a result of flood damage to the banks.				
				1	Flood search certifications for properties should also integrate evacuation routes and mapping.		
				1	Upload flood animations from the information sessions to councils website so people can understand the river behaviour as it rises and falls across the floodplain. People can assess their own evacuations simply from this if needed.		
				1	Do a direct mail out to individual properties when all of the emergency route mapping and incremental flood mapping is completed to let residents know its available and ready to use.		
				1	Councils facebook page is a good way to send information out to the community, post messages on this page when the flood mapping is completed.		
1	Council Flood search to identify flood level, floor levels and a have a relationship to the incremental flood maps.	1	Don't allow development on low land	1	People are excepting more help on the ground from Council and or SES	1	Harriett Island and Patty Island to go.

APPENDIX 3

Property Modifications	Comment	Development Controls	Comment	Response Modifications	Comment	Flood Modifications	Comment
2	Incremental maps to allow easy identification of lots The hard copy is to big a scale to know where a lot is relative to the flood.			2	Radio is the best source of info but which radio station and critical info at set times (say every 30 mins)		
3	Evacuation paths relative to incremental flood maps			3	Educate people to help themselves via the flood mapping that council are providing		
				4	Food and fuel availability for outlying areas that are cut off by flood water.		
1	Rezoning of flood prone land to land uses such as open space and recreation.			1	Better coordination of SES and voluntary staff, possibly a central or senior contact.	1	Dredge the Burnett River and related creeks.
1	Limit development approvals on flood prone land, in particular residential land uses.			1	Improved training for SES staff in relation to use of boats duri ng evacuation.	1	Levees at selected locations throughout the catchment area.
				1	Allow locals with boats to assist in evacuation procedures.	1	
				1	Improved warning signals such as use of UHF and more detailed information from Council and BOM.	1	
				1	Changing electricity isolation points so as some communities can still have power where possible.	1	
					Earlier warnings in regard to evacuation times.	1	
				1	Use UHF Radios for communication		
						1	Grow more trees to slow flood waters
1	No more development in flood plain			1	More reliable means of communicating flood warnings and evacuations	1	Dredging
				1	Earlier warnings for evacutaion		
				65	Early warning systems need to be developed so that people have ample time to evacuate	40	Shallow parts of river need to be dredged
						35	Bottle necks in river impeding flow should be widened
						40	Mouth of river should be widened to allow early rain and flood water to escape more quickly
						40	The reopening of Skyringville Passage would help with flood water escaping more quickly at the mouth of river
						35	Removal of all levee banks and raised tram lines in the Fairymead area
						50	Removal of Ben Anderson Barrage as first stage and then Bingera Weir as second stage, this would allow better flow of water through the river system helping with the removal of sand build up and would improve the environmental health of the river. Run a pipe line to either Walla Weir or Paradise Dam for
						20	Water from Monduran Dam could be channelled to irrigators on North side of river
						15	Bypass channel built like they have in other countries which will take water to the Elliot River when Burnett reaches a certain height
		60	No more infrastructure of any type to be built on flood plains				
						15	Proposed reclamation works and the building of a new port area on the Northern side of the existing Bundaberg Port be put on hold until the effects of such a development would cause upstream can be modelled
						10	Levee banks will not work in the Bundaberg as the town is split over to big an area unlike towns such as Charleville and St George but may work in places like Moore Park
						1	Raise Perry River Bridge to increase access during minor - medium flooding to reduce the extent of isolation the Goodnight Scrub and Morganville community suffer on a regular basis
				1	Advanced flood warning system be implemented for Goodnight Scrub and Morganville Community which incorporates rainfall and river levels from as far as Monto to increase the minimal warning times to 24 hours notice		
				1	Increased accountability by Sunwater for communicating water releases from Paradise Dam to downstream properties which affect access across Burnett River at Booyal Causeway and backing up of water in Perry River		
				1	If possible to contain water very important have sandbags distributed to area of North Bundaberg - Barlow Street & near by streets instead of telling people to get their own.		
				1	Siren		
				1	On the North Side - loud speakers, sand bags, some official logo to use to help ekvatuate the locals when in boats, put/buy some army ducks, SES office/station on the north side. After provide information for locals effected by mailbox, because not everyone buys a newspeper or listens to the radio. Why did the Rum Distillery know what streets and roads were affected but no one else did. All streets & roads affected should have had Flood Recovery unit/group contacted them, not if you need help seek them. I was affected, I had to clean up before the bridge was opened and then I had to go back to work. Transport to the south side when we could. Too slow and then tyring to get back to home (north side) in the evenings and it taking 2 hrs to get home.		
				1	Operational centre for Police & SES, Secure ADC site.		
				1	Need an early warning system so we can evacuate over the bridge ASAP.		
				1	Warning system - eg: sirens, especially if door knocking not an option - areas cut off. SMS warnings - not affected by power cuts.		
				1	Early warnings and ongoing information is paramount. With no power and no phone the information must come by SMS. ABC radio to keep us updated and safe. Check you BOM site is USELESS.		
				1	Many people in our area do not have mobile phone reception, therefore SMS warnings are of no use to us. Would suggest using ABC radio.		
				1	Community awareness regarding personal effects as these can be long term. A roster system to help the community so it all doesn't come at once. It should be staggered. We were inundated with help the first few days and then nothing. Help should be spread out.		
				1	Ideas - Radio advice logged in giving up to date info. SES need additional skills in boat use ie sensible approach to travelling in 'flood waters'.		
				1	consult Hayden Walker and advise Bundaberg residents (especially at North) of his summer long-term weather forecasts		
				1	ABC radio station to broadcast which areas are being affected up the river and creek systems with information provided from Council and local residents (if they can contact those people to provide information)		
				1	Orders to evacuate North Bundaberg should include instructions for Sharon, Oakwood, Meadowvale - as it was unclear last time.		
				1	Sandbag stations in local flood affected areas because by the time the announcement regarding sandbags being available at Council was delivered by the radio, access routes were already flooded (Ten Mile Road area residents couldn't gain access to sandbags as access routes were already flooded.)		
				1	Improve early warning process and alarms		
				1	Police should be present at every evacuation centre (24 hours per day)		
				1	No announcement about what is happening before it has been properly decided (eg levee Batchlers Rd) – it frightens everyone		
				1	Provide bulk fuel storage (eg Givelda State School) and decide distribution quantities		
				1	Improve broadcasting of flood information (ie false claims of dam bursting)		
				1	Provide evacuation maps		
				1	Provide earlier warnings		
				1	Install visual flood markers		
				1	Please make this information available to all residents		
				1	Please note that not everybody has the internet, and if they do, not everybody knows how to use it to gain access to this information		
				1	Flood gauge on Perry River to provide early warning to Goodnight Scrub community		

APPENDIX 3

Property Modifications	Comment	Development Controls	Comment	Response Modifications	Comment	Flood Modifications	Comment
				1	Install and implement Early Warning System		
				1	Provide radio contact and central area		
				1	Initiate E-Health for remote areas (ie medications)		
				1	Educate the people		
		1	Clear zoning of streets - estates that have not been affected but have limited access are identified to be able to return to homes.				
		1	Advise residents of levels taken of their property. Ie' Inundation level taken at each garage door in the Lakes Retirement Village also what level the Tallon Bridge will close.				
		1	Council free up some parcels of land like Grantham. Talk to Lockyer Regional Council Mayor - Steve Jones. Ballot sof people that want to participate in ballot nd relocation of homes.				
		1	Land use - Planning - Rezoning?				
		1	new plans should include water levels for buildings. We don't need a new bridge, the people of Goodnight need educating in natural disasters. Would be handy I Sunwater would advise when they release water over the causewayall year round for traffic not just flood times.				
		1	No more stupid subdivisions like Mariners Cove				
		1	Establish long term development planning so we don't build on flood plains				
		1	If isolated, we they have access/permission to use private property (ie Lagoon Park)				
1	Need to undertake weed control before it gets out of hand						
1	I would like funding and help with river bank stabilization which is getting closer to our home. Help with all kinds of suitable plants and trees to plant to help stabilize river bank.						
1	It would not be practical to raise the floor of my business.						
1	What is the floor level of 'my' living floor (inside)						
1	What is the flood level associated with my property (all in AHD)						
						1	Remove Ben Anderson Barrage, dredge river where required to maximum depths, create levees where possible (rocks, tree planting). If funding available, create by pass channel (eg Elliott River)
						1	Dredge Burnett River - not only once - on regular basis
						1	Short Term: Dredging, levees where necessary, Weir Removal if it helps reduce peak flood levels Long Term: Start construction of diversion canel to flood proof for future or remove residents from the floodplain
						1	Do something to allow water to get away quicker at the Causeway (Wallaville/Goodnight) - if possible, raise bridge over Perry River

APPENDIX 4

Minutes of Meetings

of the CRG

BURNETT RIVER FLOODPLAIN ACTION PLAN

COMMUNITY REFERENCE GROUP MEETING

MONDAY 23 SEPTEMBER 2013 – 4PM

FUNCTION ROOM, BUNDABERG MAIN ADMINISTRATION OFFICE, 190 BOURBONG STREET, BUNDABERG

MINUTES

Attendance:
Rowan Bond (Chairperson), Kay Amsler, Helen Dayman, Chris Hardy, Rob Marshman, John Olsen, Barry Ehrke, Mark Pressler, John Lee, Jon Carman, Andrew Fulton (General Manager Infrastructure & Planning), Dwayne Honor (Manager Design), Shane booth (Development Planner) AND Robyn Laing (Administration Support).

Apologies:

Apologies were tendered for Steve Cooper of Coopers Hardware and John Bailey from Wallaville.

Introduction and Welcome:
Chairperson, Mr Rowan Bond welcomed CRG members to the Meeting and referred to the role of the CRG to represent the community.

Brief Project Overview – Dwayne Honor:

Dwayne Honor presented an overview of the project, Burnett River Floodplain Action Plan. He advised that the Burnett River Flood Study commenced after 2010/11 Flood. Ex-tropical cyclone Oswald was unique in that it parallelled the coastline and headed inland to Sydney creating very high rainfall in the Burnett River Catchment which resulted in a significant flood event for Bundaberg. Approximately 16,500 cubic metres of water flowed down the Burnett River every second during the heights of this flood. To put this in perspective, he referred to such quantity of flow being similar to almost 7 Olympic swimming pools every second. The Burnett River has one of the largest river catchment in Queensland and the amount of scouring associated with this flood was unique. Urban Search and Rescue crews at the time of the flood recorded 50 homes with catastrophic damage; 448 homes severely damaged; with a total of 837 homes with flood damage. He referred to Back Electra Road area where rural residential properties were flooded with depths ranging from 5.5m to 25m in depth. The largest depth of flooding that occurred in the Bundaberg Region was just less than 27m above ground level near Ned Churchward Weir.

CRG Member, Kay Amsler told the meeting that her home in the Back Electra area experienced very high depths of flooding. They were in great peril before Bundaberg City experienced the flooding and the Pine Creek / Givelda / Electra residents didn't know this amount of flooding was coming. Residents of the said area experienced extended isolation.

Dwayne Honor advised the Meeting that flood surveying was done to record peak flood levels; many were marked by locals who live alongside the river. This information is used to calibrate and refine the flood model. The river bathymetry (river bed cross sections) were also surveyed for the Burnett River from Paradise Dam to the river mouth. The CRG's attention was drawn to the presence of two large, naturally occurring holes in the river bed; one at the Isis pump station and one just downstream of Mt Lawless.

Dwayne Honor showed the Meeting a comparison of the river bed level after the 2010/11 flood versus the 2013 flood. This comparison showed deep scouring of the river bed and some sedimentation areas along the River. He stated that approximately 3,500,000m^3 of sediment had been removed from the river bed between Ben Anderson barrage and the Port as a result of the 2013 flood causing significant bank slumping and destabilisation; some sections are now much deeper.

Dwayne Honor further stated that the flood modelling allows us to measure flood depths, velocities, hazards and shear stress to show where scouring might occur. It shows breakouts, bypasses and backwaters for different flood scenarios. The model is calibrated with data from peak flood levels of actual historic flood events of 1942, 1971, 2010, 2011 and 2013.

CRG Member, Helen Dayman stated that 2008 flood was missing from the calibration. This flood may not have had much affect in Bundaberg City but it had affected her area at Goodnight Scrub. Since Paradise Dam was built there has been frequent flooding. She explained the periods of isolation for different flood events; from 2 – 3days for small floods and up to 3-5 weeks for the 2010/11 and 2013 flood. She pointed out that these smaller floods are insignificant by the time they reach Bundaberg City but it is important to take into consideration the affect these smaller floods have in her area.

There was discussion regarding the areas quick to flood ie Perry River Bridge, Booyal Causeway, St Agnes Bridge, Currajong Creek area. It was noted that there was no historically recorded peak flood level data for the Perry River from the Bureau of Meteorology. Dwayne Honor further stated that if the flood model can replicate the bigger moderate to major floods then it should be able to replicate the lower floods that are affecting these rural areas. The Mt Rawdon area had very high rainfall and additional gauges and upgrades will be done in this area in coming months.

CRG Member, Jon Carman referred to the affect of river flooding on the boating community. Dwayne Honor likened Paradise Dam to a giant measuring jug which tells us what is coming our way. Burnett and Kolan River floodplains join at Moore Park. Council learnt after 2010/11 floods, that it needed to acquire an understanding of the relationship between rain gauges at Paradise Dam and Walla and the respective flooding to the City which led to regression analysis to determine this flood level relationship of key river gauges to Bundaberg. Council has also developed mapping to show at what point on the Bundaberg gauge the flood affects individual properties. He also stated that on average it takes 24 hours for flood waters to reach the City from Paradise Dam and 17 hours from Walla.

CRG member, Kay Amsler pointed out that her area at Pine Creek / Back Electra had less warning time before flooding and that her community needed to understand this. Her community needs to not only understand the relationship between gauge levels and flood levels of the properties but also the roads for evacuation purposes. She stated that phones do not work in her area and that there is no access to help other than what they can do for themselves. There is no help from emergency services owing to isolation. CRG member, Helen Dayman stated that it was the same in her area at Goodnight Scrub and that residents had to take note of the rainfall at Monto and Mundubbera which provides approximately 24 hours notice to prepare for evacuation or isolation.

On the lower Burnett, the flood warning system will be upgraded from Woongarra Pump Station to Mt Lawless, St Agnes, Perry River in November 2013 ready for the next wet season. Currently, there is no redundancy if Telstra IP networks fail. With the proposed upgrade the rain gauges will be linked to the Bureau of Meteorology's ALERT technology which is a VHF radio

network. All information will be streamed real time to the main administration building of Bundaberg Regional Council at the same time as the Bureau of Meteorology. An additional 6 rain gauges will be installed in the lower Burnett River catchment as part of this upgrade. This upgrade will help with flood warning across the lower Burnett and also includes the Paradise Dam gauge.

Dwayne Honor further advised the Meeting that the flood model accurately predicts the behaviour of flooding in the lower Burnett and allows Council to undertake 'what if' scenarios. The flood model is now ready to assess flood risks and impacts to assist with identifying the top five flood resilience options to be submitted to the State Government by December. Detailed engineering assessment will be undertaken in the first half of 2014 on these five options.

CRG Member, John Olsen pointed out that there were two different issues to be considered: risk of life and property; and flood resilience options.

Dwayne Honor stated that Council's window of opportunity to acquire funding support for flood resilience options was closing by the month which is why Council is running all aspects of the project in parallel to meet the State Government's December timeline. The five options could include projects like raising of homes, communication and upgrades of early flood warning systems and infrastructure to improve flood resilience.

CRG Member, Kay Amsler asked if Council was undertaking 'what if' models of Paradise Dam failing and Dwayne Honor stated that a State Government report was expected soon on the Paradise Dam. Andrew Fulton stated that one of the options to be investigated was whether Paradise Dam could be extended to act as a flood mitigation dam. The meeting noted that Paradise Dam was on a permanent release as there are no flood gates on this dam.

CRG member, Rob Marshman asked regarding the capacity of Paradise Dam and Dwayne Honor advised that Paradise Dam had a capacity of just over 300,000 ML and that about ⅔ of Paradise Dam's total storage capacity was reached in one hour of inflow during the 2013 disaster.

CRG member, Barry Ehrke pointed out that the Government may not fund what we identify as the top five options. Chairman, Rowan Bond stated that it was unlikely that both the CRG and the appointed Technical Working Group was going to come up with same top five options. Andrew Fulton advised the Meeting that the Minister was aware that this CRG had been appointed and its purpose. Rowan Bond further stated that this CRG will submit a report to Council in December 2013 clearly identifying the community's top five flood resilience options. Individually, he stated, we have a responsibility to interact with our community. Any option is considered however, left field ideas will naturally fall off as we go through this process. Barry Ehrke asked that it be made very clear to the community that this report is only the community's recommendation of what the top five options should be and not necessarily what is submitted to the Government for funding.

Proposed Timeline:

Chairman, Rowan Bond stated that he would like the third meeting to be held in mid November and call a fourth meeting for December so there is clear direction from the CRG for that final report to Council.

A Media Statement outlining to the community the various members comprising the CRG was passed around for perusal by the CRG Members.

Terms of Reference:

Chairman, Rowan Bond asked if everyone had closely read the Terms of Reference and sought discussion on the role of a CRG member. He referred to his role as the Chair and asked for general agreement or proposed changes.

CRG Members, Jon Carman and Helen Dayman moved that the Terms of Reference, as tabled at the Meeting, be accepted.

The motion was put and carried.

Media Protocol:

CRG Member, Helen Dayman referred to the tabled media protocol and asked how this worked with passing information back and forth between members of the community and the CRG members. She sought clarification to see if there were any restrictions on what the CRG could give out to the community.

Chairman, Rowan Bond stated that the intention of the media protocol was to ensure a standard message goes out from this group. Should any CRG member wish to make media statements, it should be made clear that it was a personal statement and not a statement of the CRG group. He clarified by stating that our main role is to get information to and from the community via our networks (ie using community newsletter) and that there were no restrictions on seeking information from our community. If there is descent within this group, then that discussion should be within this group, not with the media.

CRG Members, Chris Hardy and John Olsen expressed concern regarding the media protocol preventing them from speaking as they saw fit. Chris Hardy raised the matter of resigning from the CRG. Chris Hardy referred to her efforts on the flood mitigation group and the Chairman, Rowan Bond asked Chris Hardy to submit this information collected from the recent meetings and other information gathered since the 2013 flood to this CRG for inclusion in the community consultation process. He stated that this was valuable information that the CRG should process. CRG Member, John Olsen stated that he would resign immediately if he could not speak his own personal opinion and Rowan Bond assured CRG members that everyone would have a fair say in this meeting and that he encouraged everyone to speak. He further stated that the CRG would be operating independently from Council.

CRG members, Jon Carman and Rob Marshall moved that the media protocol be accepted.

The Motion was put and carried.

The Chair allowed further discussion to take place during which various CRG members encouraged Chris Hardy to refrain from resigning and remain on the CRG. Chris Hardy stated that she represented the people who tried to make a difference from 2002. Chris and her friends have already submitted their flood ideas and it is well known what they want. Chairman, Rowan Bond stated that this CRG really needs your input in view of your extensive community

network. CRG Member, John Lee stated that you are one of the most valued members of the CRG but this Action Plan represents the whole catchment not just North Bundaberg. CRG Member, Barry Ehrke stated that you can have your own views in the media but you just don't say it is the views of the CRG. The Meeting was advised that Minutes of CRG Meetings would be posted on the Council's website along with technical reports.

Community Information Sessions:

Chairman, Rowan Bond referred to the community information sessions to be held around the region during the week commencing 24 September 2013. Dwayne Honor stated that the sessions would offer a range of static and interactive information. A brief overview of the flood study will be delivered by GHD's Flood Engineer. The attendees will divide into groups to view various information stands on the history of Burnett River, Early Flood Warning System Upgrade, information supplied by the Bureau of Meteorology, Incremental Flood Mapping which shows the relationship between the gauge readings at Paradise Dam and Walla to properties in the Burnett River catchment. Questionnaires will be used to gather information form the community and Council asked all CRG members to assist Council in collecting this information.

CRG Member, Helen Dayman stated that her community obtained approval to erect community noticeboards for isolated areas and that a voluntary database of vulnerable residents was being prepared which would include GPS coordinates of their location and document who is on medication. This model of community self help was supported by Council's Disaster Management Officer, Matt Dwyer who would like to see other communities use a similar model. The Meeting was further advised that the 'Get Ready' campaign was coming up and the community information sessions will be sharing some of this information. By request, Dwayne Honor offered to join Helen Dayman in a community information meeting in her area at Goodnight Scrub. Chairman, Rowan Bond also offered to attend if he was available.

In answer to questions raised by Helen Dayman, Andrew Fulton stated that it was reasonable to ask if paradise dam could be augmented so that it offers some flood mitigation.

Multi-Criteria Assessment Process - MCA:

Dwayne Honor stated that the MCA facilitates consideration of economic, social and environmental impacts. A key action of this CRG is to review and adopt the criteria and weightings prior to it being used for assessment. This tool will process the ideas for flood resilience. The Agenda for the second meeting will include a draft of this MCA for discussion at the next Meeting.

At the suggestion of Rowan Bond, **the Meeting agreed to create an independent email address (and small website if possible) to facilitate communication between CRG meetings.**

Next CRG Meeting:

It was decided to hold the next CRG Meeting on Tuesday, 8 October at 4pm in the Bundaberg Office.

This concluded the business of the Meeting at 6.10 pm.

BURNETT RIVER FLOODPLAIN ACTION PLAN

COMMUNITY REFERENCE GROUP MEETING

TUESDAY 8 OCTOBER 2013 – 4PM

COMMITTEE ROOM, BUNDABERG MAIN ADMINISTRATION OFFICE, 190 BOURBONG STREET, BUNDABERG

MINUTES

ATTENDANCE:
Rowan Bond (Chairperson), Kay Amsler, Helen Dayman, Rob Marshman, John Olsen, Barry Ehrke, Mark Pressler, John Lee, Jon Carman, John Bailey, Steve Cooper, Rob Calligaris (Council's Design Team Leader), Dan Copelin (GHD Flood Consultant), Robyn Laing (Administration Support).

CONFIRMATION OF MINUTES:

CRG Member, Kay Amsler requested that page 1, 2nd last paragraph be amended to show, "Pine Creek / Givelda / Electra residents" and, "the CRG's attention was drawn to the presence of two large, naturally occurring holes in the river bed;".

CRG MEMBERS, JOHN OLSEN AND BARRY ERHKE MOVED that the minutes of the first CRG Meeting held on 23 September 2013 be confirmed subject to inclusion of the above amendments and that the amended minutes be made available on Council's website.

The motion was put CARRIED.

At this stage, CRG Chairman, Rowan Bond advised the Meeting that a resignation had been received from CRG Member, Christine Hardy and that with the agreement of the Meeting; it was proposed to leave the position open in case Ms Hardy requests to re-join the CRG. The Meeting unanimously agreed to leave the position unfilled and retain Christine Hardy in CRG email listings so Ms Hardy receives all information and was able to rejoin the CRG later in the process, if desired.

CRG MEMBERS, JOHN CARMAN AND HELEN DAYMAN MOVED that Christine Hardy's position on the CRG be left open.

THE MOTION WAS PUT AND CARRIED.

REPORT ON COMMUNITY CONSULTATION PROCESS:

CRG Chairman, Rowan Bond stated that he felt there had been a positive outcome to the recently held community information sessions.

Rob Calligaris presented a report from GHD outlining preliminary results from the community consultation process held to identify and assess preferred floodplain risk management options that builds flood resilience and fosters community preparedness. Comprehensive communication, public consultation and stakeholder engagement was undertaken as follows to

educate the community on the flood model and Floodplain Action Plan and seek their input to assist Council identify the top five floodplain resilience options:

- CRG expressions of interest sought and confirmed
- Media interviews on ABC Wide Bay, 4BU and Seven
- BRC website content updates – prominent location
- Dedicated email floods@bundaberg.qld.gov.au
- Stakeholder briefings and presentations
- Advertisements in 3 local papers to promote CRG and Info Sessions
- Email update to over 10,000+ individuals and organisations to encourage participation
- Speaking role at TAFE on 22 August
- Info Session Posters across community touch-points
- Facebook posts and Tweets reaching 4,000+ people
- Factsheets x 3
- YouTube videos and animations

During the above consultation process, the community was invited to submit their ideas to improve flood resilience to dedicated email addresses: *floods@bundaberg.qld.gov.au* or *floodplaincrg@gmail.com*; talk to a CRG member (who were present at community information sessions); and complete a Community Questionnaire. It was noted that 280 or more residents attended 10 community information sessions held at 6 different locations across the region. These sessions outlined the outcomes of the 2013 flood study, gave an overview of the floodplain action plan process, issued invitation to make submissions, provided mapping and information stations and also gave the opportunity for community members to have one on one discussion with Councillors, Council staff and GHD representative (flood consultant).

Steve Cooper advised there were individual businesses with ideas but had been reluctant to submit their submissions as it would look like they were furthering their own business. **The Meeting agreed that CRG Member, Steve Cooper and CRG Chairman, Rowan Bond would consult with the Bundaberg Chamber of Commerce regarding the possibility of Steve Cooper representing them and taking a submission for flood resilience ideas.**

The preliminary report presented at the Meeting showed early analysis of the feedback received from the community indicating that the majority favoured flood response/warning mechanisms/evacuation plans (49%) and response modifications including structural modifications/infrastructure (48%). It was noted that this result would alter when GHD updated their findings with the latest submissions.

It was further noted that the wording of Sharon/South Kolan is to be amended to read, "Pine Creek / Givelda / Electra / South Kolan / Sharon" where it appears in the GHD report.

CRG Member, Mark Pressler attended the Meeting at 4.20pm

Andrew Fulton (General Manager Infrastructure & Planning) and Dwayne Honor (Manager Design Services and Project Manager), Ben Regan (GHD Flood Consultant) joined the meeting via telephone conference facility at 4.45pm to discuss the Multi Criteria Analysis spreadsheet which had been emailed to the CRG for their perusal. Andrew Fulton stated that the weightings for the criteria were to be determined by the CRG. The CRG were requested to give consideration to the likely funding available when determining rankings for some of the options.

CRG Member, Helen Dayman referred to the recently released Review of Dam Safety Management Actions for Paradise Dam (Flood Event of January-March 2013). The Meeting agreed to forward a copy of this report to Council for Andrew Fulton to read.

This concluded the teleconference with Messrs Fulton, Honor and Regan and the Meeting returned to the order of business, continuing with GHD's presentation on the preliminary findings of the community consultation process.

CRG member, John Olsen tabled a list of questions (attached to minutes) for flood consultant GHD to answer and thus authenticate the outcome. CRG Members, Barry Ehrke and Rob Marshman also had questions regarding the flood model; some of which were answered at the Meeting and others were referred to GHD consultant, Dane Copelin to answer outside of this Meeting via email: *floodplaincrg@gmail.com.*

John Olsen stated that the Burnett River had been modified beyond the level of responsible management and that he was concerned that information on the natural level of the Burnett River was not included. There was discussion regarding the lack of tidal flow in the river and stagnant sections upstream. CRG Member, Jon Carman stated that there is a much lower tidal prism since installation of the Ben Anderson Barrage. He referred to compacted sediment in the vicinity of the Burnett River Bridge and Millaquin and stated that the problem was fine siltation rather than sand and that the Burnett River was slowly moving south. He further stated that Harriet Island was growing in size and that it hardly existed prior to 1942 flood. There was discussion regarding removal of Ben Anderson Barrage to improve tidal flow and reduce sedimentation and John Lee stated that he had observed more sedimentation now than in previous years. CRG Member, Mark Pressler pointed out that the Ben Anderson Barrage had been installed to provide irrigated water to farms in the Woongarra system and stated that the recent drop at Ben Anderson Barrage to 2.2m (to carry out repair work) had put approximately 35 irrigators out of action. Without this barrage, there will be no farms on the south side. CRG Member, Rob Marshman referred to LiDAR imagery taken at the peak of the 2013 flood and stated that the floodplain area at Fairymead was the natural diversion for high flood levels and that the levee construction was dictating the water levels in the city.

Dan Copelin (GHD Flood Consultant) drew the Meeting's attention to the large size of the Burnett River system and stated the 2013 flood of the Burnett River was something like 4-5 times the volume of the 2011 Brisbane flood.

Multi Criteria Analysis (MCA) Weightings:

GHD Consultant, Dan Copelin advised the Meeting that this tool was a method of assessment often used to evaluate different criteria and that it gave the CRG an opportunity to give meaning to what criteria they felt was more important.

There was some discussion and amendment to the criteria proposed by GHD. The attached draft criteria and weighting was resolved at the Meeting; noting that the MCA (as amended at the Meeting) would be forwarded by email to the CRG for further review. CRG members were asked to advise the Chair no later than 10 October 2013 of their agreement or propose additional amendment.
The CRG requested that all flood submissions be collated in one database and emailed to CRG members for review for the purpose of eliminating unrealistic submissions. It was noted that this amended list was also required by 10 October 2013.

Next Meeting Date:

It was resolved to hold the next CRG Meeting in the Bundaberg Office on Thursday 31 October 2013 at 4pm.

This concluded the business of the Meeting at 8.05pm.

Overall Categories - Calculation of Weightings

	ADOPTED WEIGHT
Economic	25%
Social	40%
Environmental	35%

Economic Criteria

A	Overall cost-benefit
B	Cost of implementation
C	Cost of maintainance / upkeep
D	Inundation of agriculture land
E	Impact on local business / commercial land
F	Impact on residential properties
G	Impact on municipal infrastructure / utilities
H	Impact on fisheries
I	Impact on tourism

Social Criteria

A	Communication / notification during a flood event
B	Flood warning time
C	Frequency & duration of flooding or isolation / effects of isolation
D	Impact on direct exposure to flood hazard / safety
E	Visual amenity
F	Cultural heritage
G	Impact on community infrastructure
H	Impact on evacuation routes
I	Impact on recovery / accommodating displaced victims of a flood

Calculation of Weightings

	A	B	C	D	E	F	G	H	I		SCORE	CALCULATED WEIGHT
A											3	8%
B	A										1	3%
C	A	C									2	6%
D	D	D	D								6	17%
E	E	E	E	E							7	19%
F	F	F	F	F	F						8	22%
G	G	G	G	D	E	F					5	14%
H	H	H	H	D	E	F	G				4	11%
I	A	B	C	D	E	F	G	H			0	0%

Weighting Calculation

	A	B	C	D	E	F	G	H	I		SCORE	CALCULATED WEIGHT
A											7	19%
B	A										6	17%
C	C	C									6	17%
D	A	B	D								5	14%
E	A	B	C	D							0	0%
F	A	B	C	D	F						1	3%
G	A	B	C	D	G	G					2	6%
H	A	B	C	D	H	H	H				4	11%
I	A	B	I	I	I	I	I	H			5	14%

Environmental Criteria

A	Impact on terrestrial environment (flora / fauna)
B	Impact on aquatic / riparian environment (flora / fauna)
C	Difficulty of environmental approvals
D	Impact on river stability / sedimentation
E	Erosion / scour to floodplain

Calculation of Weightings

	A	B	C	D	E		SCORE	CALCULATED WEIGHT
A							2	20%
B	A						3	30%
C	A	B					0	0%
D	D	B	D				3	30%
E	E	B	E	D			2	20%

Modelling questions

FROM JOHN OLSEN...

I personally have questions to ask before being convinced that the scope of the modelling is sufficiently rigorous to cover all bases.

. Does the modelling date from a period where natural conditions occurred, and before impoundments changed the river?

. If the modelling does not do that , then the results could well be skewed in relation to rainfall volume v river height reached during flood events past and present.

Why?

. Because the river heights of a natural system are the base line factor. They have become elevated due to the influences of the human activity. We need to know, (as best we can), to what extent human activity has elevated river heights during floods, and to what extent the duration of flooding has changed.

Other modelling concerns and questions.

. Has the modelling accounted for cm capacity of river narrowing caused by the installation of training walls? How much water capacity has been displaced by training walls?

. The model needs to consider the changed tidal influences at play since the training walls were put in place across the mouth of Skyringville Passage. Skyringville pass was the natural northern entrance of the river . The training walls have changed the exhaust direction of the river.

. It seems implausible that were the northern entrance re-opened, that the silt level deposits in the Port Bundaberg sea leads area would not be significantly reduced.

. This is because the sedimentary drift of silt etc is carried in the direction the water is flowing.

. Therefore, whilst a simplistic example, it follows that were the north wall breached to permit say, 30% of the tidal flow to escape in its natural water course, then approx. 30% less silt should build up in the Port sea leads. At the very least, dredging should be reduced by a comparative margin, and shipping access could be achieved at an earlier date, and at a lesser cost.

. Some learned locals are saying that Moore park beach is eroding away because the water carrying the sand which used to be carried by tide from the river through Skyringville Passage no longer replenishes the beach front because the tidal flow has been modified. The sand now finds it's way east into the sea leads and settles there, instead of being transported northward to replenish the Moore Park beaches.

. Does the modelling take into account the creeks and streams which were filled in and subjected to development over time?

These streams were nature's drainage system, the system which helped drainage occur at the earliest possible period after rainfall.

. In terms of flood relief, the CRG could identify specific problem areas. Some of these will be mentioned in public submissions, whilst others may not.

It would be helpful to identify solutions as well. Again I stress that necessary items such as early warning systems are a must. However they in no way relate to flood level relief.

BURNETT RIVER FLOODPLAIN ACTION PLAN

COMMUNITY REFERENCE GROUP MEETING

THURSDAY 31 OCTOBER 2013 – 4PM

COMMITTEE ROOM, BUNDABERG MAIN ADMINISTRATION OFFICE, 190 BOURBONG STREET, BUNDABERG

MINUTES

ATTENDANCE:

Rowan Bond (Chairperson), Kay Amsler, Helen Dayman, Rob Marshman, John Olsen, Barry Ehrke, John Lee, Jon Carman, Steve Cooper, Andrew Fulton (General Manager Infrastructure & Planning), Rob Calligaris (Council's Design Team Leader), Robyn Laing (Administration Support) and Snr Sergent Grantley Marcus, (QPS Liaison Officer between Disaster Management and Minister for Local Government, Community Recovery & Resilience, Hon David Crisafulli).

APOLOGY:

An apology was tendered for John Bailey, Dwayne Honor (Council's Design Manager and Project Manager) and Mark Pressler.

CONFIRMATION OF MINUTES:

CRG MEMBERS STEVE COOPER AND JOHN OLSEN MOVED that the Minutes of the CRG Meeting held on 8 October 2013 (as tabled at this Meeting) be confirmed and made available on Council's website.

The motion was put CARRIED.

MULTI CRITERIA ANALYSIS (MCA):

CRG MEMBERS, HELEN DAYMAN AND STEVE COOPER MOVED that the amended criteria and weightings for assessing the flood resilience submissions (as tabled at this meeting) be adopted.

The motion was put CARRIED.

FLOOD RESILIENCE SUBMISSIONS:

Dan Copelin (GHD Flood Consultant) joined the Meeting via teleconference to provide explanation on the tabled flood resilience options summarised from community consultation (copy attached to these Minutes).

Andrew Fulton attended the Meeting at 4.15pm

The Meeting discussed in detail the additional flood resilience options tabled at the Meeting by CRG Members, Jon Carman, Barry Ehrke and Rob Marshman. Dan Copelin offered support for the idea from Jon Carman (Option 10) to construct levees to reduce the depth and velocity of water in North Bundaberg in the event of major floods; noting that such a large volume of water as experienced in the 2013 flood event, cannot be kept out of North Bundaberg all together without causing adverse effects in other areas with regard to increased velocities and peak flood heights.

CRG Member, Jon Carman referred to the idea of raising the North Perry Railway Line (Option 14) and Dan Copelin advised that a levee could be built along the rail corridor instead of raising the railway line. He discussed the method of using concrete infill panels in the rail corridor and also temporary lift-in panels on roads to provide flood resilience.

CRG Member, Barry Ehrke outlined the reasons for his proposal to open up Skyringville (Option 30) and stated that from his experience, you always start at the mouth and open it up first. In reply, Dan Copelin advised that preliminary modelling had shown that removal of certain restrictions in the river had a greater effect than opening up the mouth. The recent dredging undertaken at Port Bundaberg had been included in the model. Preliminarily testing (for a 2013 flood event) of diversion channels and re-opening the Skyringville passage (as described in options 30 and 21) only provided a benefit to the area around the Port of Bundaberg and offered no benefit to the populated areas further upstream. He further stated that widening the river at Millaquin Bend (Option 31) offered a substantial benefit to the city area. Whilst the river mouth is a constraint, there are so many places for the flood waters to release, that widening the mouth does not provide much relief to the flooded areas of the city.

CRG Member, Jon Carman enquired about the extent of benefits to be received from the proposed Rubyanna diversion channel (Option 20) and Dan Copelin advised that early preliminary testing had shown that the benefits depleted upstream of Paddy's Island.

Andrew Fulton asked if Option 31 to improve the restrictions in the river in the Millaquin area increased the backwater flood levels. Dan Copelin advised that preliminary testing in the flood model showed that the widening of the river at Harriet Island (Option 35) and Millaquin bend (Option 31) decreased the quantity of backwater experienced in East Bundaberg and also offered improvements to North Bundaberg and upstream areas. As all the flood water rejoins the river down near the Fairymead levee, no significant increase was modelled for downstream areas. Dan clarified that whilst substantial benefit was modelled from widening the river at the Millaquin bend, greater improvements were modelled when the river was widened from Harriet Island to Millaquin bend.

In reply to questions raised by CRG Member, Rob Marshman with reference to Option 31, Dan Copelin advised that preliminary modelling had shown that dredging works at Millaquin bend had potential to reduce flood levels in East Bundaberg in the order of 600mm. Further, the east Bundaberg levy (option 2) would prevent backwater in East Bundaberg without affecting the flood heights elsewhere. As some properties in East Bundaberg flood regularly, widening the river at Millaquin would assist in all events not just major events; which was a matter to be noted for consideration.

With reference to Option 19, Dan Copelin advised the Meeting that structures to prevent flood waters breaking the bank at Perry Street caused increased peak flood heights and velocities in other areas of North Bundaberg. If the levee was continued to Mariners Way the peak flood

heights on the southern side of the river increase in the order of 1 – 1.5 metres. Dan Copelin confirmed Rob Marshman's comments that efforts to prevent flooding of North Bundaberg resulted in adverse affects somewhere else. It was noted that more benefit could be received mitigating against flooding that happened every 20-30 years, than the one major event that happened once every 100 years or more.

Option 10 would provide additional time for evacuation in a major flood event and whilst flooding would still be experienced, this proposed levee would provide immunity for medium flooding; which is experienced more frequently than the 2013 event.

Helen Dayman drew the Meeting's attention to option 38 to upgrade regional Bridges and enquired about the modelling undertaken to date. She stated that whilst the community would like Booyal Crossing upgraded, given the width and velocity of flood water, she did not think it would be realistic to construct a bridge. However, raising the crossing a couple metres above regular flood height and heights experienced during Paradise Dam releases, would offer great benefit to the community. It was noted that Pine Creek, Cherry Creek and Log Creek should be included. Dan Copelin advised that he could make a preliminary recommendation on what heights the bridges/crossings should be subject to additional hydraulic work and agreed that there would be substantial benefit received from modest upgrading of bridges/crossings in these regional areas. At this stage, the Meeting discussed the possibility of upgrading a road through the State Forest and private property via Promiseland Road to be used in times of evacuation in lieu of upgrading bridges/crossings over Pine Creek and Cherry Creek.

John Olsen spoke regarding this proposal to remove Ben Anderson Barrage (Option 28) and tabled additional information (attached to these Minutes). In reply to John Olsen's comments, Dan Copelin clarified his comments of 'major implications for water supply' by stating that he did not mean it was impossible but would incur high costs to secure and deliver an alternative water supply. Dan Copelin also pointed out that securing a supply of water in drought years would need to be considered. John Olsen reiterated previous comments that modelling should be undertaken from a pristine state of the river to fully understand the elevated state of the river since construction of Ben Anderson Barrage. At this stage, Dan Copelin referred the Meeting to his email circulated prior to this Meeting, answering the concerns raised by John Olsen (copy attached). To address the first issue, he stated that preliminary modelling showed the removal of Ben Anderson Barrage to offer a reduction of 1 – 2 cm in flood height during a 2013 flood event. Whilst it looks like a large imposing structure, the barrage has a crest level of about 2m and the flood level in 2013 was approximately 14 metres. The structure is low compared to 2013 flood levels so it is not exerting an impact on peak flood levels upstream or downstream of the barrage. He further stated that this does not mean that the barrage would not have an affect in smaller flooding. He reiterated previous comments by stating that restrictions other than the barrage (such as Millaquin bend) were driving the high flood levels rather than other structures built in the river. The second issue raised by John Olsen was the affect on flood levels caused by increased rate of sedimentation upstream of the structure. Dan Copelin agreed that it was probably true that the barrage had caused sedimentation upstream of the structure and referred to previous studies undertaken after the barrage was built. These sediment transport studies found that the barrage did not substantially contribute to reduction in river depth. It was noted that sedimentation occurs naturally and that sedimentation may have built up even if the barrage had not been constructed. Currently, the barrage is likely holding back sedimentation upstream of the structure and it can only be concluded from our limited knowledge that the barrage is not contributing to sedimentation downstream. The hydraulic studies undertaken in the 1980s and 1990s are not clear about a moderately silted up river

flooding to higher depths given that flooding scours sediment anyway. Dan Copelin stated that the removal of Ben Anderson Barrage was omitted from the list of proposed flood resilience projects in view of the preliminary modelling results, the findings in the 1980s and 1990s hydraulic studies and major implications for water delivery and security of supply in drought conditions.

John Lee asked Dan Copelin if the barrage had any impact on the flow of the river in the 2013 event and Dan Copelin replied stating that the barrage is located on a straight reach of the river and had no affect on direction of flood waters. Whilst there is evidence of the river meandering in the lower reaches throughout time, there is no evidence of this happening in the stretch of river where the barrage is located.

Rob Marshman referred to the flow velocities in GHD's email dated 31 October 2013 (copy attached to these minutes) and stated that many of these recorded velocities seem to be less than what was observed at the time of the 2013 Flood. Dan Copelin explained that the surface velocity is higher than the average velocity taken in a cross section and that whilst some of those surface velocities were excessively high; such velocities will not be shown in GHD's results which only reflect averaged velocities.

Rob Marshman referred to Option 25 and asked regarding the frequency of dredging at Millaquin bend. Dan advised that all dredging and widening has yet to be determined after receiving input from Bundaberg Port Authority. Rob Marshman raised further questions concerning costings and Dan Copelin advised that only the highest order costing would be utilised in assessing and comparing these flood resilience options.

Helen Dayman asked questions regarding the proposed levees in North Bundaberg (Option 10). The Meeting was advised that the proposed levees would offer flood immunity for a flood greater than the 2010/11 event but smaller than the 2013 event. Historically, flood levees have been built to the height of the last flood but the height of a flood levee can be built to offer flood immunity for smaller flooding such as a one in 50 year event.

The Meeting discussed the benefit of combining flood resilience options. Dan Copelin confirmed that the reduced flood heights from Option 31 - Millaquin bend would greatly reduce the height and engineering required for the East levee in Option 2. It was noted that the homes and properties benefiting from the North levee proposed in Option 2 only came into effect for a 2013 flood event and that these properties did not flood below this level of flooding.

Dan Copelin agreed with comments by CRG Members that widening the full reach or just Millaquin bend and raising evacuation roads seemed to make the most sense at this early stage of the investigations.

The CRG Members were asked to comment on the Wallaville levee (option 12). Dan Copelin stated that it might be better to address evacuation routes rather than leave a small community isolated in a flood event.

Helen Dayman asked if Paradise Dam had been modelled in the event of a failure. Snr Sergent Grantley Marcus stated that he was expecting a report from Sunwater on this matter and that he would put forward a submission to provide the CRG with some sort of appreciation of those questions. Dan Copelin stated that modelling had been undertaken for the Probable Maximum Flood which would be greater than a dam break. He further stated that upgrading Paradise

Dam to a flood mitigation dam would require a tripling of the dam's volume to reduce the current 100-year flood to the equivalent of the current 50-year flood.

CRG Chair, Rowan Bond referred the Meeting's attention to Option 38 – regional bridge upgrades. It was agreed to include Pine Creek, Cherry Creek and Log Creek (at the end of School Lane / Pine Creek Road) as these roads are cut off with frequent minor flooding. It was noted that there are a number of creek crossings that require upgrading to maintain access during minor to medium flood flooding and the Meeting suggested that these crossings be identified for submission to Council to commence a program of upgrades. Upgrading of alternative access routes in lieu of bridge/ crossing upgrades was discussed at length.

CRG Chair, Rowan Bond thanked Dan Copelin for his time and concluded the teleconference.

The Meeting resolved to adopt the summarised list of flood resilience options prepared by GHD for assessment with the agreed multi criteria and designated weightings subject to the following amendments:

Option 12 – Open up the Wallaville Ring Levee to protect those properties flooded in the 2013 event.

Option 20 – Rubyanna Diversion Channel would significantly reduce safe anchorage for boats.

Option 21 – Amend to include an option to take a channel from the apex in the bend of the river at Fairymead across to Skyringville.

Option 26 – Include the option of removing a 5 metre high ridge separating Fairymead from Skyringville to encourage flood waters to flow to Skyringville.

Option 25 – Clarify area of dredging at Fairymead Bend in the vicinity of Rubyanna Creek and the old Fairymead Molasses Wharf.

Option 27 – Amend to include responsible removal of mangroves from the town reach.

Option 29 – Seek clarification if Perry Island is Paddy's Island and whether this option is for the removal of sedimentation only.

Option 36 – Amend to include removal of part of Harriett Island – being the southern bank above Tallon Bridge to straighten the flow path.

Option 38 – Amend to include Pine Creek, Cherry Creek and Log Creek (in the vicinity of Pine Creek Road / School lane) and/or an alternative evacuation route for Wallaville Bridge.

OTHER MATTERS:

Paradise Dam:

Snr Sergent Grantley Marcus offered to arrange for a Sunwater representative to present emergency plans for Paradise Dam to CRG. It was noted that notification of releases from

dams was now compulsory and that Paradise Dam was to be upgraded with sensors to give warning of impending failure.

Removal of debris from banks of Burnett River:
John Olsen referred to the build up of debris in the Burnett River and reported the following sites for attention:

1. Rubyanna Creek (near Millaquin pond)
2. Kirbys Wall Boat Ramp – just past the wash out
3. Finemore Caravan Park, Quay Street

NEXT MEETING DATE:

It was agreed to make a tentative date of Tuesday 19 November 2013 to commence at 4pm in the Bundaberg Office for the next CRG Meeting. *Meeting Date to be confirmed by the CRG Chair.*

This concluded the business of the Meeting at 8.15 pm.

Memorandum

28 October 2013

To	Rob Calligaris		
Copy to	Dwayne Honor; Robyn Laing		
From	Daniel Copelin	Tel	0733163608
Subject	List of Options for Multi Criteria Analysis	Job no.	41/26909

In consultation with BRC, GHD have prepared a list of options for the multi criteria analysis (MCA). The list has been compiled based on feedback received from the community, direct input from the Community Reference Group and consultation with Council officers. The list represents a range of potentially viable large-scale floodplain risk management options that will be taken forward for consideration in the MCA, with a view to establishing the "top five" options by December. A total of 40 items are presented in Table 1 below, with 24 of those to be considered in the MCA. Where an option has been excluded from further consideration, preliminary justification is provided. Further detail and explanation will be provided as part of the final Options Report. A schematic map of each option, showing possible alignments and extents of works, is also attached.

The options in Table 1 are generally large and complex projects that would require a substantial commitment of resources. The high-level MCA process will help to rank these large projects, so that a smaller list can be taken forward for more detailed investigation. Future detailed investigations into the most favourable options will include cost-benefit assessments and other investigations in project constraints and risks.

The alignment and extent of the works are preliminary and suitable for high-level assessment only. Further investigation may reveal that, for example, only a part of a levee is required or that an alternate alignment is more appropriate.

It is noted that a wide range of other options and suggestions have been tabled as part of the community consultation process across the broad categories of Property Modification Measures, Development Controls, Response Modification Measures and Flood Modification Measures. Many of these suggestions (such as improved flood information for residents, flood warning systems, additional rain / stream gauges, and better provisions for recovery centres) are relatively simple and low cost or are already planned for implementation, and have hence been excluded from the current MCA process. These other suggestions will be discussed as part of the overarching Floodplain Risk Management Study to be completed in 2014.

Regards

Daniel Copelin

GHD 145 Ann Street Brisbane QLD 4000 GPO Box 668 Brisbane QLD 4001 Australia
T 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Memorandum

Table 1 – List of Options for Multi Criteria Analysis

ID	Type	Name	Description.	Include in MCA (Yes / No)
1	Levee	North Levee	A levee extending north along the high ground from North School hill, protecting parts of Bundaberg North and low lying areas in Gooburrum south of Tantitha Road. The levee could be constructed to protect against a major flood (2013 or greater).	**Yes**
2	Levee	East Levee & Floodgate	A levee along Quay St East, and extending north past the mill. The flood protection system would include a flood gate at Bundaberg Creek. The levee could be constructed to protect significant areas in Bundaberg East, South and Central against a major flood (2013 or greater).	**Yes**
3	Levee	Perry St to Mariners Way Levee	A levee along Perry Street extending to Mariners Way, to prevent flood waters breaking out of the river into Bundaberg North during a major flood event.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
4	Levee	North Bank and East Levees	A levee along the north bank of the town reach, combined with the East Levee and floodgate option. The levee systems would constrain all flood flows to the river corridor.	**Yes**
5	Levee	North and East Levees	A levee along the high ground north of North School Hill, combined with the East Levee and floodgate option. The levee systems would constrain all flood flows to the river corridor, while allowing breakout flows across Perry Street during a major flood event.	**Yes**

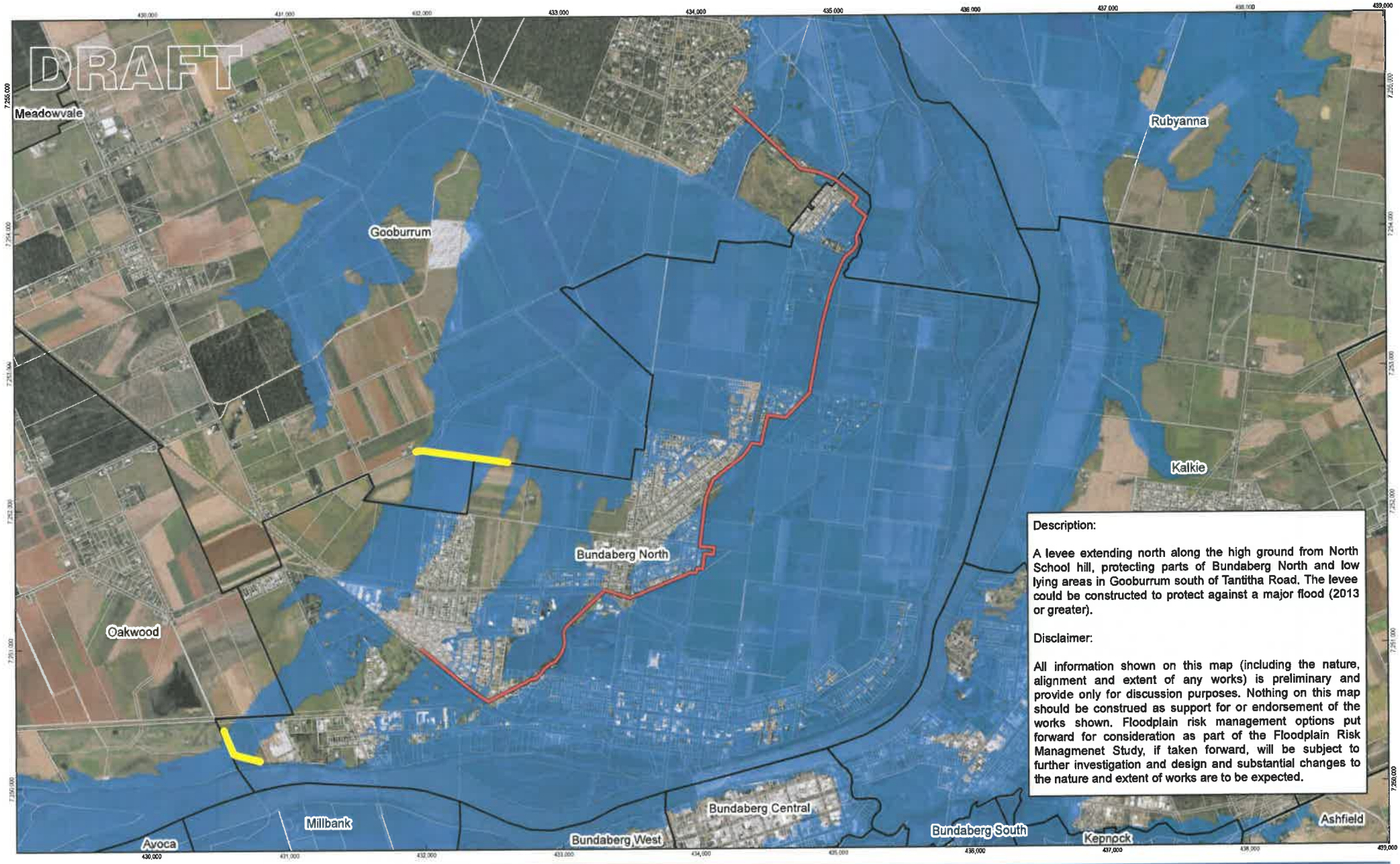
GHD 145 Ann Street Brisbane QLD 4000 GPO Box 668 Brisbane QLD 4001 Australia
T 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

6	Levee	West Hinkler Ave Levee	A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
7	Levee	Perry & Wilmot St Levee	A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
8	Levee	Perry St & Hinker Ave Levee	A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
9	Levee	Hinker Ave to Cameron St Levee	A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
10	Levee	Low Level North Bundaberg Levees	A system of low-level levees to protect parts of Bundaberg North from flood events smaller than the 2013 event. The first levee is along Perry Street and would act to prevent the breakout of flow from the river, and the second levee between Mount Perry Road and Mariners Way would prevent the ingress of backwater flooding.	**Yes**
11	Levee	Port of Bundaberg Levee	A levee or sea wall along the river bank in the urban area at the Port of Bundaberg.	**Yes**
12	Levee	Wallaville Levee	A ring levee to protect the urban areas in Wallaville from major flooding.	**Yes**

13	Levee & Channel	West Hinkler Ave Levee & Gardens Channel 1	A combined levee and channel option to protect parts of Bundaberg North from the full impact of high velocity flood waters, while providing additional flow conveyance capacity.	No. Adverse hydraulic impacts, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
14	Levee & Channel	Rail Levee & Perry St to Cameron St Levee with Gardens Channel 2	A combined levee and channel option to protect parts of Bundaberg North from the full impact of high velocity flood waters, while providing additional flow conveyance capacity.	No. Similar to other options.
15	Levee & Channel	Gardens Channel 2 with Adjacent Levee	A combined levee and channel option to protect parts of Bundaberg North from the full impact of high velocity flood waters, while providing additional flow conveyance capacity.	No. Levee offers no additional benefits compared to channel alone.
16	Levee & Channel	North Bank and East Levees with Gardens Channel 2	A levee along the north bank of the town reach, combined with the East Levee and floodgate option and a large bypass channel near the botanical gardens. The levee systems would constrain all flood flows to the river corridor, while the bypass channel would provide relief for floodwaters during a major event.	**Yes**
17	Levee & Channel	North and East Levees with Gardens Channel 2	A levee along the high ground north of North School Hill, combined with the East Levee and floodgate option. The levee systems would constrain all flood flows to the river corridor, while allowing breakout flows across Perry Street during a major flood event. The bypass channel would provide relief for floodwaters during a major event.	**Yes**
18	Channel	Gardens Channel 1	A 100m wide and 2m deep (nominal dimensions only) flood bypass channel constructed near the Botanical Gardens to provide relief for flood waters during a major flood event.	No. Limited hydraulic benefits compared to cost.
19	Channel	Gardens Channel 2	A 250m wide and 2m deep (nominal dimensions only) flood bypass channel constructed near the Botanical Gardens to provide relief for flood waters during a major flood event.	**Yes**
20	Channel	Rubyanna Bypass Channel	A 500m wide diversion channel with an invert level of -2m AHD (nominal dimensions only) to improve the flood carrying capacity of the river in the Rubyanna area.	**Yes**

21	Channel	Fairymead Diversion Channel 1	A 200m wide diversion channel with an invert level of -3m AHD (nominal dimensions only), to allow floodwaters to bypass the critical constriction at the Fairymead Bend. The channel discharges to the sea near the mouth of Skyringville Passage.	Yes
22	Channel	Fairymead Diversion Channel 2	A 200m wide diversion channel with an invert level of -3m AHD (nominal dimensions only), to allow floodwaters to bypass the critical constriction at the Fairymead Bend. The channel reconnects with the river downstream of the bend opposite the port.	No. Diverts too much water towards Port, increasing flood levels,without significant upstream benefits.
23	Dredging	Town Reach Dredging	Lower the river along the town reach by a nominal 3m by dredging.	Yes
24	Dredging	Barrage to Port Dredging	Lower the river between the barrage and the port by a nominal 3m by dredging.	Yes
25	Dredging	Selective dredging at foundry, Miliquin Bend and Fairymead Bend	Selective dredging (deepen river by a nominal 3m) at critical constrictions at the Foundry, Millaquin Bend and the Fairymead Bend.	Yes
26	Floodplain works	Removal of Fairymead Levees	Removal of existing levees at Fairymead to allow flood waters from the river to escape over the floodplain to the north and west.	Yes
27	River works	Removal of mangroves from town reach	Removal of riparian vegetation along the town reach to increase the flood carrying capacity of the river.	Yes
28	River works	Removal of Ben Anderson Barrage	Removal of Ben Anderson Barrage to directly reduce peak water levels during a flood event.	No. No significant hydraulic benefit, major implications for water supply.
29	River works	Removal of sediment from north bank, Harriet Island and Perry Island	Removal of accumulated sediment (to a nominal depth of 0.5m) along the north bank of the town reach, but allow mangroves to re-establish on the inter-tidal mud flats to help preserve river bank stability.	Yes
30	River works	Reopen Skyringville Passage	Removal of the north sea wall opposite the Port of Bundaberg, and dredging of the old river mouth to a nominal depth of 5m to reopen Skyringville Passage.	Yes
31	River works	Millaquin Bend widening (north bank)	Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.	Yes

32	River works	Edina St widening (north bank)	Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.	No. Shifts problem downstream, needs to be combined with all town reach widening.
33	River works	Foundry widening (north bank)	Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.	No. Shifts problem downstream, needs to be combined with all town reach widening.
34	River works	Fairymead Bend widening	Excavate the north bank of the Fairymead bend to a nominal depth of 5m to improve the flood-carrying capacity of the river at a critical constriction location.	No. Diverts too much water towards Port, increasing flood levels.
35	River works	Town reach widening (north bank)	Removal of sediment and excavation of ground along the north bank of the town reach to improve the flood-carrying capacity of the river and remove critical constrictions.	**Yes**
36	River works	Remove Harriet Island	Remove Harriet Island by excavating to a nominal depth of 5m.	No. Limited hydraulic benefits, shifts problem downstream.
37	River works	Deepen and widen north channel at Harriet Island	Undertake dredging and excavation to deepen and widen the channel to the north of Harriet Island. Nominal width of 200m and nominal depth of 5m.	Limited hydraulic benefits, shifts problem downstream.
38	Road / bridge upgrade	Regional Bridge Upgrades	Targeted upgrading of key bridges in the regional Burnett River floodplain to keep evacuation routes open for longer periods in major flood events, and otherwise reduce the frequency and duration of isolation.	**Yes**
39	Road / bridge upgrade	Bundaberg North Evacuation Route Upgrades	Selected raising of roads in Bundaberg North to keep evacuation routes open for longer in major flood events, and otherwise reduce the frequency of road closures due to flooding.	**Yes**
40	Property	Funding for house raising / restumping	Provision of funding for residents to raise and restump homes in highly flood prone areas.	**Yes**



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0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Technology Park and Batchlers Rd Levees (Seperate Project)

North Levee (Indicative Alignment)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA North Levee

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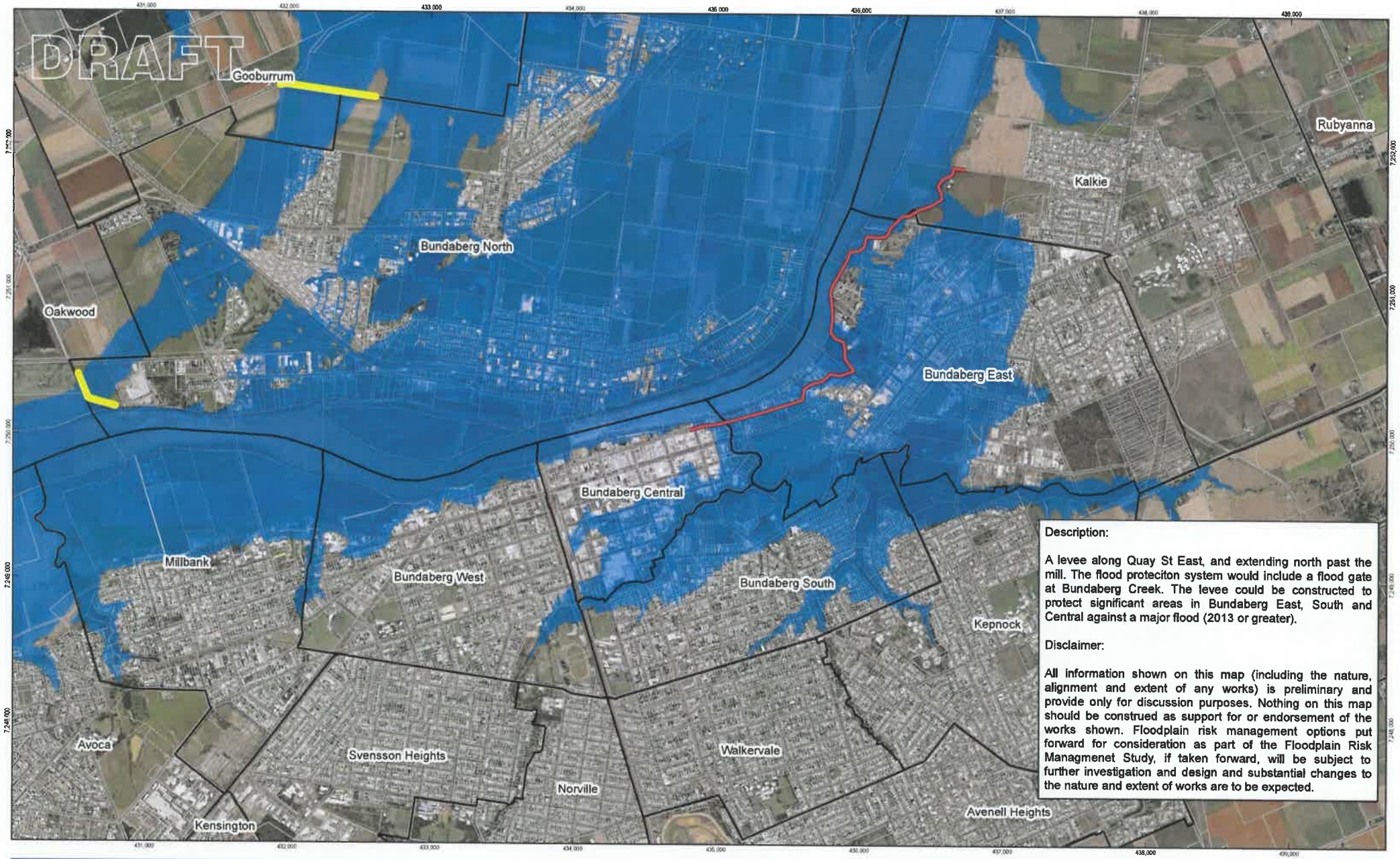
Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A levee along Quay St East, and extending north past the mill. The flood proteciton system would include a flood gate at Bundaberg Creek. The levee could be constructed to protect significant areas in Bundaberg East, South and Central against a major flood (2013 or greater).

Disclaimer:

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- East Levee (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

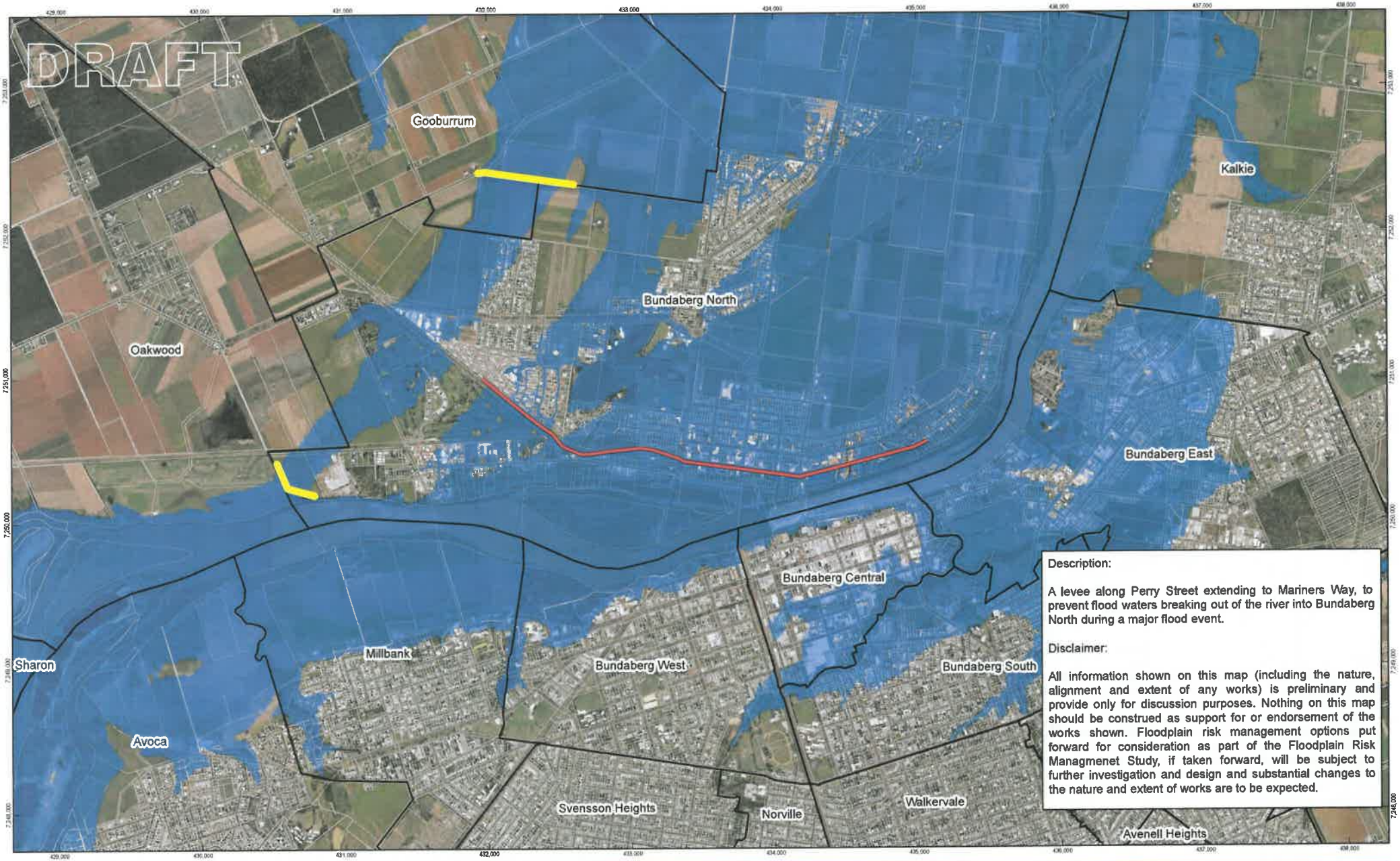
Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA East Levee

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_002_MCA_EastLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:24,000 @A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Technology Park and Batchlers Rd Levees (Seperate Project)

Perry St to Mariners Way Levee (Indicative Alignment)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

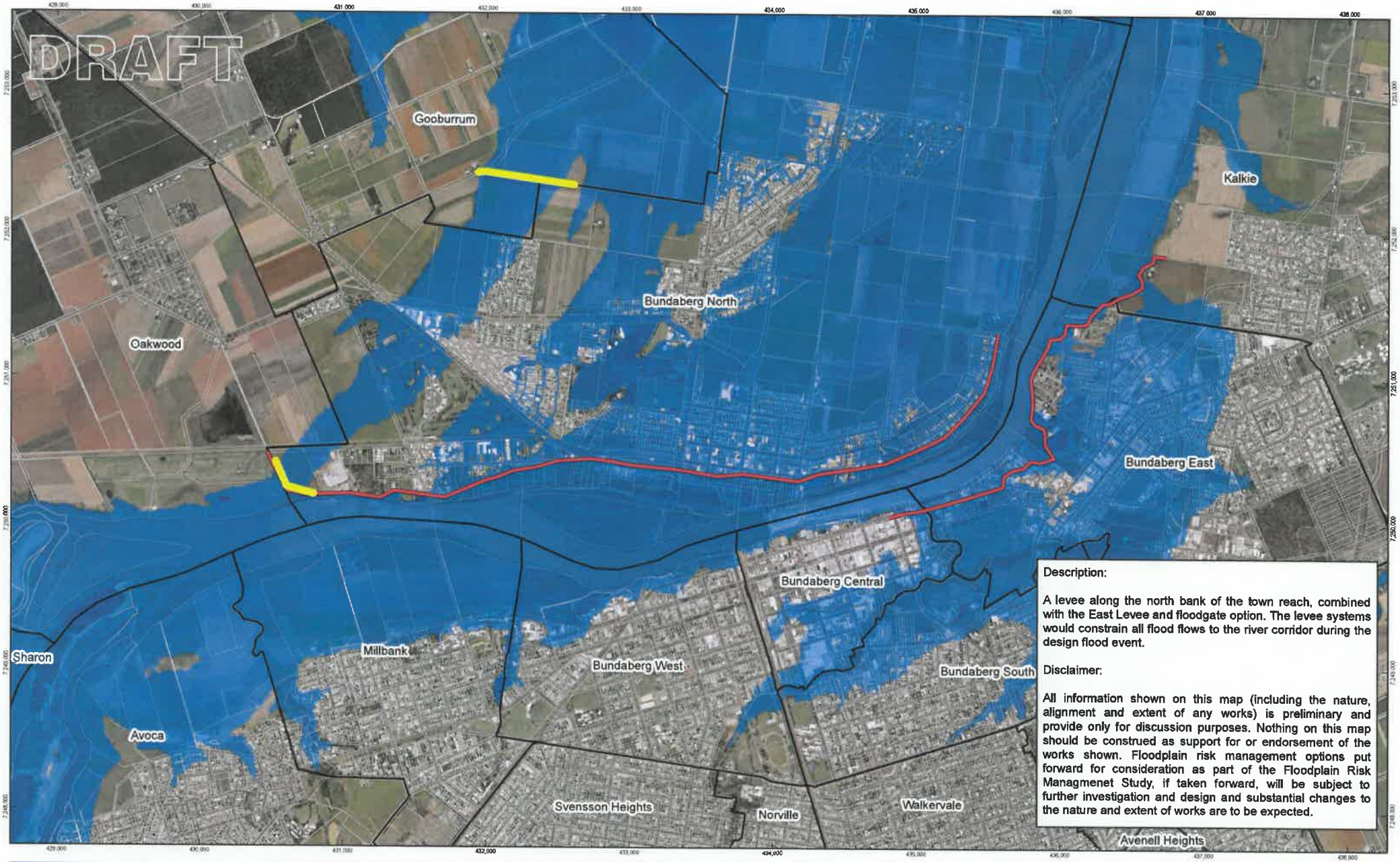
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Perry Street to Mariners Way Levee

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41269909_003_MCA_PerryStMarinersWayLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- North Bank and East Levees (Indicative Alignment)
- 2013 Flood Extent

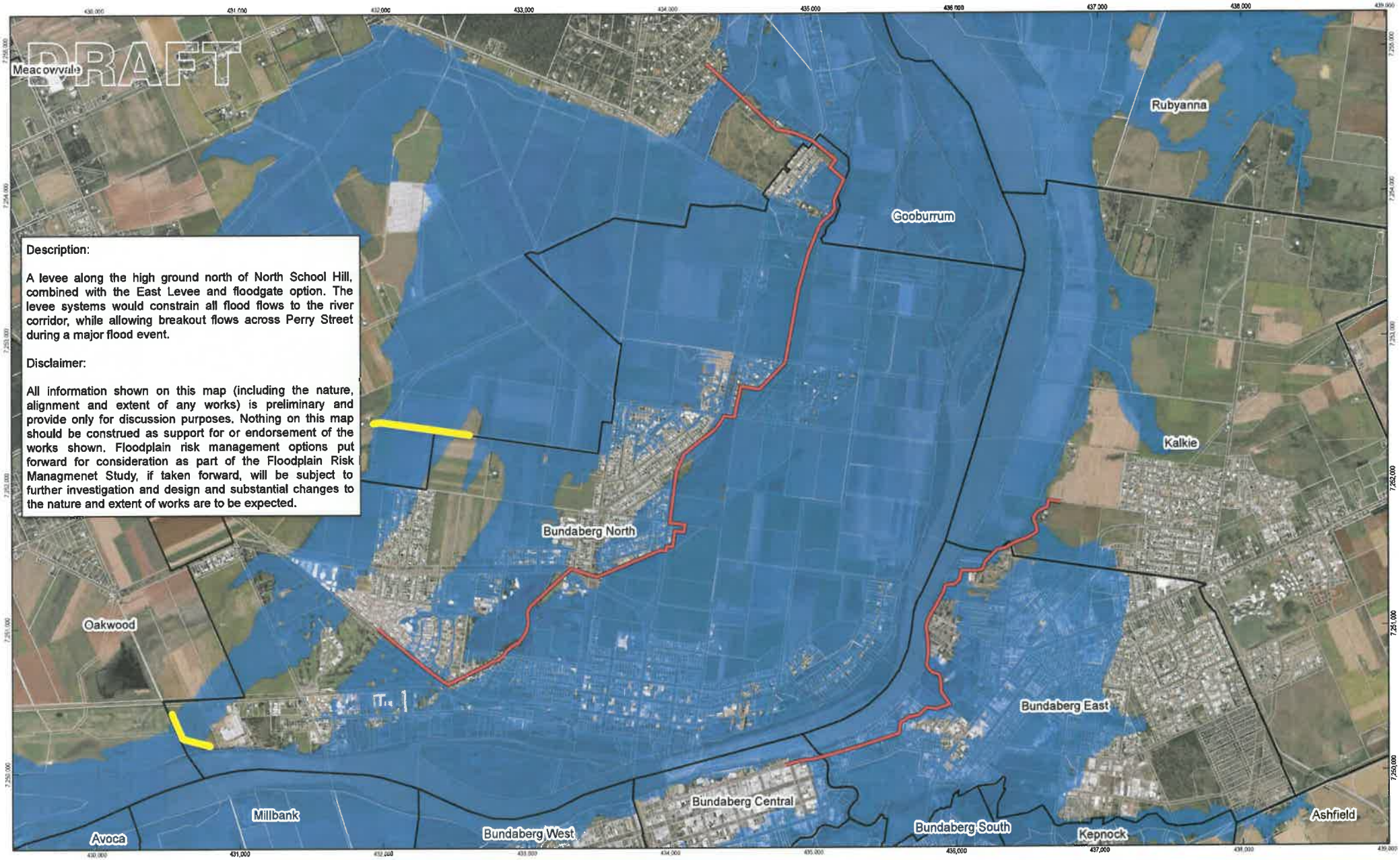
G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_004_MCA_NorthBankEastLevees.mxd

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA North Bank and East Levees

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 28 Oct 2013

Preliminary Mitigation Options for MCA North and East Levees

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Data source: Data Custodian, Data Set Name/Title, Version/Date.

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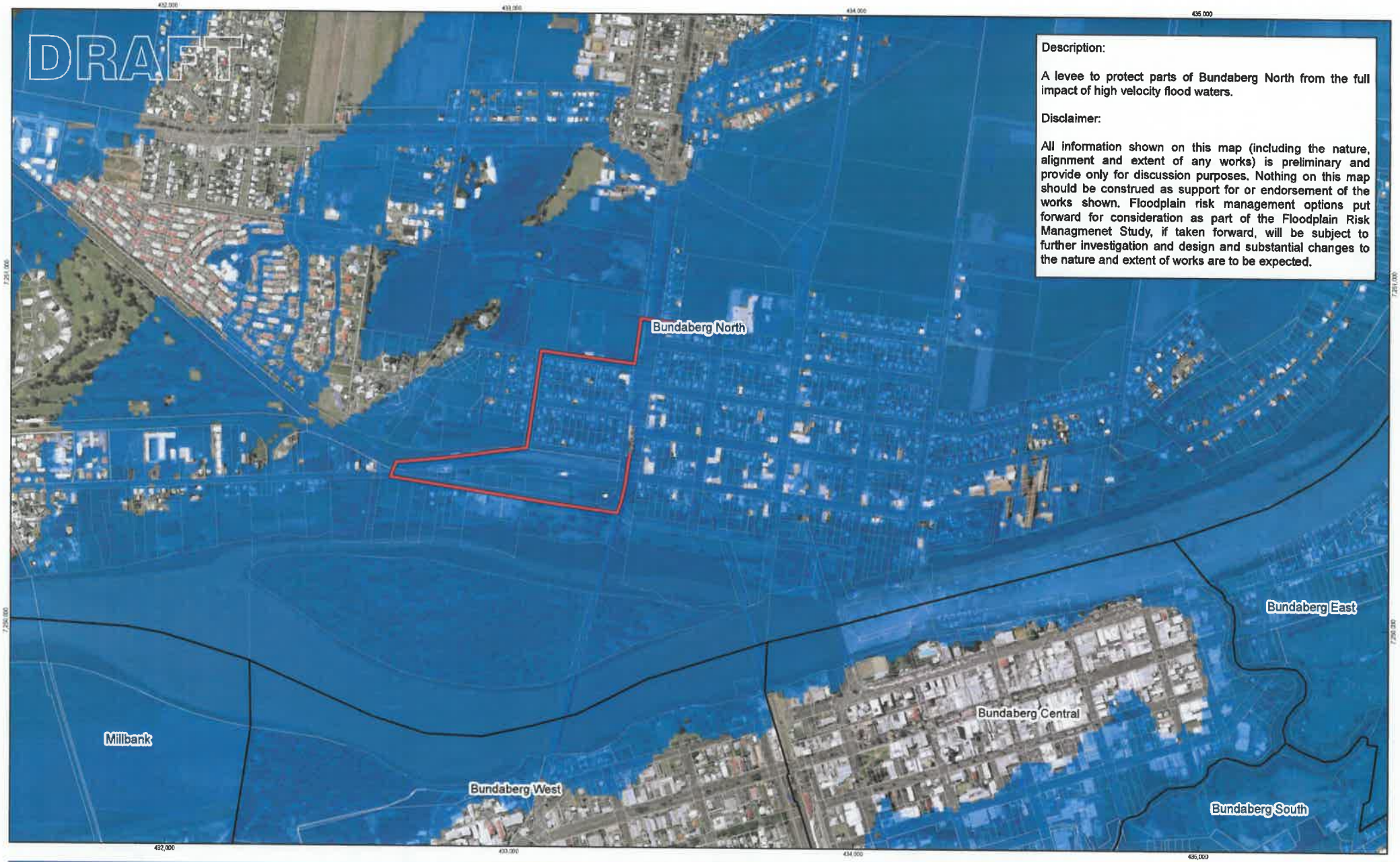

1:10,000 @A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- West Hinkler Avenue Levee (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA West Hinkler Avenue Levee

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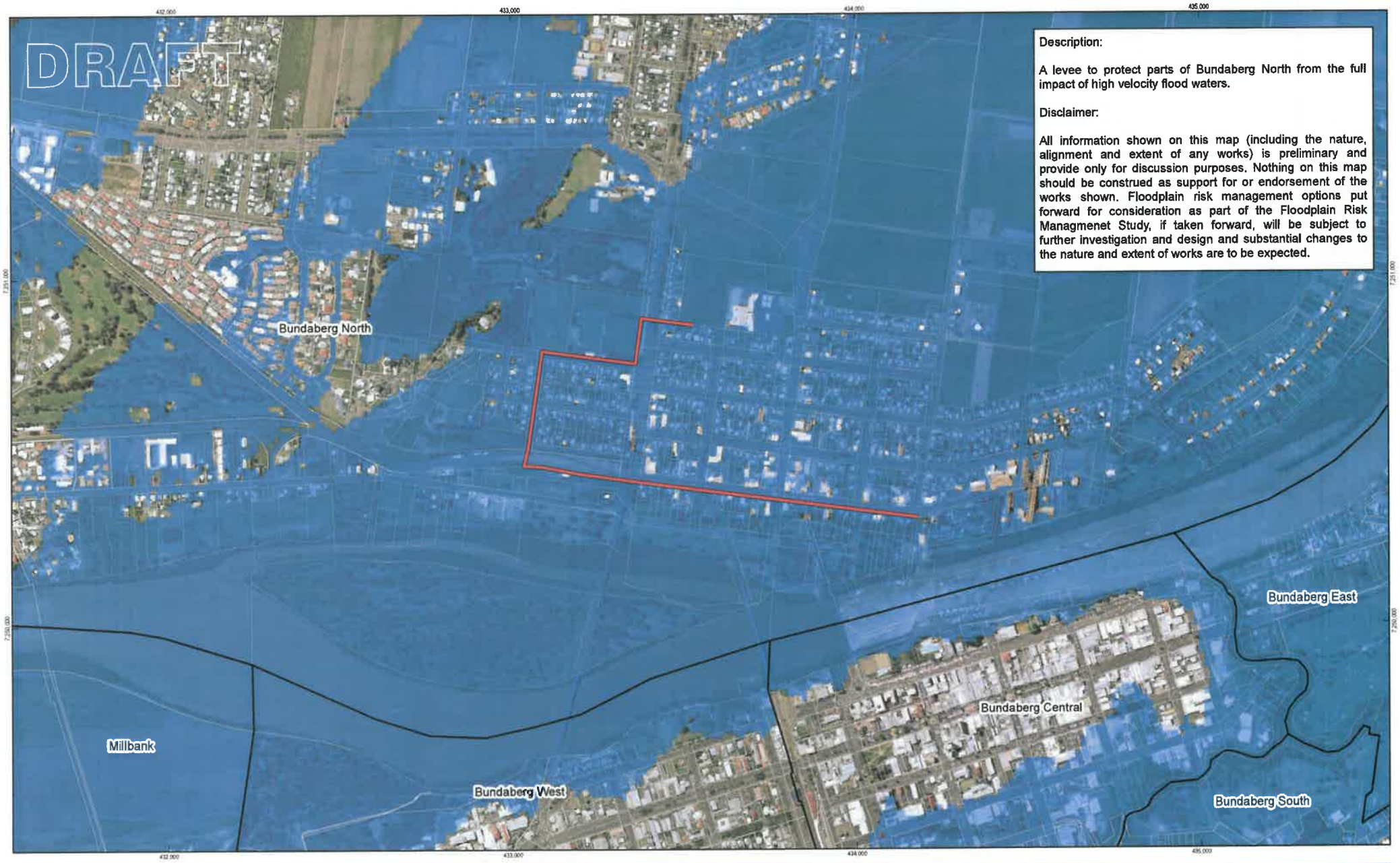

1:10,000 @A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Perry and Wilmot Street Levee (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

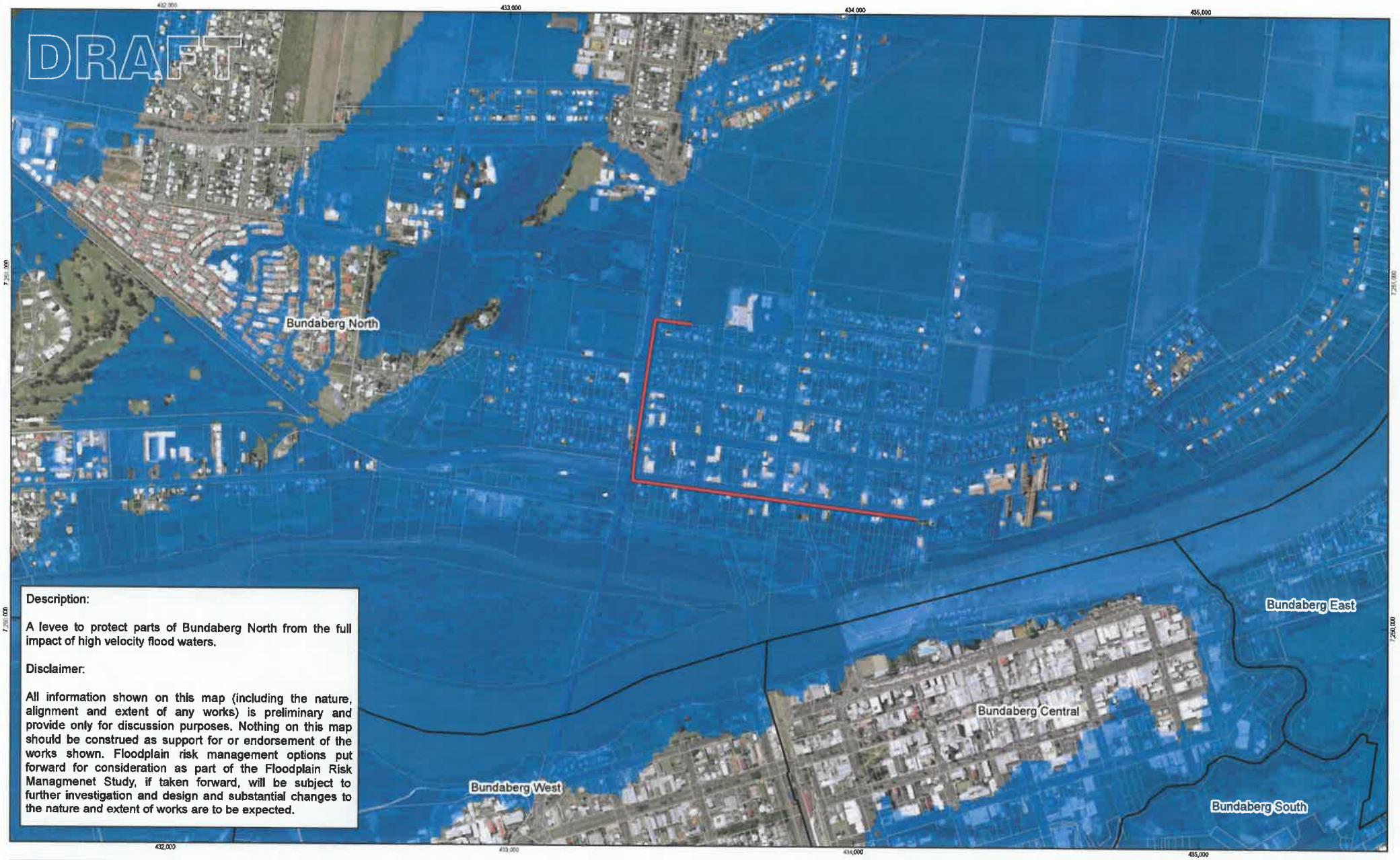
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Perry and Wilmot Street Levee

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_007_MCA_PerryWilmotStLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.

Disclaimer:

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1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Perry Street and Hinkler Avenue Levee (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

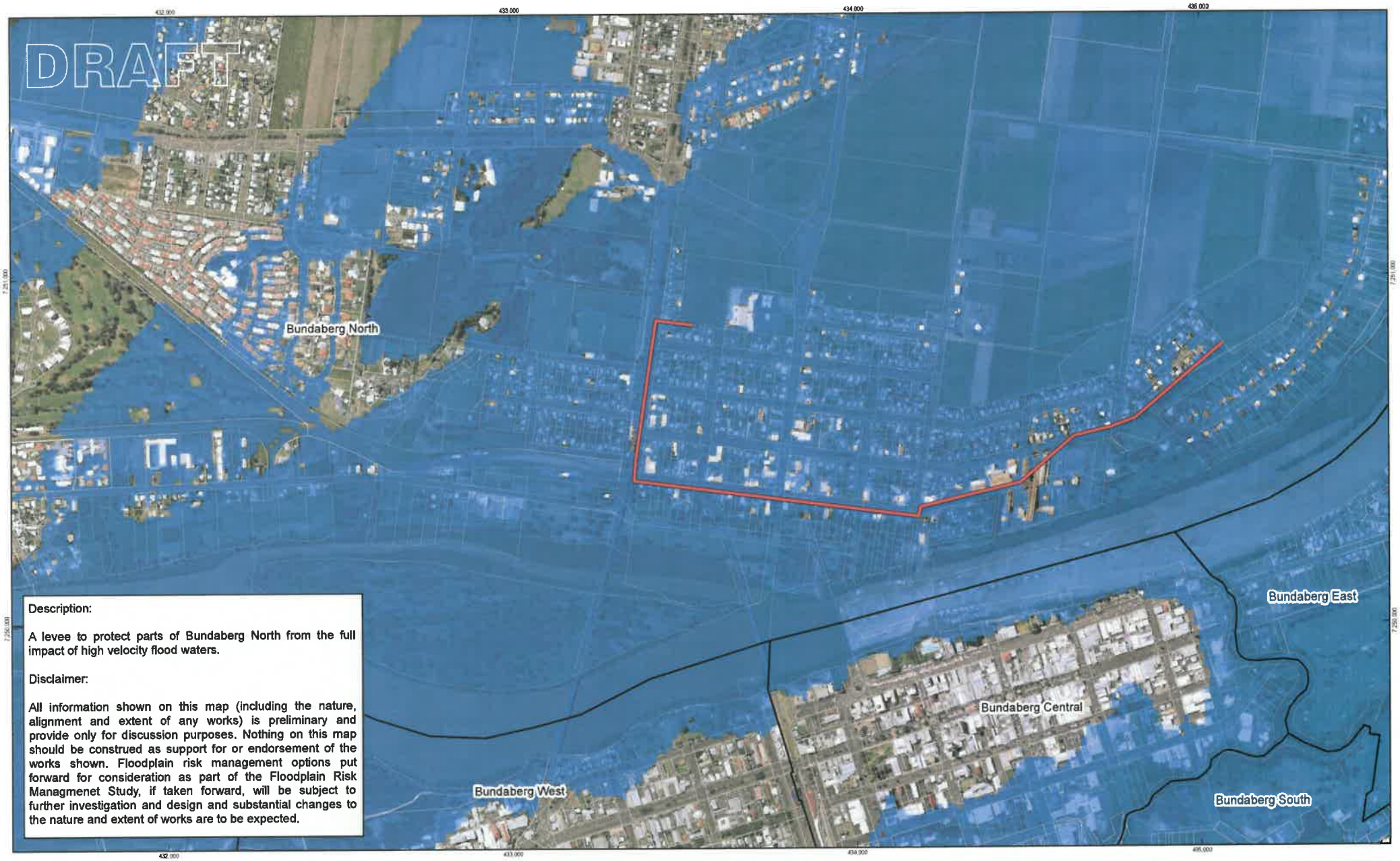
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Perry Street and Hinkler Avenue Levee

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41269908_008_MCA_PerryStHinklerAveLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Hinkler Avenue to Cameron Street Levee (Indicative Alignment)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Hinkler Avenue to Cameron Street Levee

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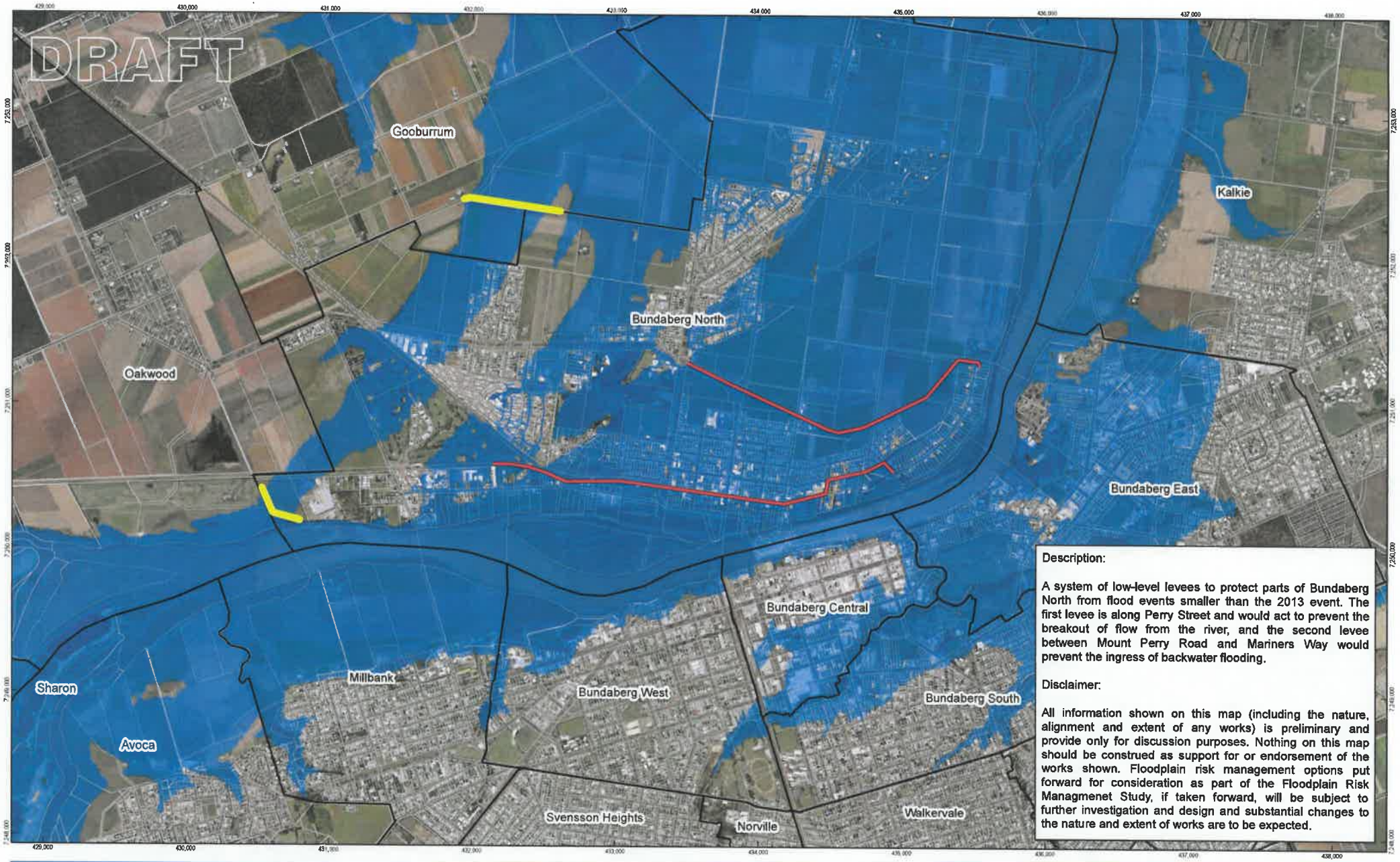

Description:

A system of low-level levees to protect parts of Bundaberg North from flood events smaller than the 2013 event. The first levee is along Perry Street and would act to prevent the breakout of flow from the river, and the second levee between Mount Perry Road and Mariners Way would prevent the ingress of backwater flooding.

Disclaimer:

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Low Level North Bundaberg Levees (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Low Level North Bundaberg Levees

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Data source: Data Custodian, Data Set Name/Title, Version/Date.

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Port of Bundaberg Levee (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Port of Bundaberg Levee

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_011_MCA_PortLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

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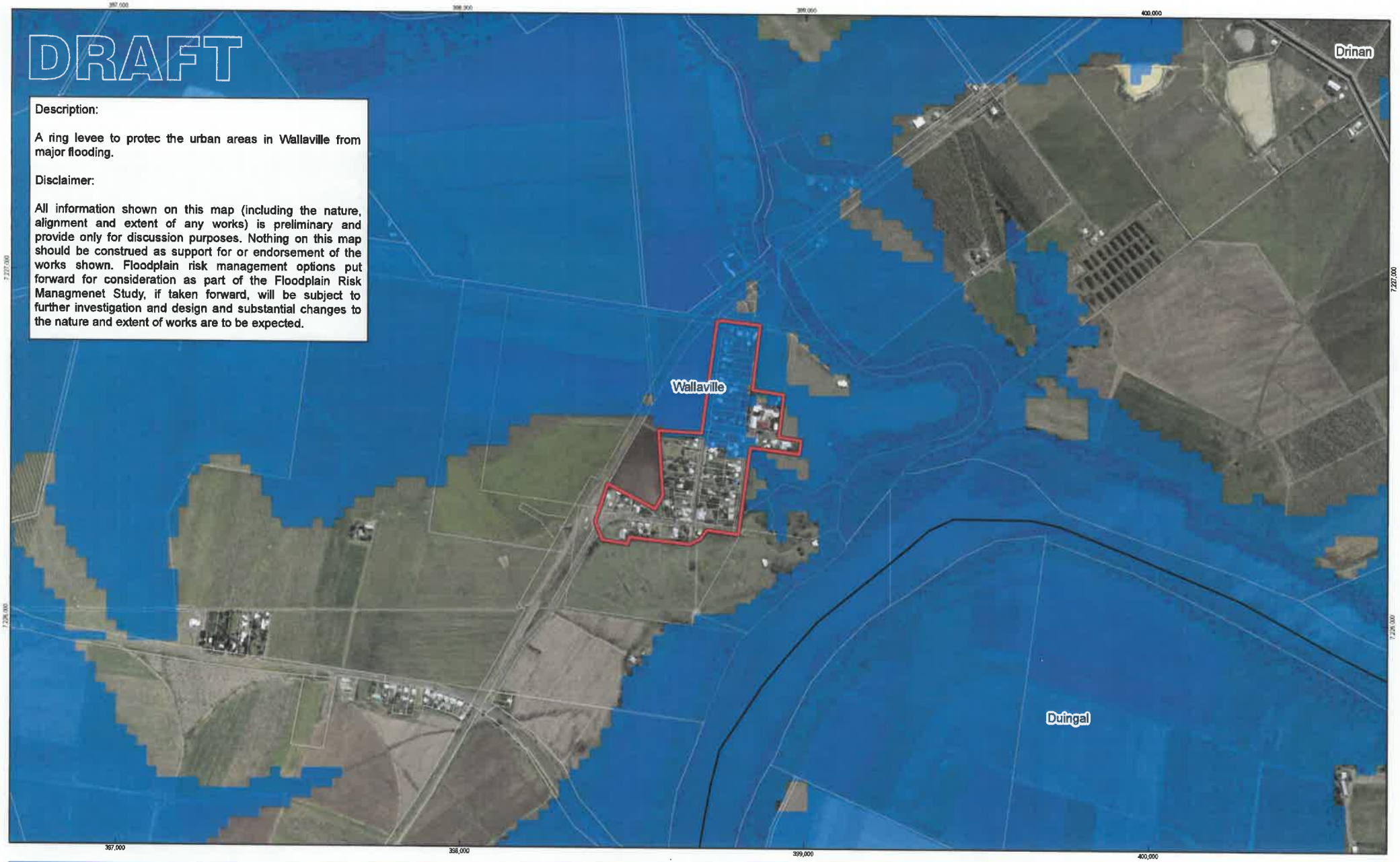

1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Wallaville Levee (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Wallaville Levee

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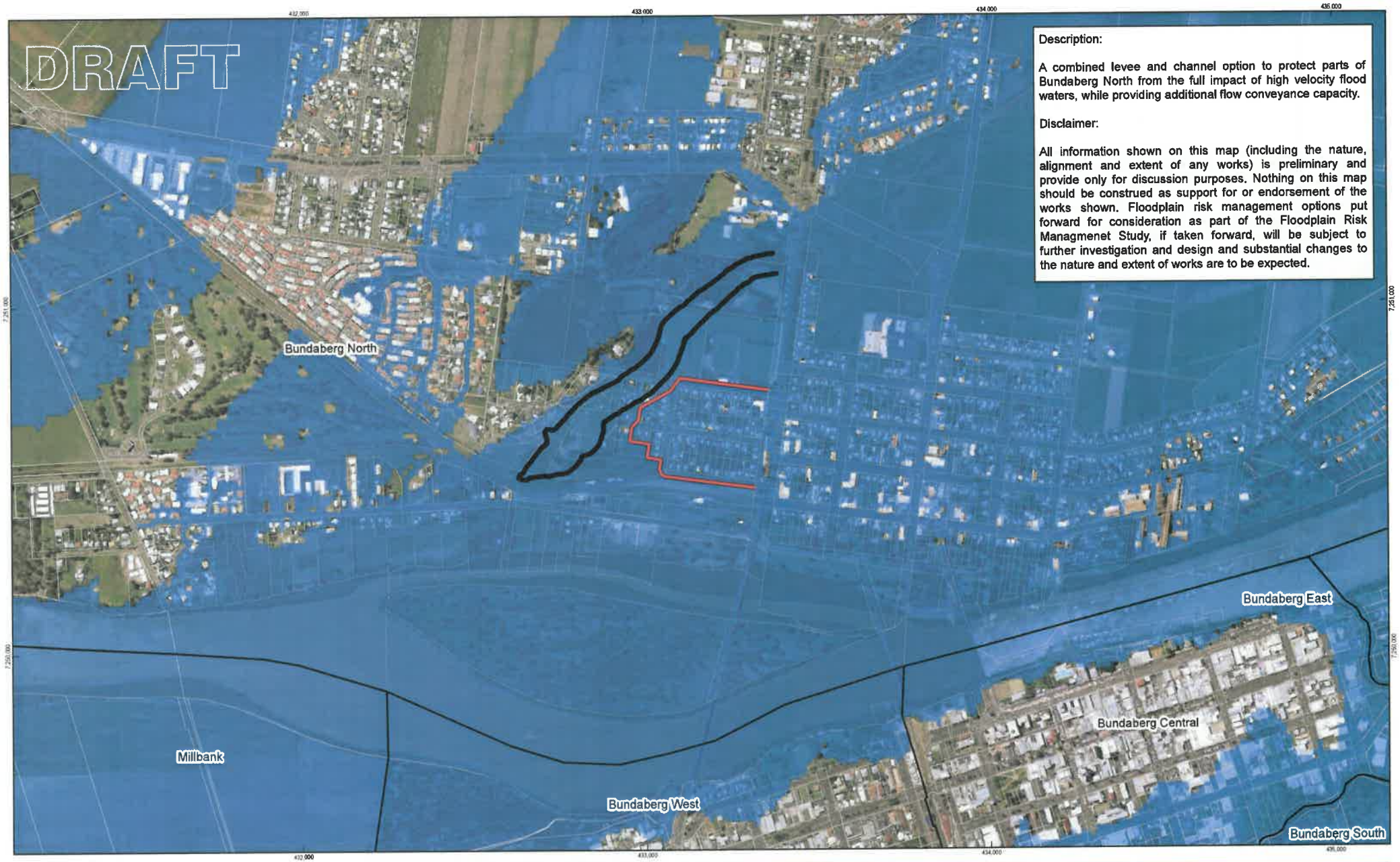

1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- West Hinkler Avenue Levee (Indicative Alignment)
- Gardens Channel 1 Extents (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA West Hinkler Avenue Levee & Gardens Channel 1

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_013_MCA_WestHinklerAveLeveeChn1.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

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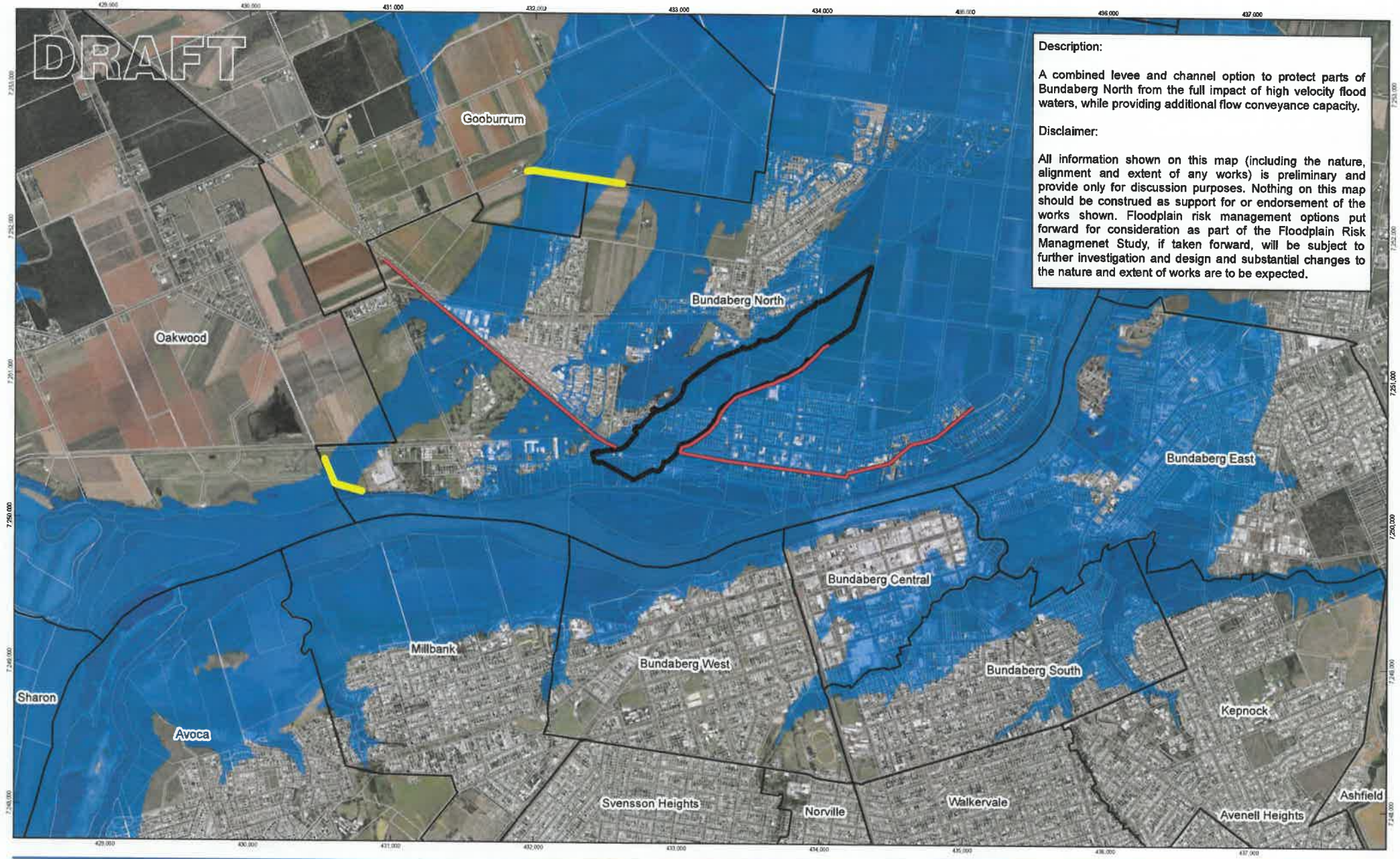

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- 2013 Flood Extent
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Rail & Perry St to Cameron St Levees (Indicative Alignment)
- Gardens Channel 2 Extents (Indicative Alignment)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Rail, Perry St to Cameron St Levees & Channel

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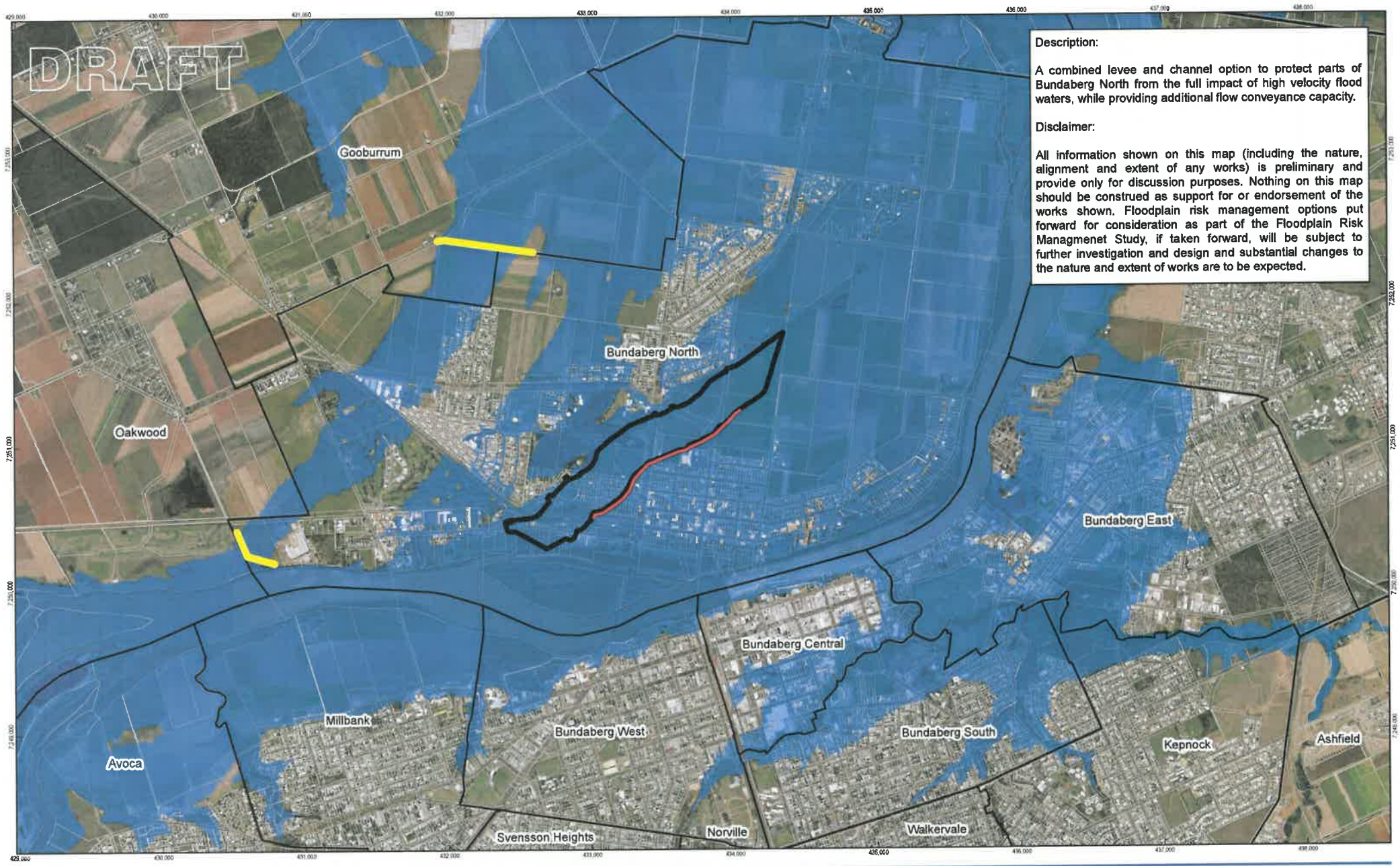

1:24,000 @A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- 2013 Flood Extent
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Adjacent Levee (Indicative Alignment)
- Gardens Channel 2 Extents (Indicative Alignment)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Gardens Channel 2 with Adjacent Levee

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Data source: Data Custodian, Data Set Name/Title, Version/Date.

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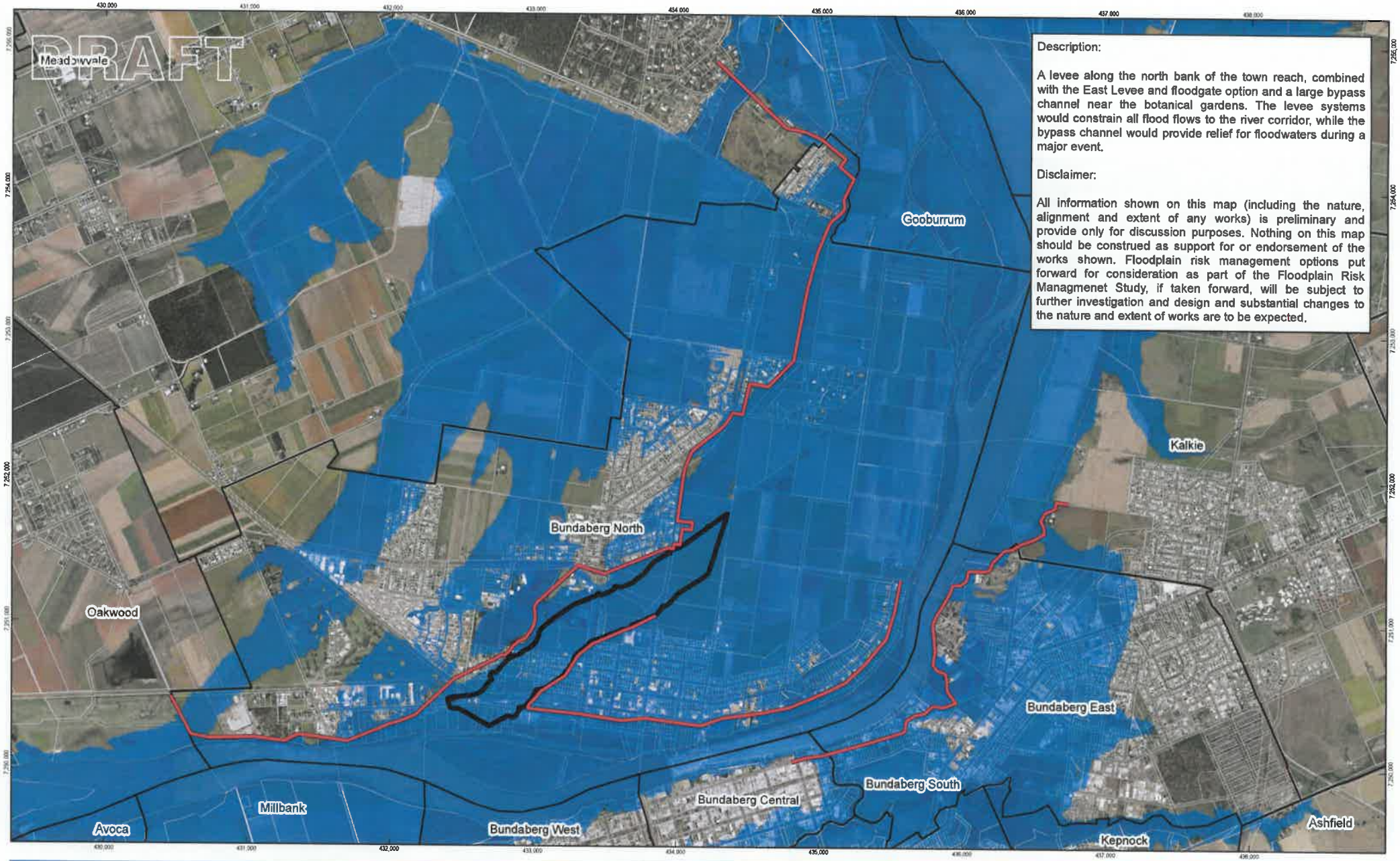

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- North Bank and East Levees (Indicative Alignment)
- Gardens Channel 2 Extents (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council	Job Number 41-26909
Burnett River Floodplain Risk Management Study	Revision A
	Date 25 Oct 2013

Preliminary Mitigation Options for MCA North Bank & East Levees with Gardens Channel 2

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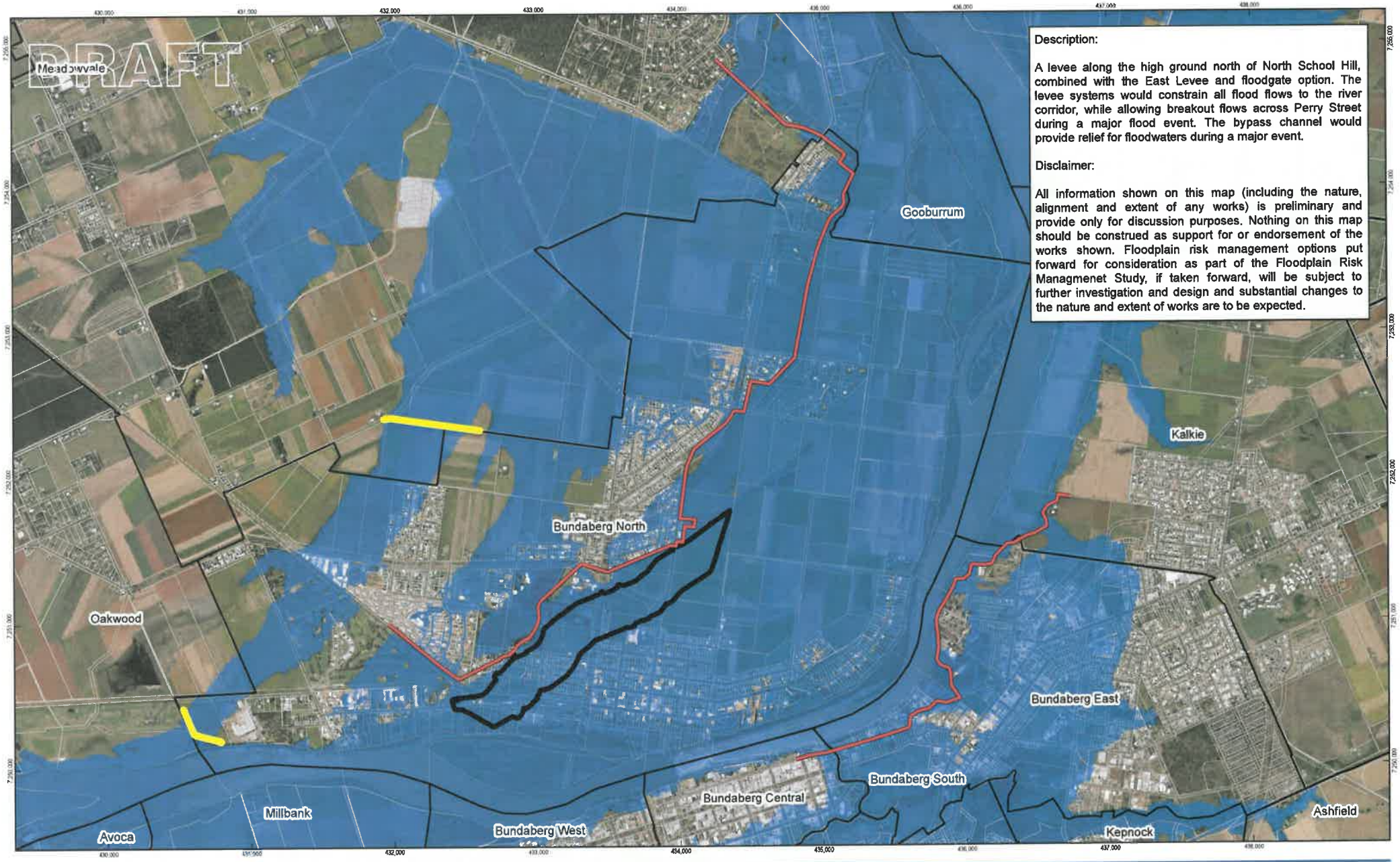

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- 2013 Flood Extent
- Technology Park and Batchlers Rd Levees (Seperate Project)
- North and East Levees (Indicative Alignment)
- Gardens Channel 2 Extents (Indicative Alignment)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA North & East Levees with Gardens Channel 2

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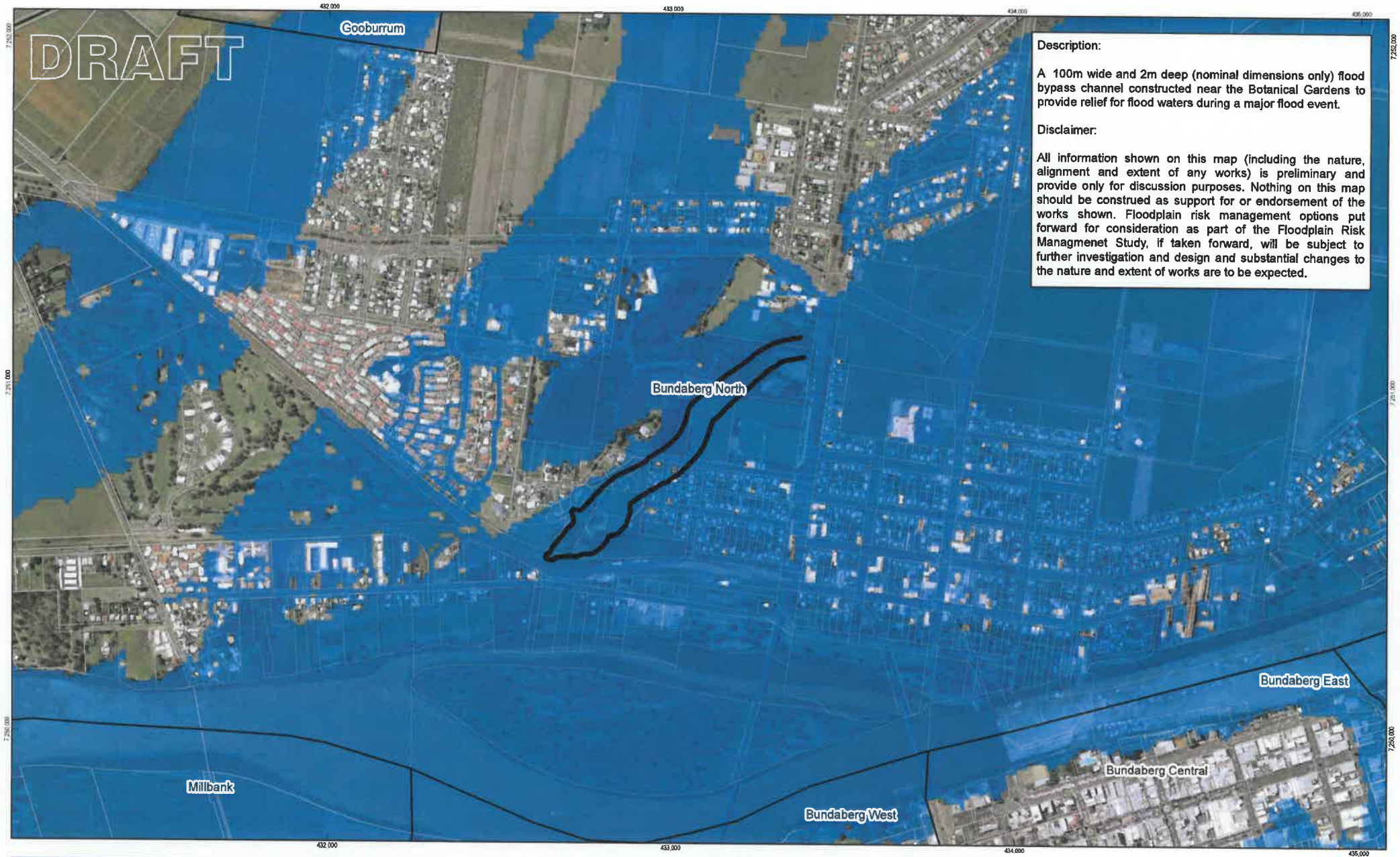

Description:

A 100m wide and 2m deep (nominal dimensions only) flood bypass channel constructed near the Botanical Gardens to provide relief for flood waters during a major flood event.

Disclaimer:

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1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre
Localities
Gardens Channel 1 Extents (Indicative Alignment)
2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Gardens Channel 1

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Data source: Data Custodian, Data Set Name/Title, Version/Date.

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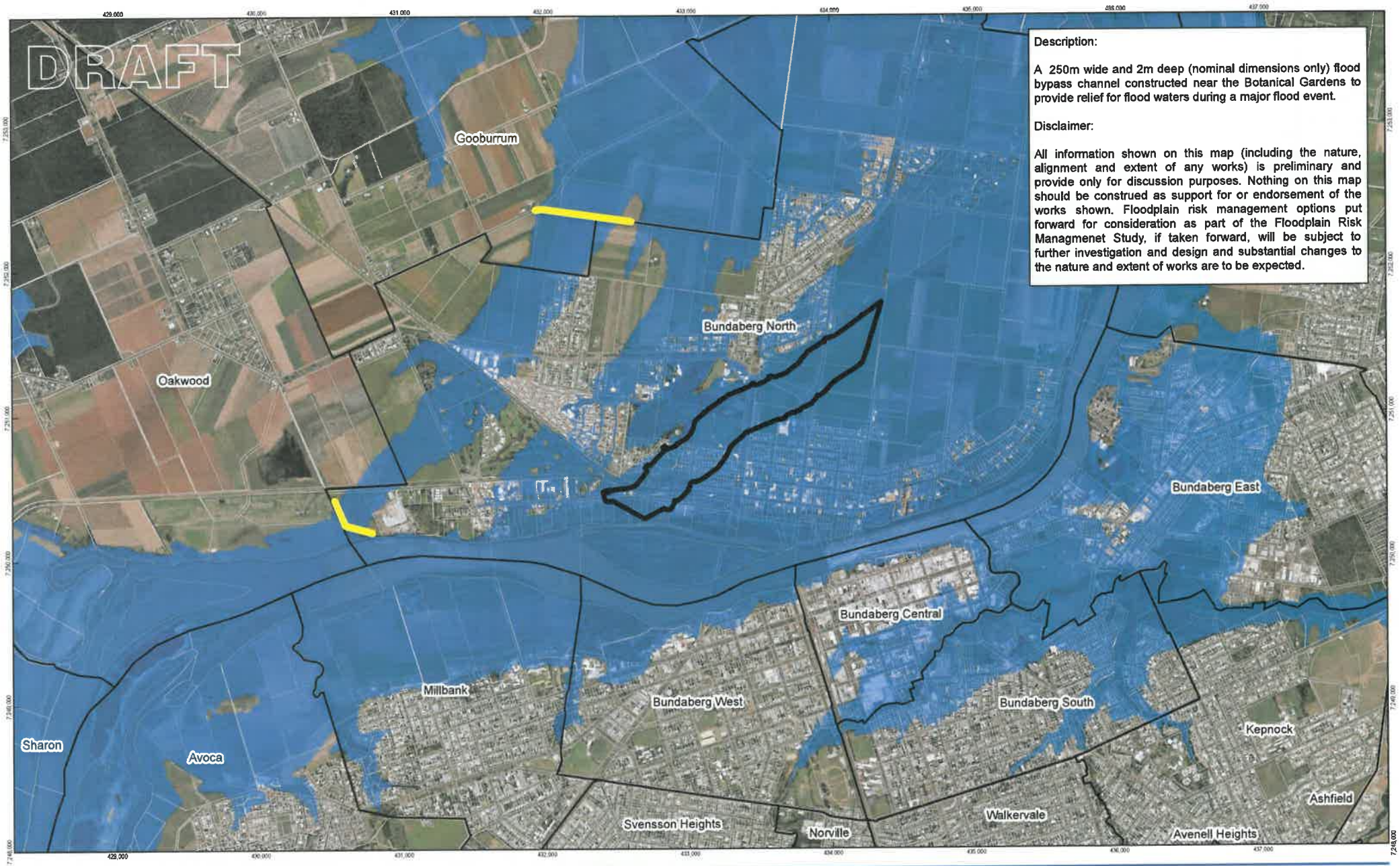

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- 2013 Flood Extent
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Gardens Channel 2 Extents (Indicative Alignment)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Gardens Channel 2

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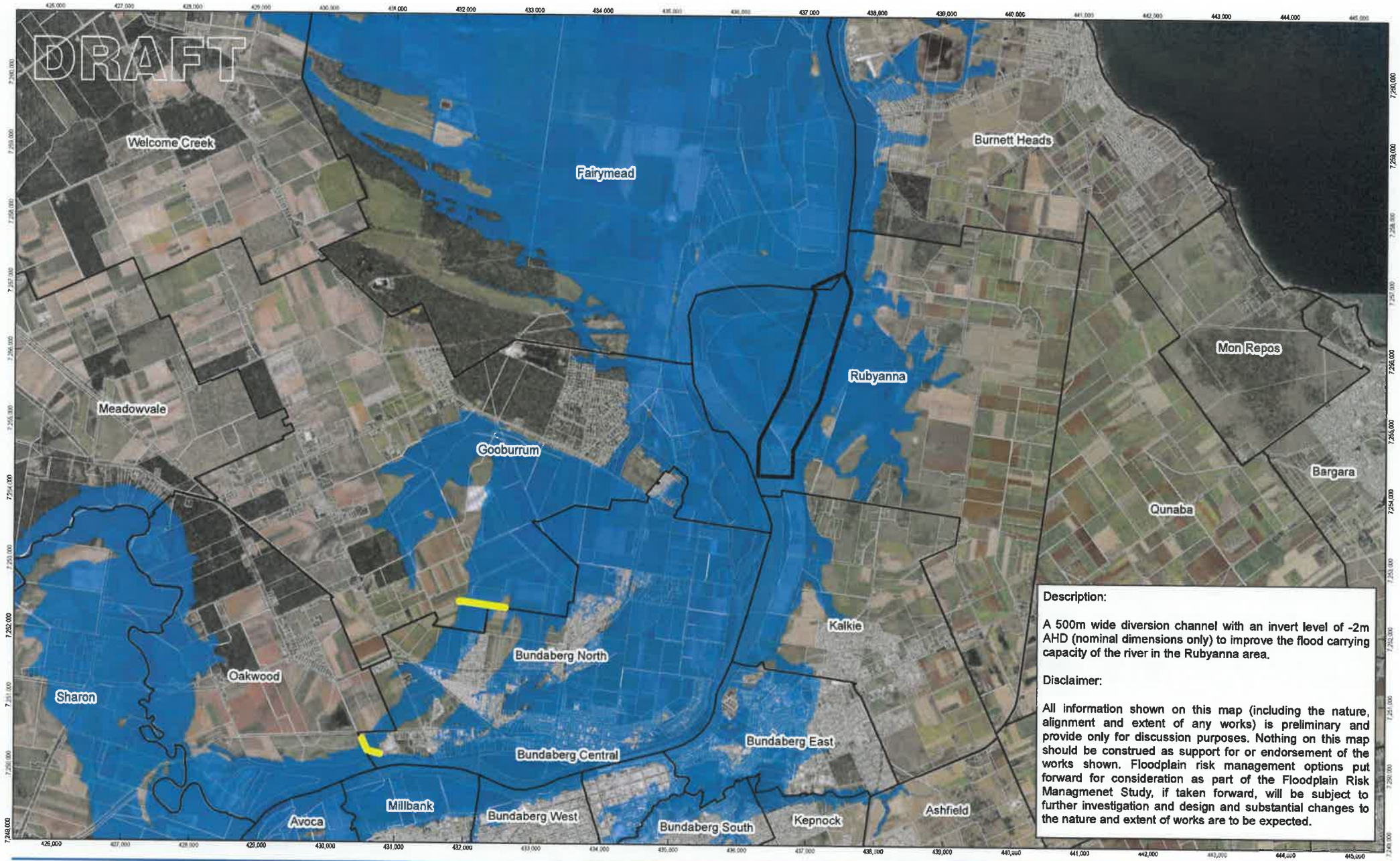

1:50,000 @A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Rubyanna Bypass Channel (Indicative Alignment)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Rubyanna Bypass Channel

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Data source: Data Custodian, Data Set Name/Title, Version/Date.

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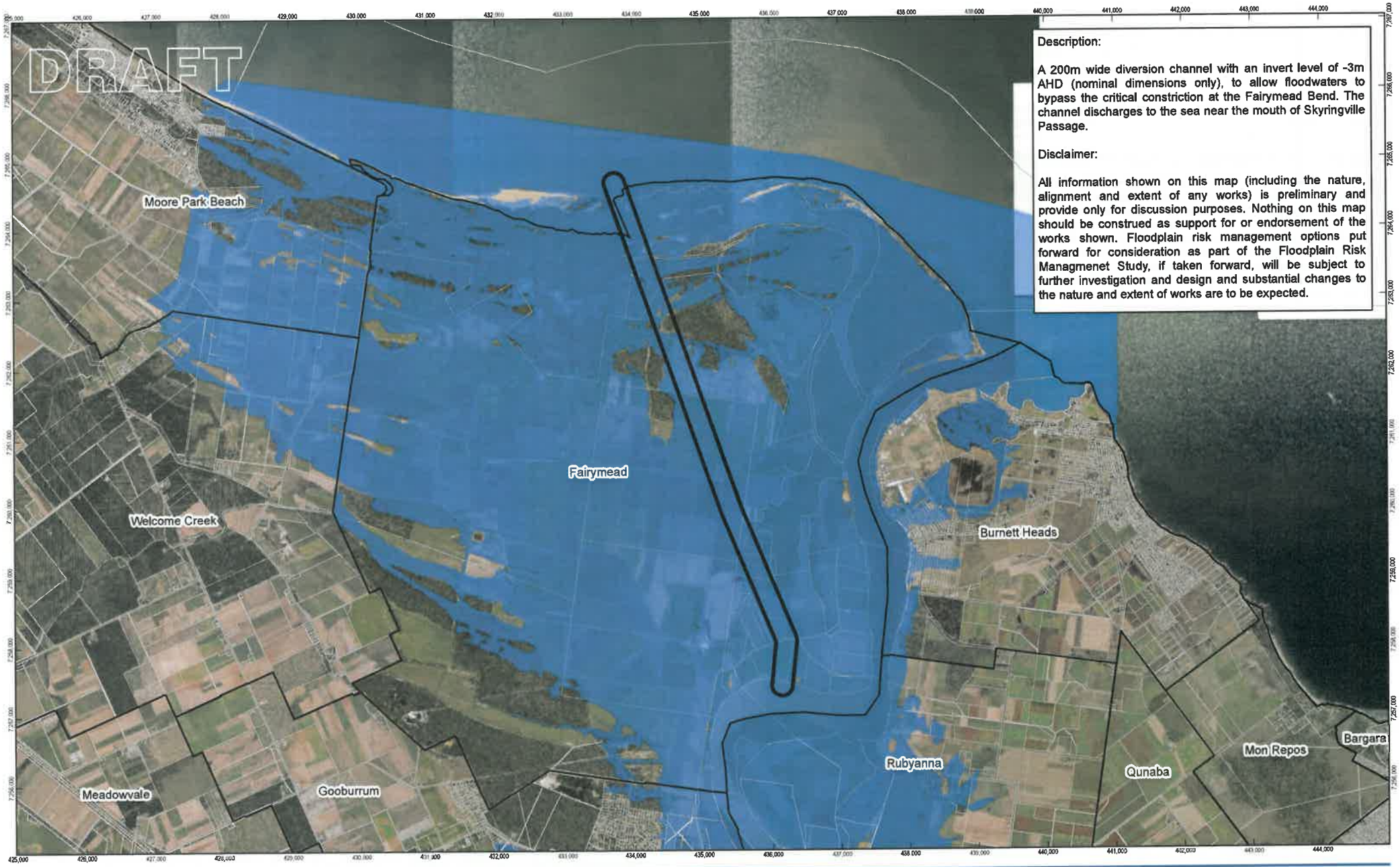

1:50,000 @A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Fairymead Diversion Channel 1l (Indicative Alignment)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

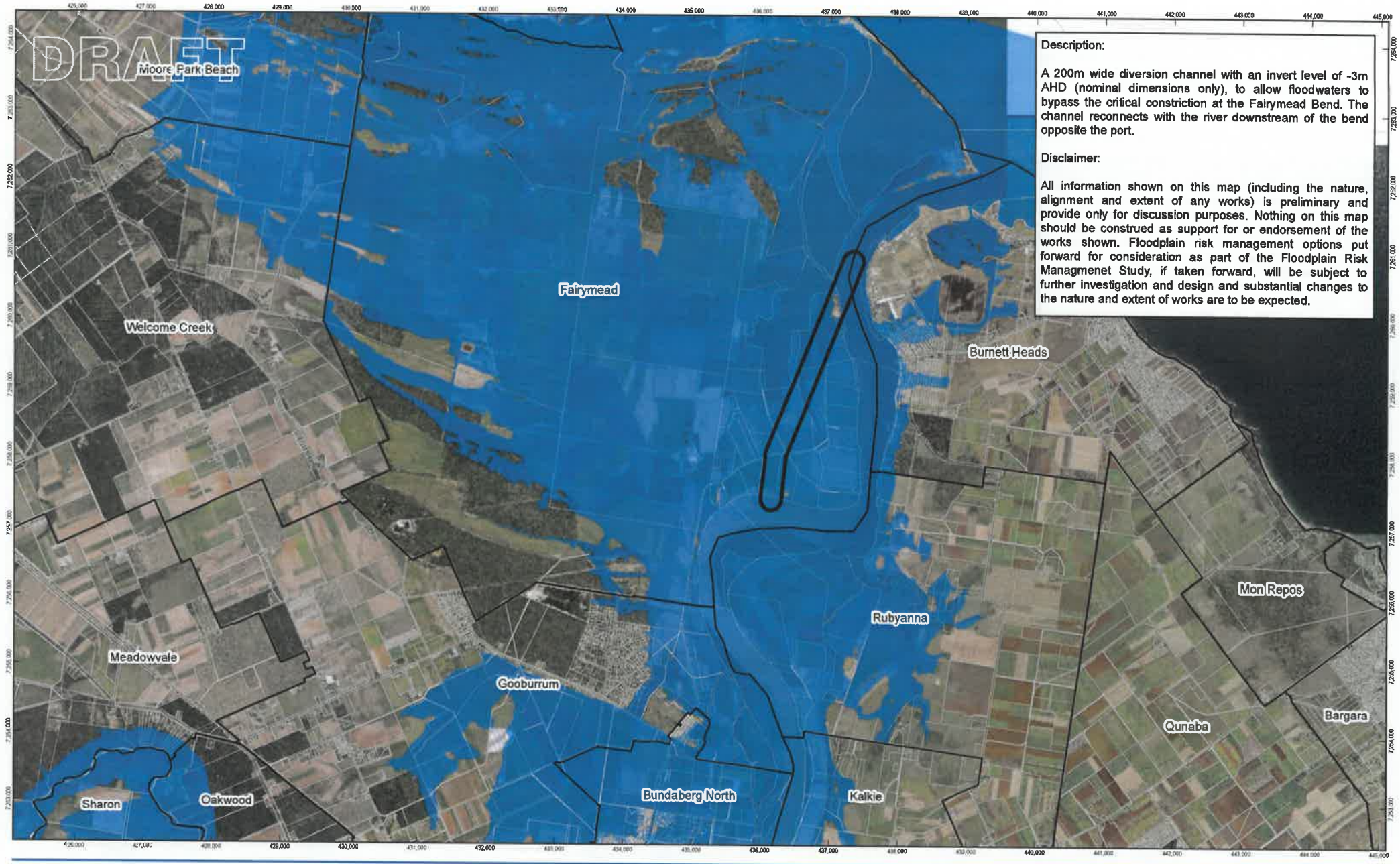
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Fairymead Diversion Channel 1

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41269O9_021_MCA_FairymeadChn1l.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A 200m wide diversion channel with an invert level of -3m AHD (nominal dimensions only), to allow floodwaters to bypass the critical constriction at the Fairymead Bend. The channel reconnects with the river downstream of the bend opposite the port.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:50,000 @A3

0 500 1,000 1,500 2,000 2,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre
Localities
Fairymead Diversion Channel 2 (Indicative Alignment)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

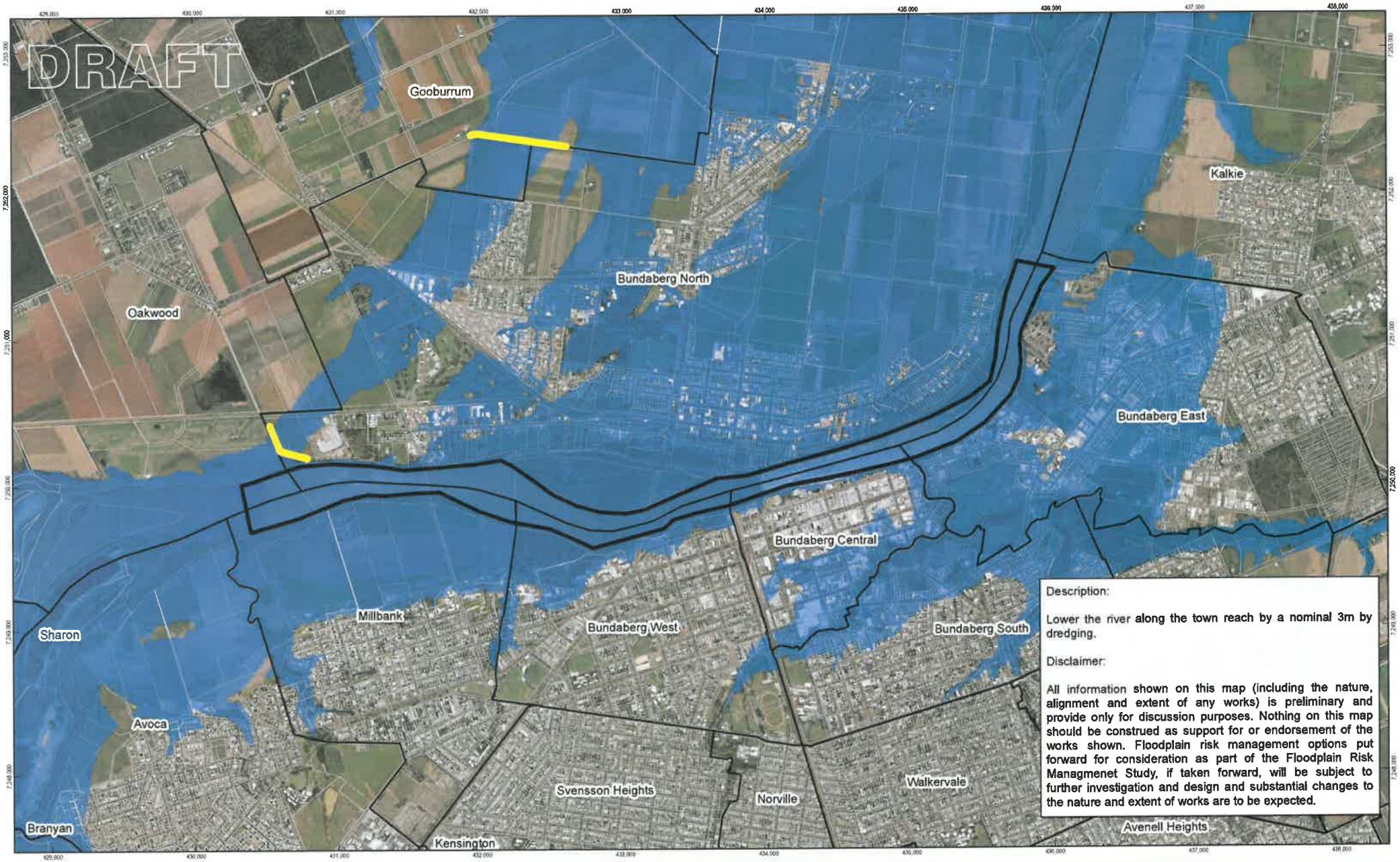
Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Fairymead Diversion Channel 2

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_022_MCA_FairymeadChnl2.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:24,000 @A3

0 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Town Reach Dredging Extents (Indicative Alignment)

Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

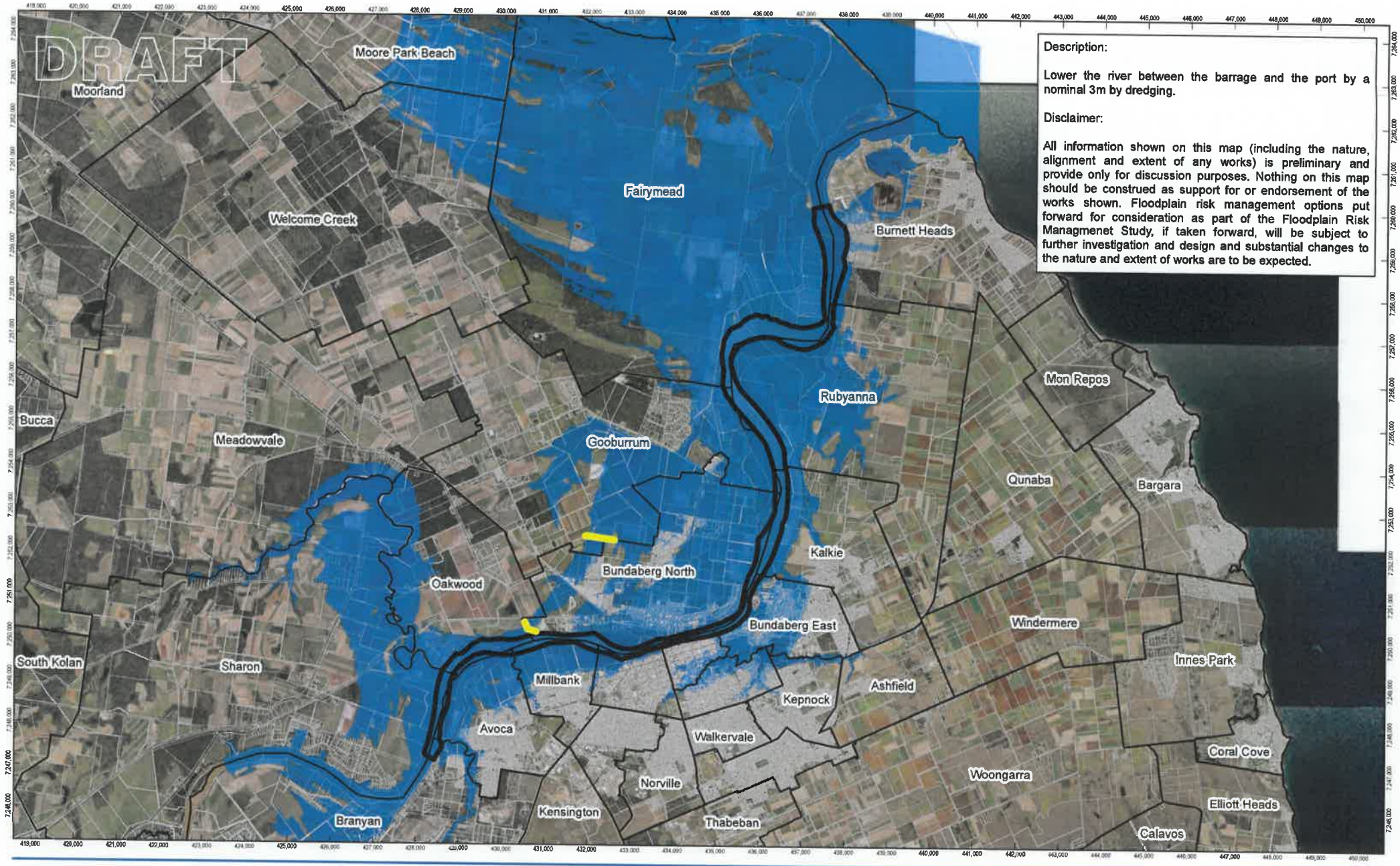
Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Town Reach Dredging

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_023_MCA_TownReachDredge.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:80,000 @A3

0 800 1,600 2,400 3,200 4,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Barrage to Port Dredging Extents (Indicative Alignment)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41\26909_024_MCA_BarragePortDredge.mxd

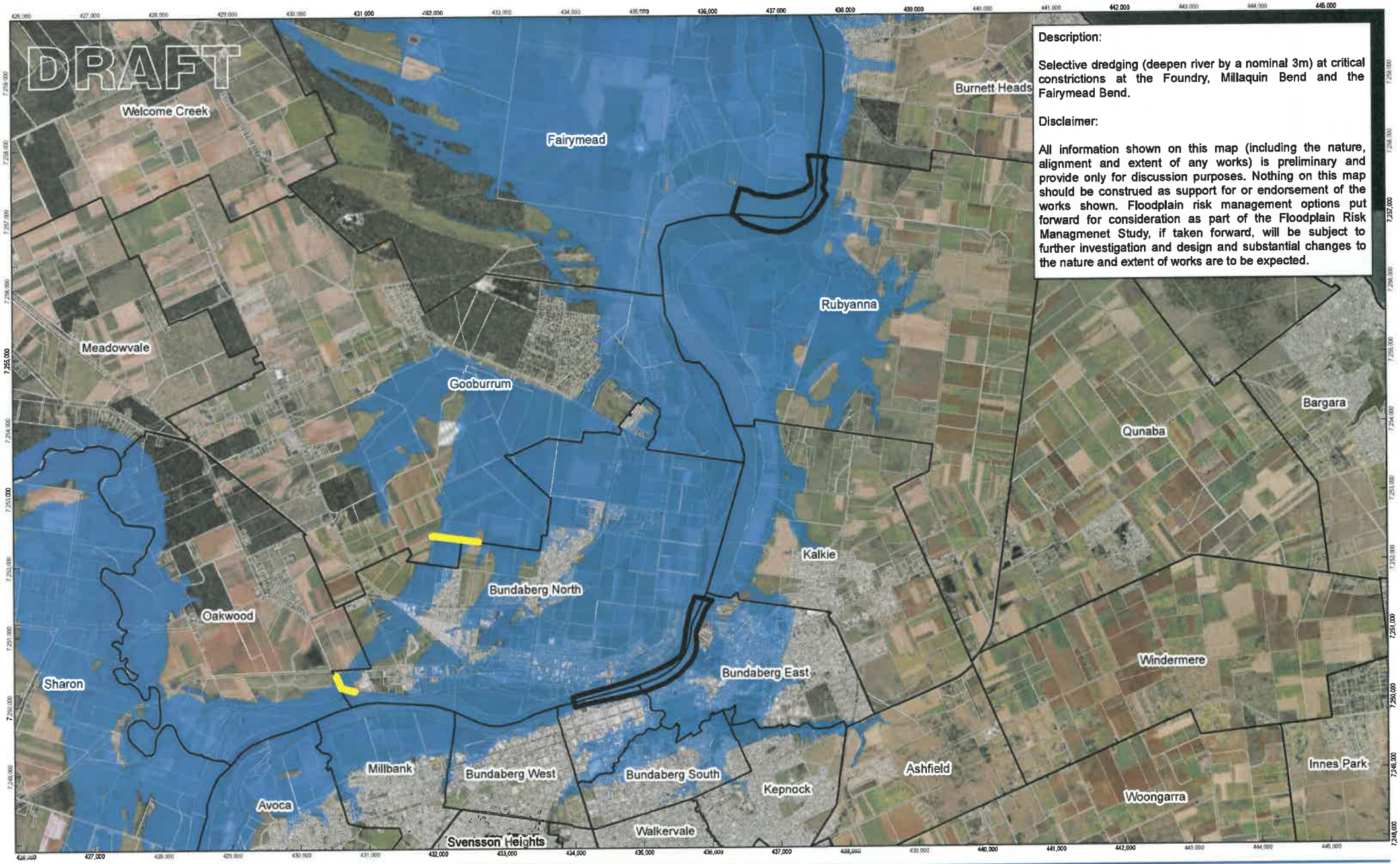
Data source: Data Custodian, Data Set Name/Title, Version/Date.

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Barrage to Port Dredging

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:50,000 @A3

0 500 1,000 1,500 2,000 2,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Millaquin & Fairymead Bends Selective Dredging Extents (Indicative Alignment)
- Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

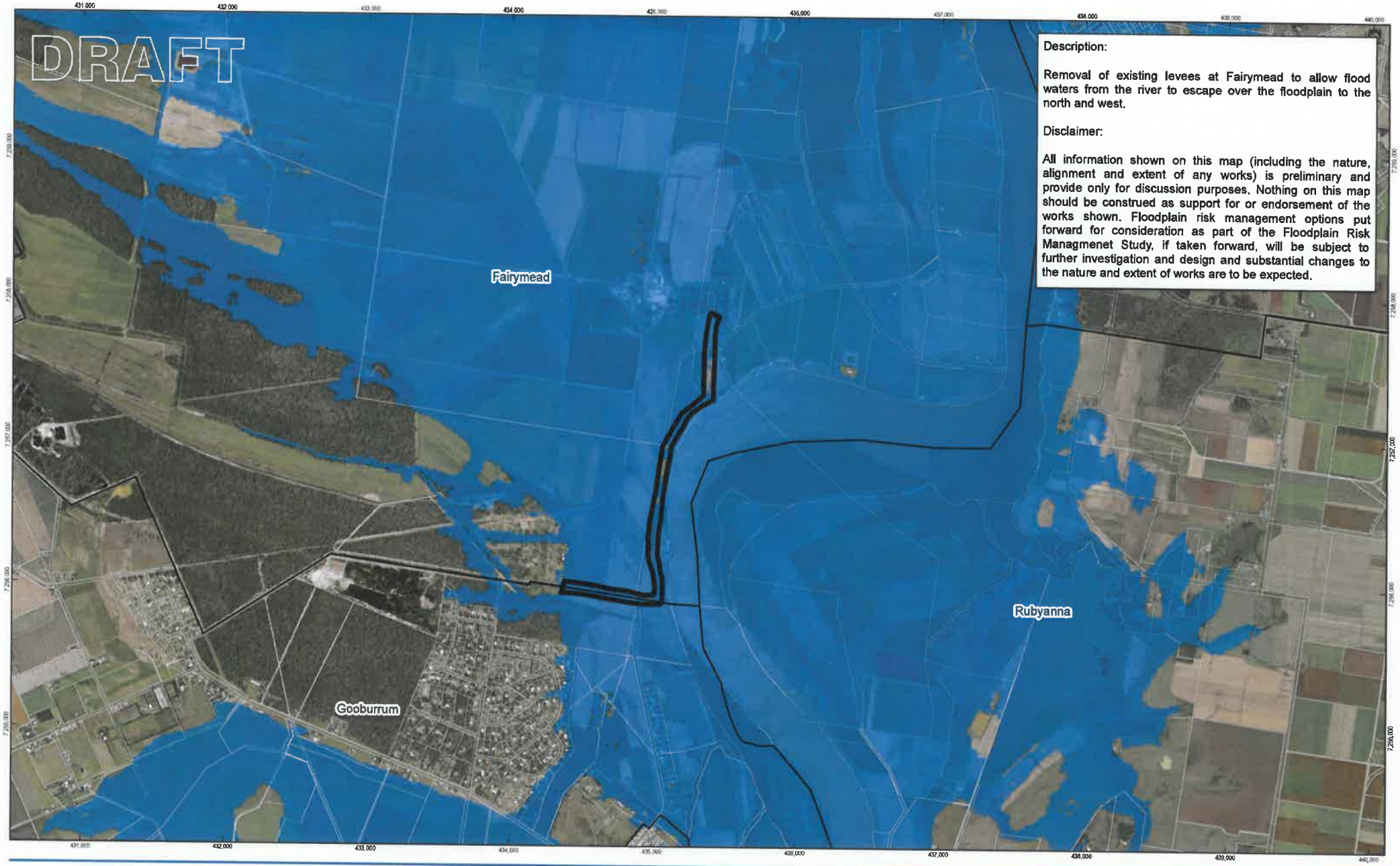
Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Millaquin & Fairymead Bends Selective Dredging

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_025_MCA_FoundryMillFairymeadDredge.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Fairymead Levees (Indicative Alignment)
- 2013 Flood Extent

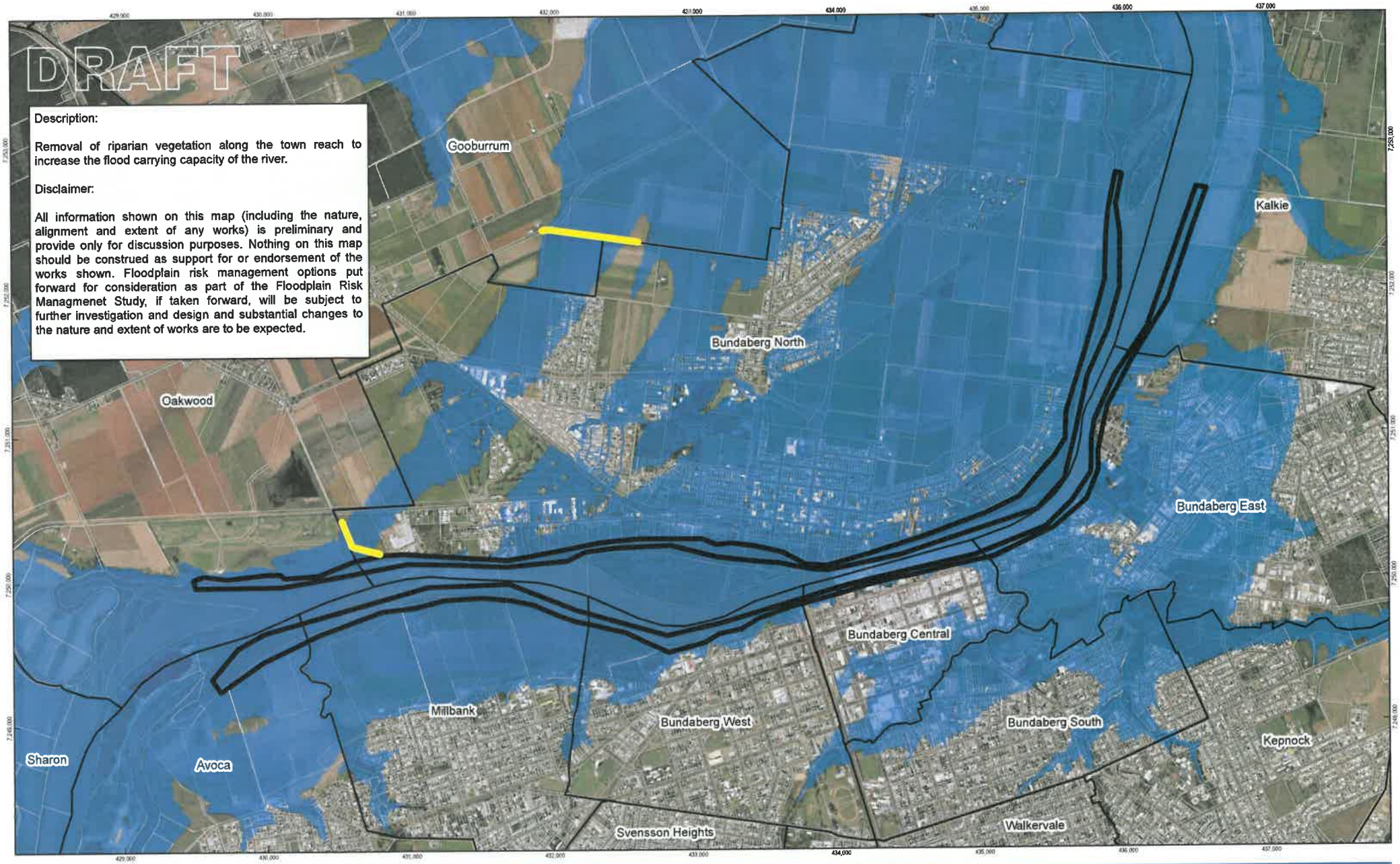
Bundaberg Regional Council	Job Number 41-26909
Burnett River Floodplain Risk Management Study	Revision A
	Date 25 Oct 2013

Preliminary Mitigation Options for MCA Removal of Fairymead Levees

G:\41\26909\GIS\Maps\MXD\09_MCA_Options\41\26909_026_MCA_FairymeadLevees.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Extent of Mangrove Removal (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

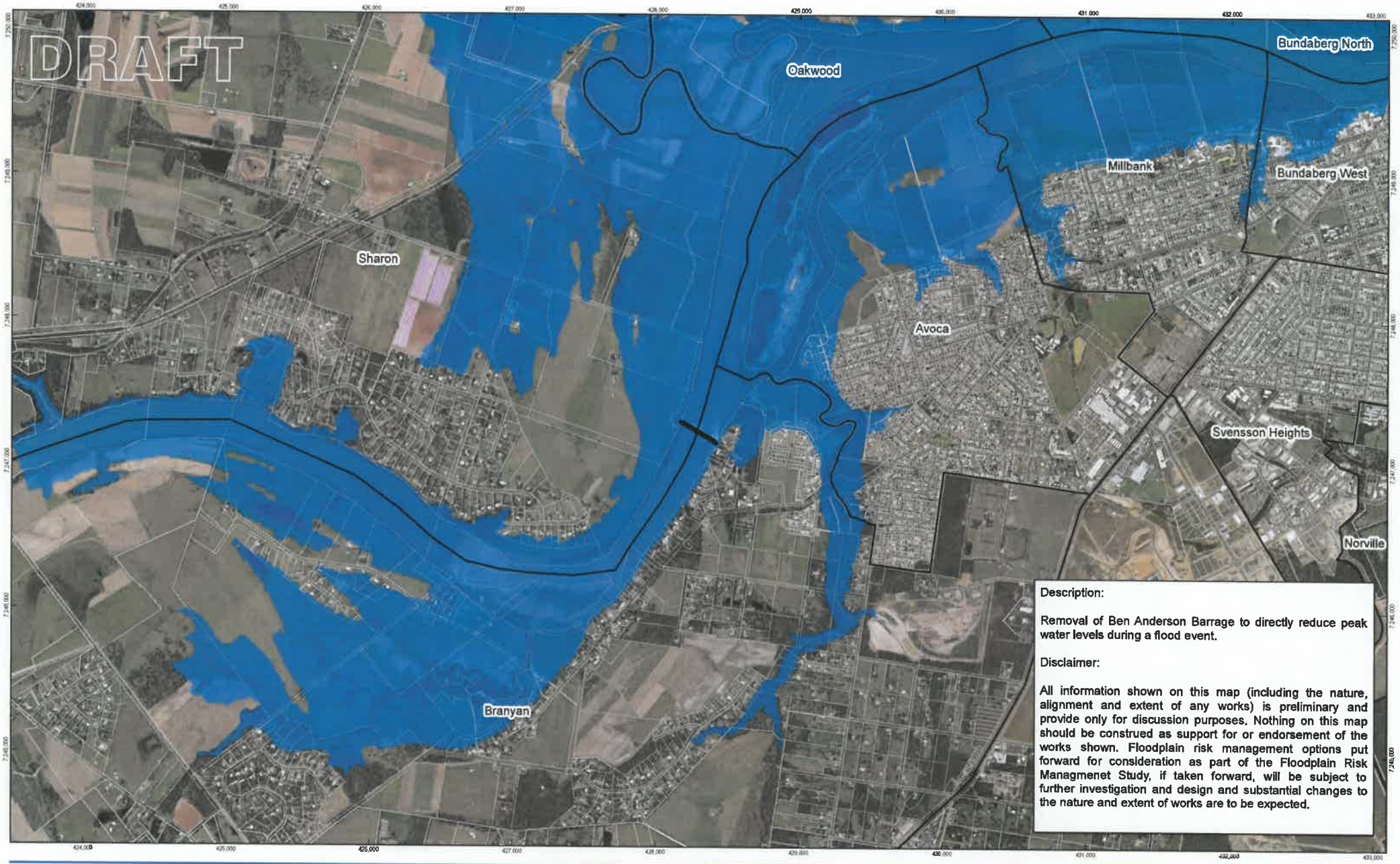
Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Removal of Mangroves from Town Reach

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_027_MCA_MangrovesTownReach.mxd

Data source. Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Location of Ben Anderson Barrage
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

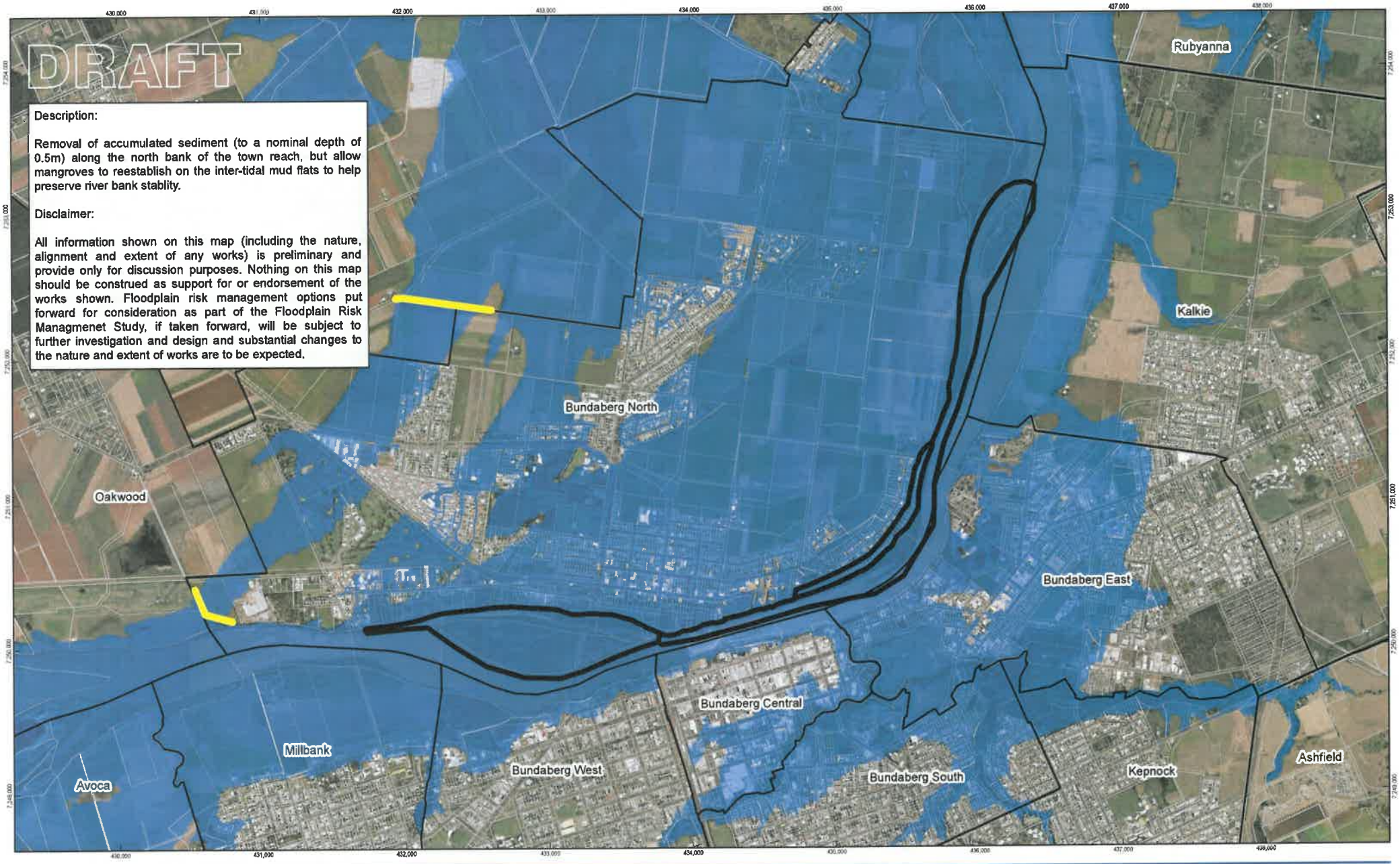
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Removal of Ben Anderson Barrage

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_028_MCA_BarrageRemoval.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Extents of Sediment Removal (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

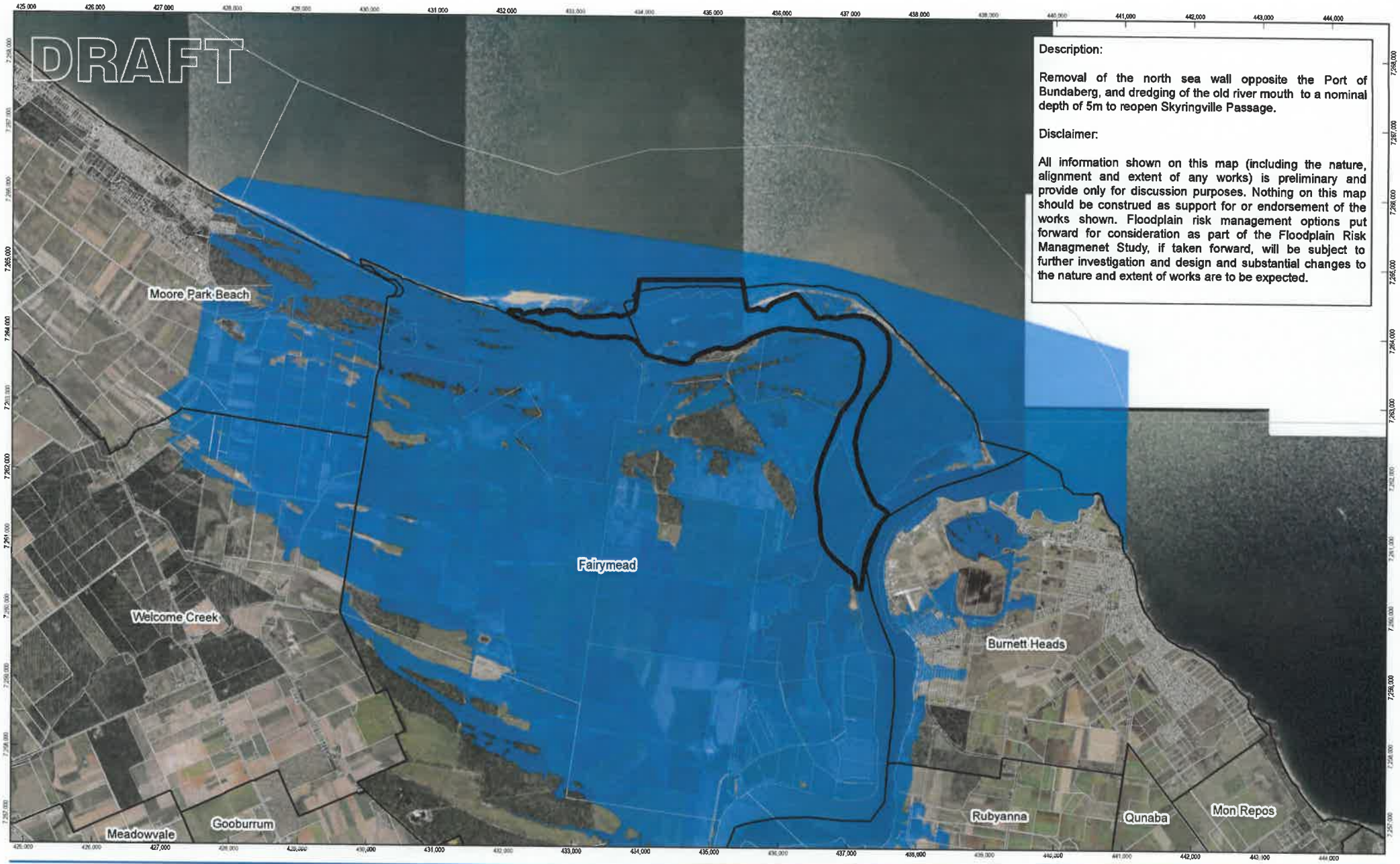
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Removal of Sediment from Town Reach

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_029_MCA_TownReachSedimentRemoval.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:50,000 @A3

0 500 1,000 1,500 2,000 2,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Skyringville Passage Extent of Works (Indicative)
- 2013 Flood Extent

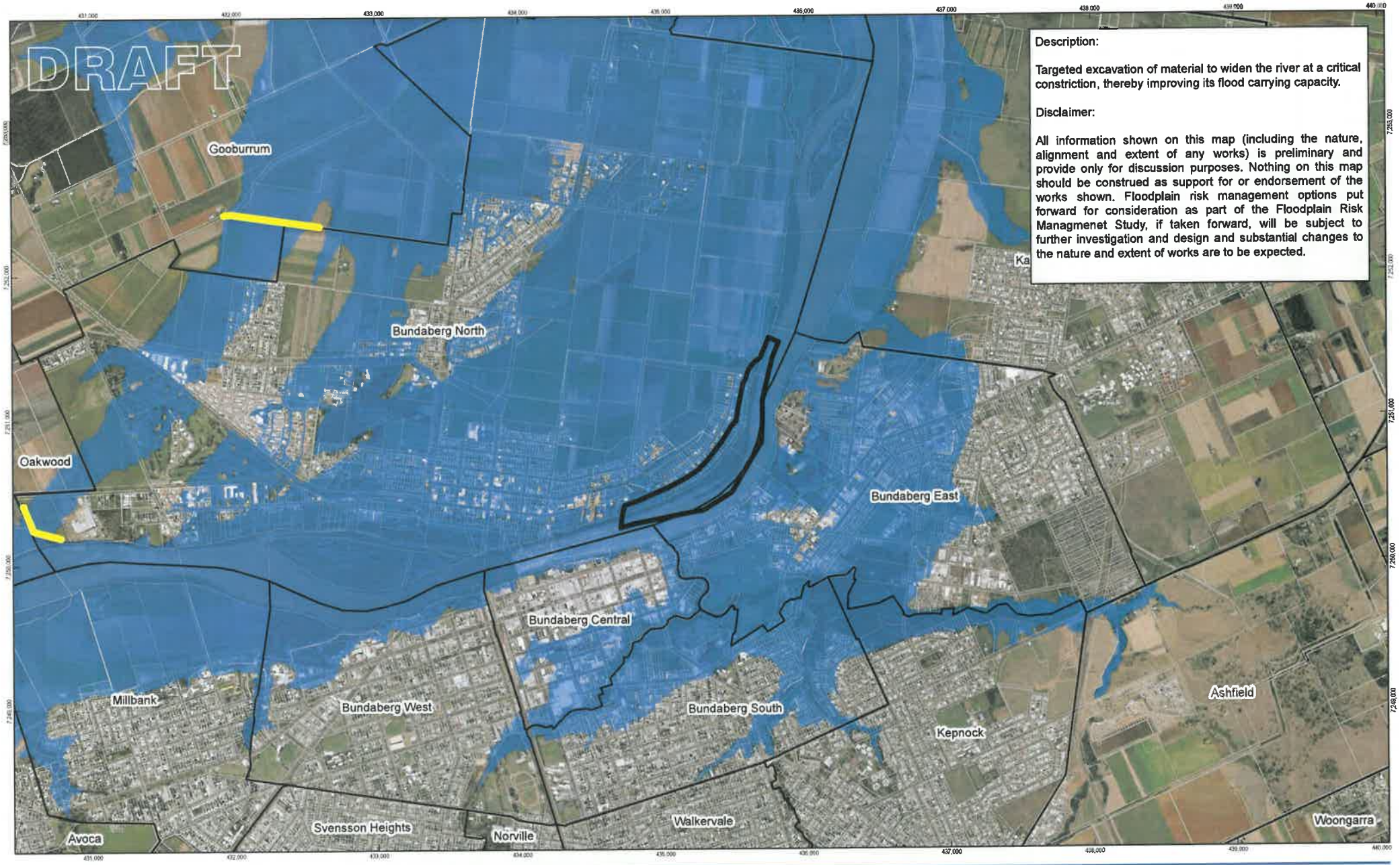
Bundaberg Regional Council	Job Number 41-26909
Burnett River Floodplain Risk Management Study	Revision A
	Date 25 Oct 2013

Preliminary Mitigation Options for MCA Reopening of Skyringville Passage

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_030_MCA_SkyringvillePassage.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Millaquin Bend Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

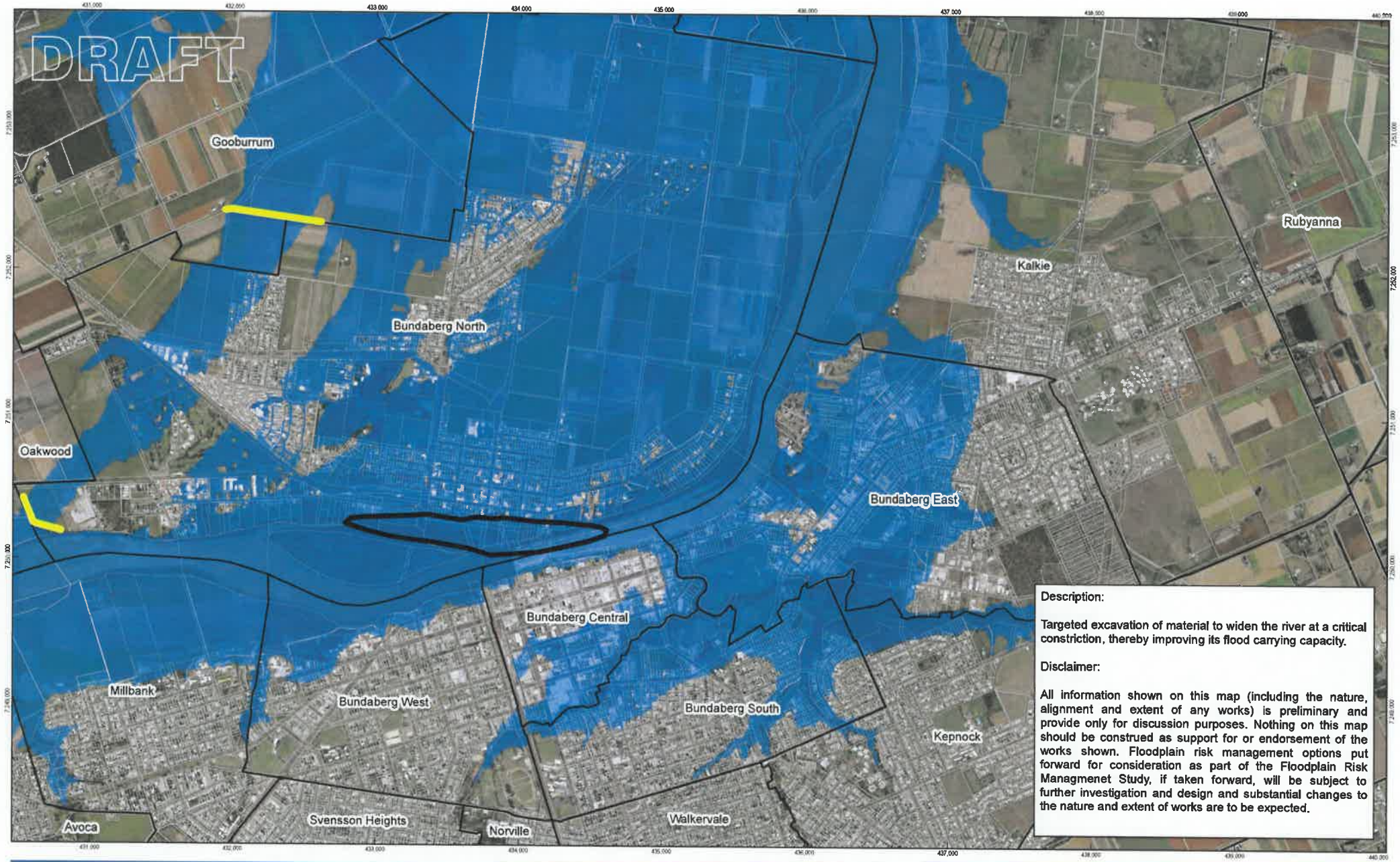
Job Number	41-26909
Revision	A
Date	28 Oct 2013

Preliminary Mitigation Options for MCA Millaquin Bend Widening

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41\26909_031_MCA_MillaquinBendWidening.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Edina St Park Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

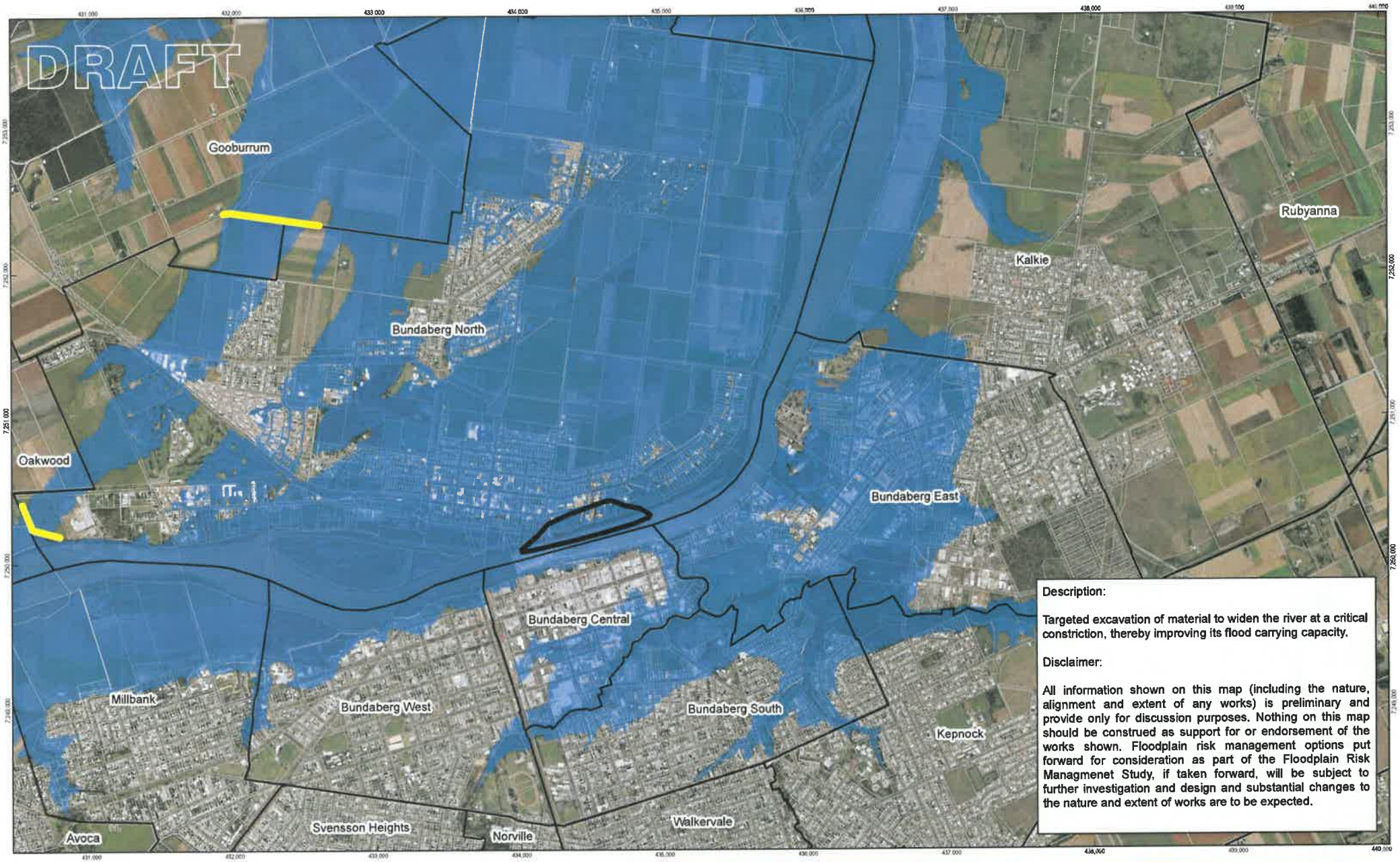
Job Number	41-26909
Revision	A
Date	28 Oct 2013

Preliminary Mitigation Options for MCA Edina Street Park Widening

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_032_MCA_EdinaStParkWidening.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Foundry Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 28 Oct 2013

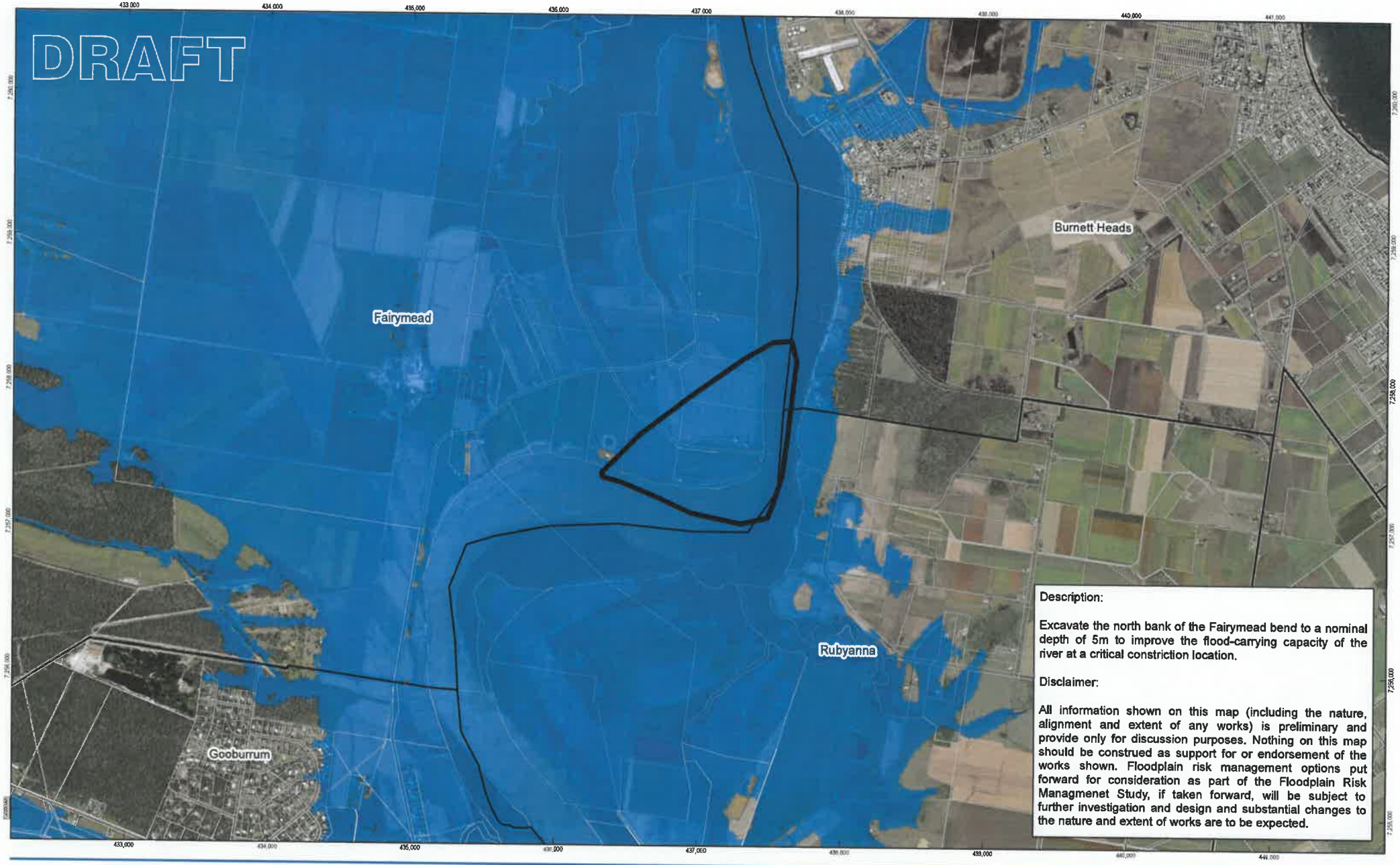
Preliminary Mitigation Options for MCA Foundry Widening

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41\26909_033_MCA_FoundryWidening.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

DRAFT



Description:

Excavate the north bank of the Fairymead bend to a nominal depth of 5m to improve the flood-carrying capacity of the river at a critical constriction location.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Fairymead Bend Widening Extent of Works (Indicative)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Foundry Widening

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_034_MCA_FairymeadBendWidening.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

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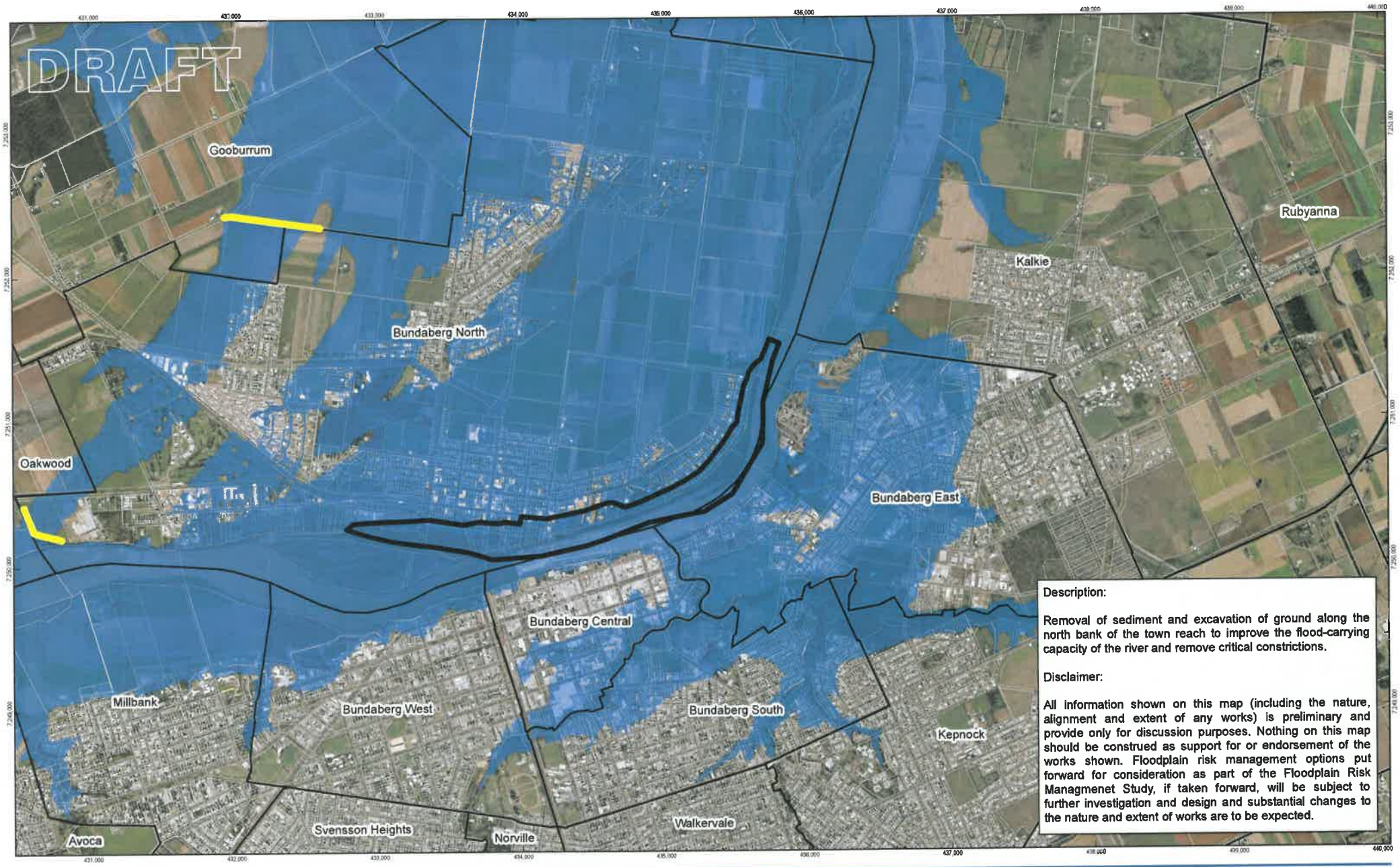

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Town Reach Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Town Reach Widening

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_035_MCA_TownReachWidening.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

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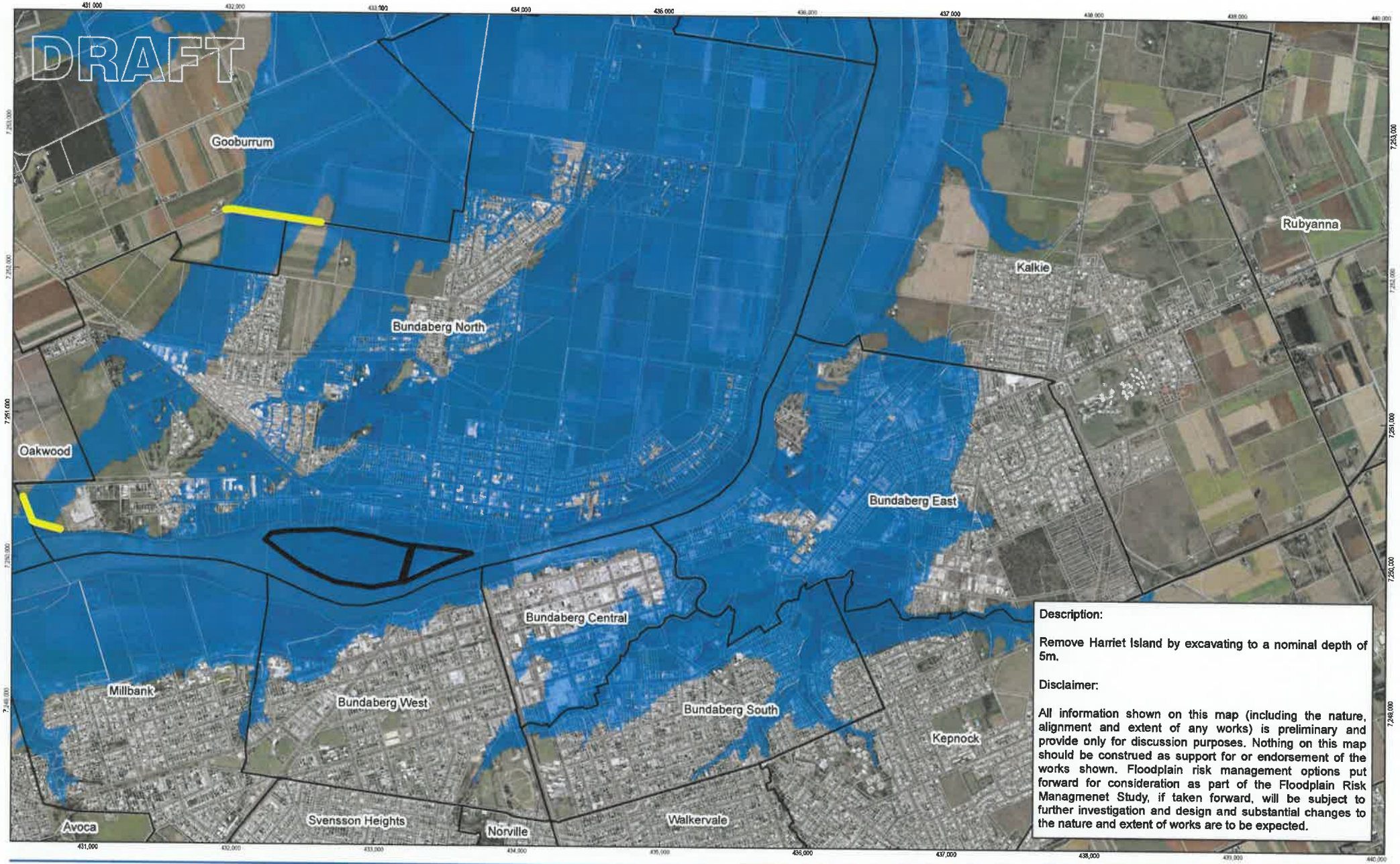

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Harriet Island Removal Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA Harriet Island Removal

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Data source: Data Custodian, Data Set Name/Title, Version/Date.

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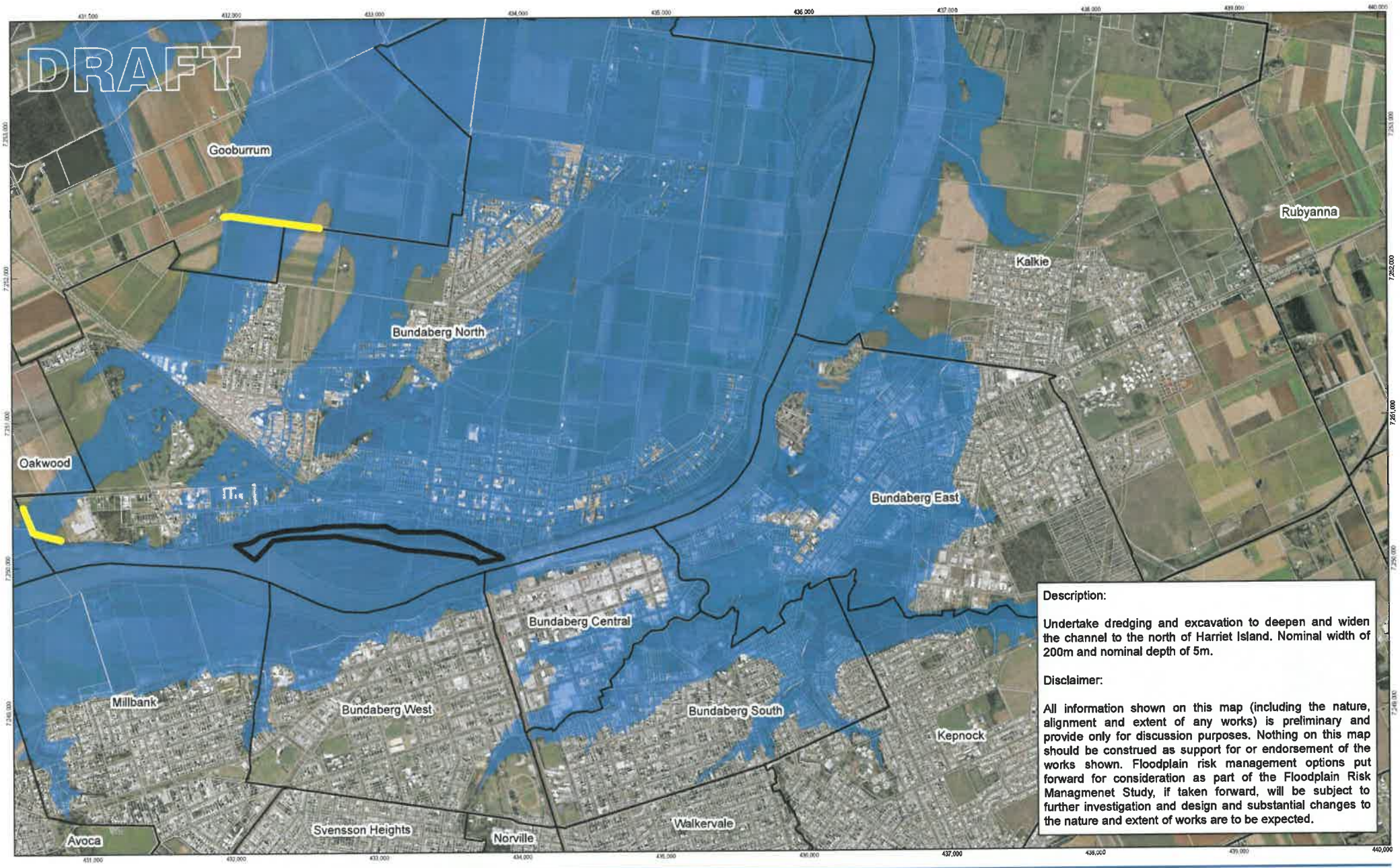

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre
Localities
North Channel Widening Extent of Works (Indicative)
Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number 41-26909
Revision A
Date 25 Oct 2013

Preliminary Mitigation Options for MCA North Channel Widening Works

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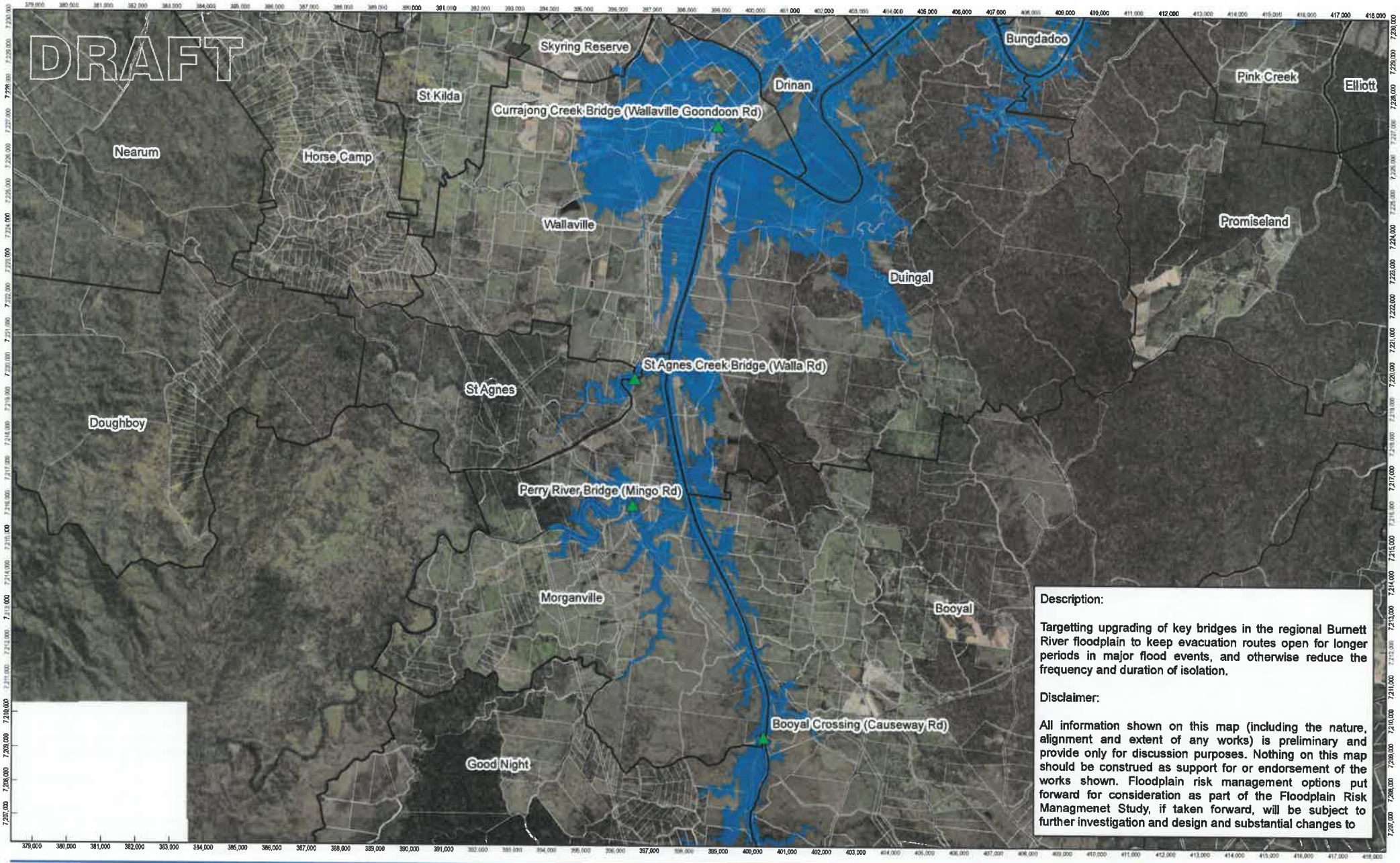
Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:100,000@A3

0 1,000 2,000 3,000 4,000 5,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre
Localities
Regional Bridge Upgrades
2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Regional Bridge Upgrades

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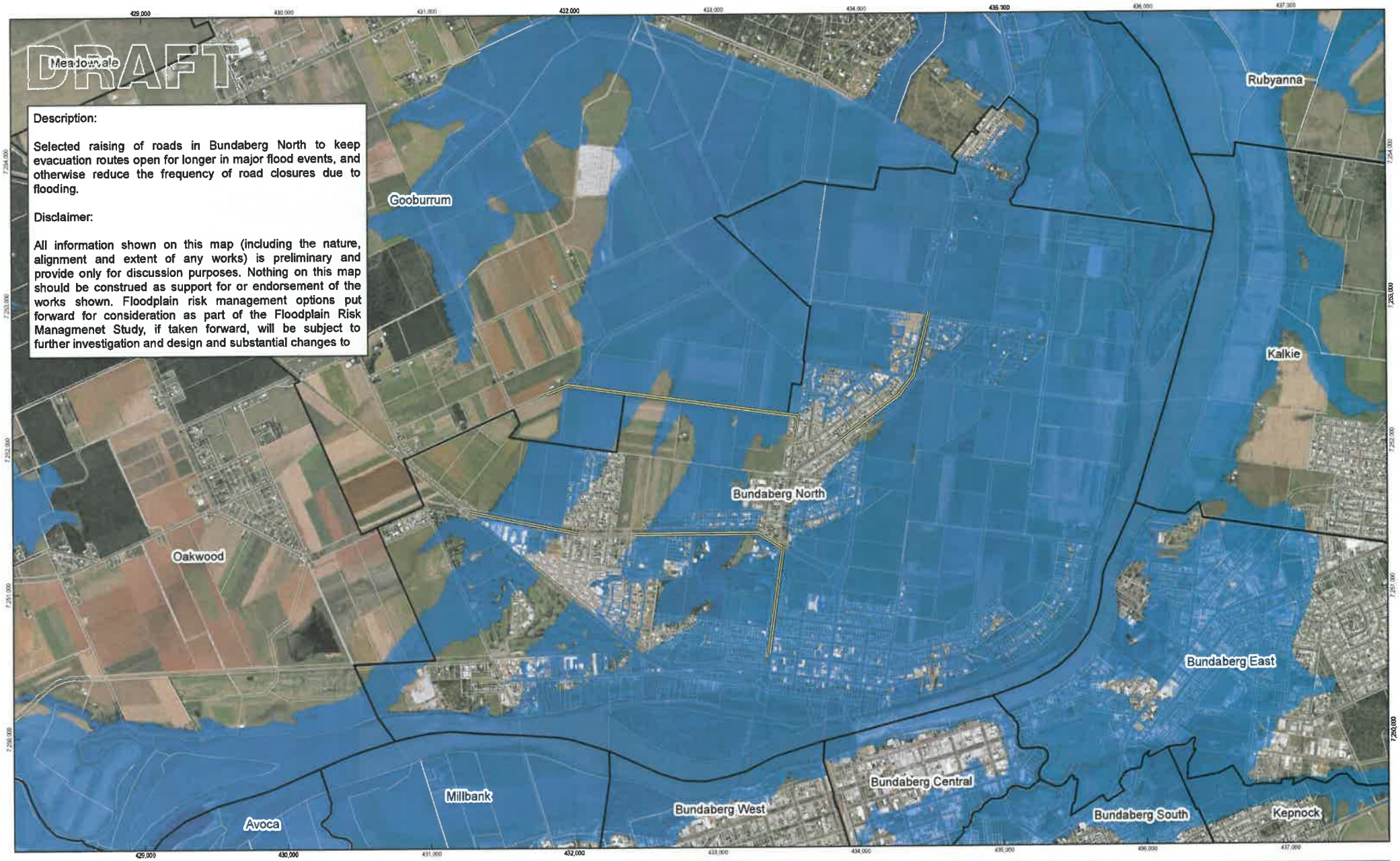
Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:24,000 @A3

0 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Bundaberg North Evacuation Route Upgrades (Preliminary)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Bundaberg North Evacuation Route Upgrades

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\41126909_039_MCA_BundabergNorthRoadUpgrades.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Robyn Laing

From: Dan Copelin [redacted]
Sent: Thursday, 31 October 2013 2:38 PM
To: Rob Marshman; Rowan Bond [redacted]
Cc: ~~Robyn Laing; Rob Calligaris; Dwayne Honer~~
Subject: RE: FW: Volume and Velocity Records of Burnett River Flood
Attachments: CRG_XS (2).docx

Follow Up Flag: Follow up
Flag Status: Completed

Rob,

Revised sections on a consistent x-axis scale, plus the new section through Millaquin Bend (XS 7) attached.

Regards,

Dan Copelin
Civil Engineer - Waterways & Water Resources

GHD
[redacted]

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Please consider our environment before printing this email

From: MarsCEL [redacted]
Sent: Thursday, 31 October 2013 11:47 AM
To: Dan Copelin; Rowan Bond [redacted]
Cc: ~~Robyn Laing; Rob Calligaris (InTouch); Dwayne Honor (InTouch)~~
Subject: RE: FW: Volume and Velocity Records of Burnett River Flood

Cheers mate, I'll have a look at this and take it to the meeting this afternoon.

Regards

Rob Marshman
B.Eng, RPEQ, MIEAust
MarsCEL *Civil / Structural*
[redacted]

As a company, we value customer satisfaction, and are continually seeking to improve our service delivery; therefore we request that you please provide feedback regarding our services?

From: Dan Copelin [redacted]
Sent: Wednesday, 30 October 2013 5:05 PM
To: MarsCEL; Rowan Bond [redacted]
Cc: [redacted]
Subject: RE: FW: Volume and Velocity Records of Burnett River Flood

Hi Rob,

As requested, we have extracted the cross-sections in those locations. We also have included the peak water level surface and peak velocities from our calibrated 2013 event model.

Regards,

Dan Copelin
Civil Engineer - Waterways & Water Resources

GHD
[redacted]
WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

From: MarsCEL[redacted]
Sent: Tuesday, 29 October 2013 12:16 PM
To: Dan Copelin
Subject: RE: FW: Volume and Velocity Records of Burnett River Flood

Dan

Could you provide this information.

Regards

Rob Marshman
B.Eng, RPEQ, MIEAust
MarsCEL *Civil / Structural*
[redacted]

From: MarsCEL
Sent: Tuesday, 29 October 2013 11:55 AM
To: [redacted]
Cc: Rowan Bond [redacted]
Subject: FW: FW: Volume and Velocity Records of Burnett River Flood

Dwayne

During your presentations of the flood modelling investigations, you mentioned council had surveyed river cross-section at various locations of the river. Would it be possible to compare some of those cross-sections for a visual indication of the potential impacts various mitigation options may have.

There seems to be a lot of speculation amongst the group this may just help to gain a better understanding of the flood event and I am unable to get accurate cross-sections from Google Earth or the council interactive mapping (it appears as if all contours have been removed from the interactive mapping from below the flood waters in the areas of interest.

Regards

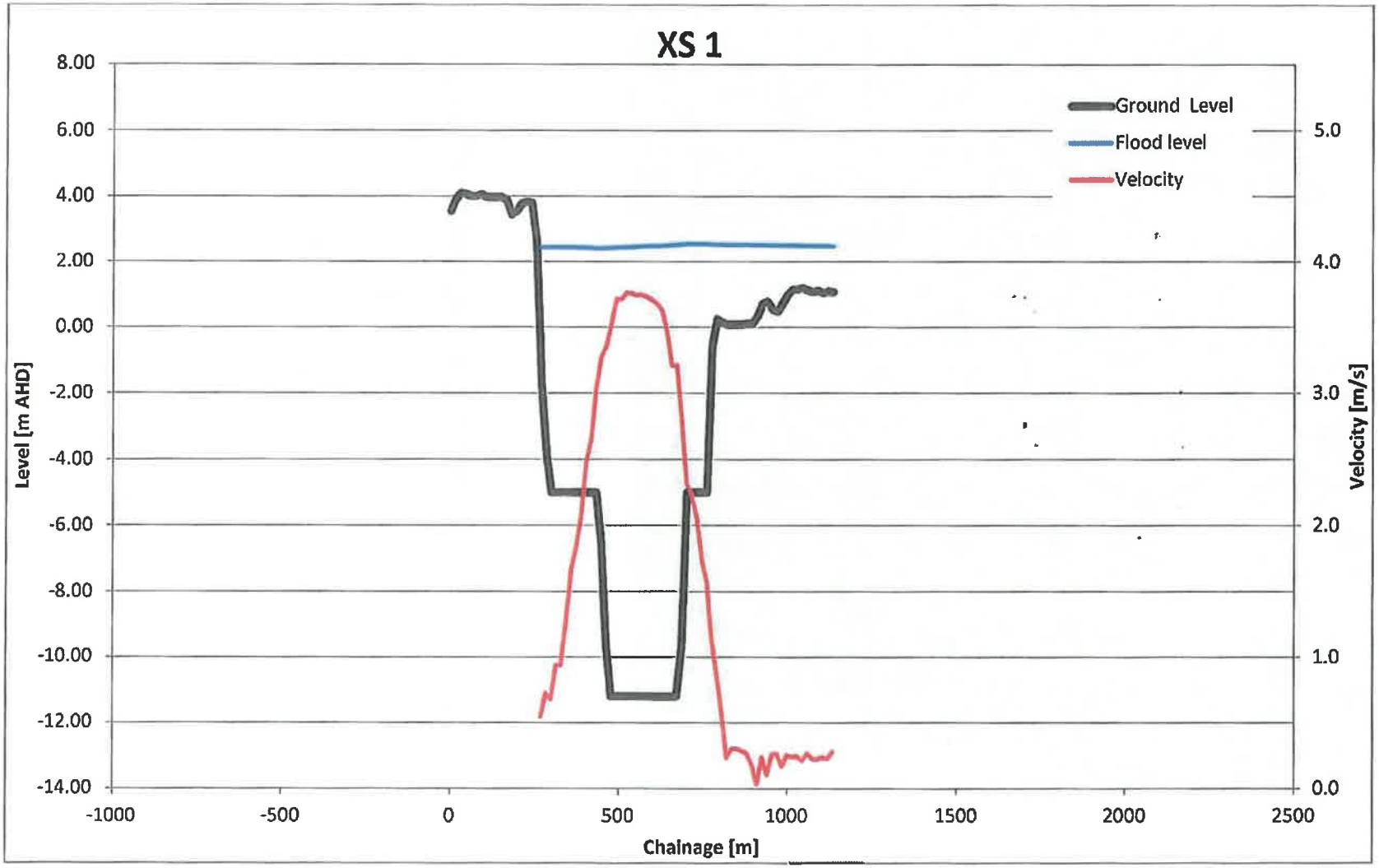
Rob Marshman
B.Eng, RPEQ, MIEAust
MarsCEL *Civil / Structural*
[redacted]

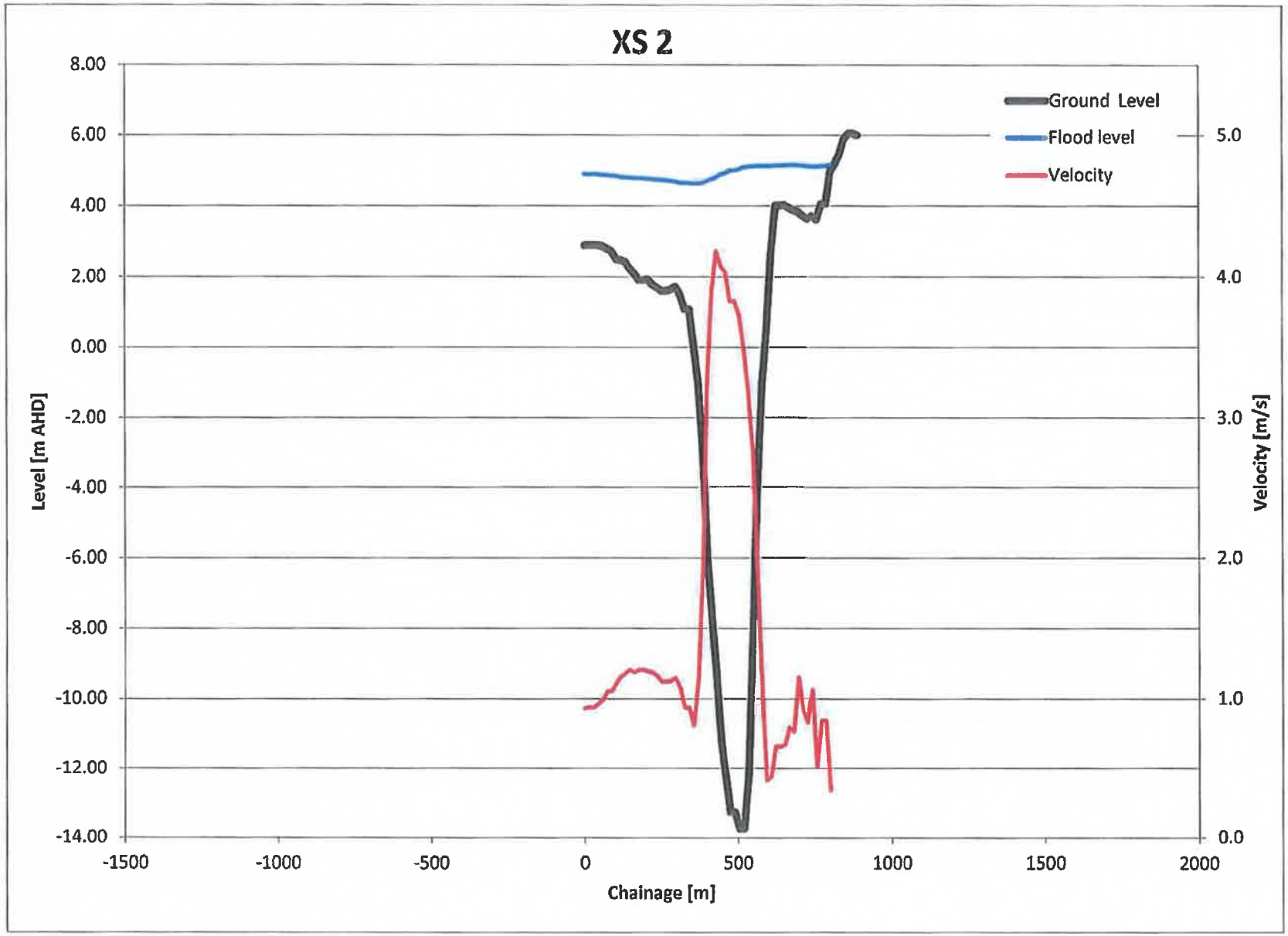
[redacted]
Sent: Friday, 25 October 2013 9:08 PM
[redacted]

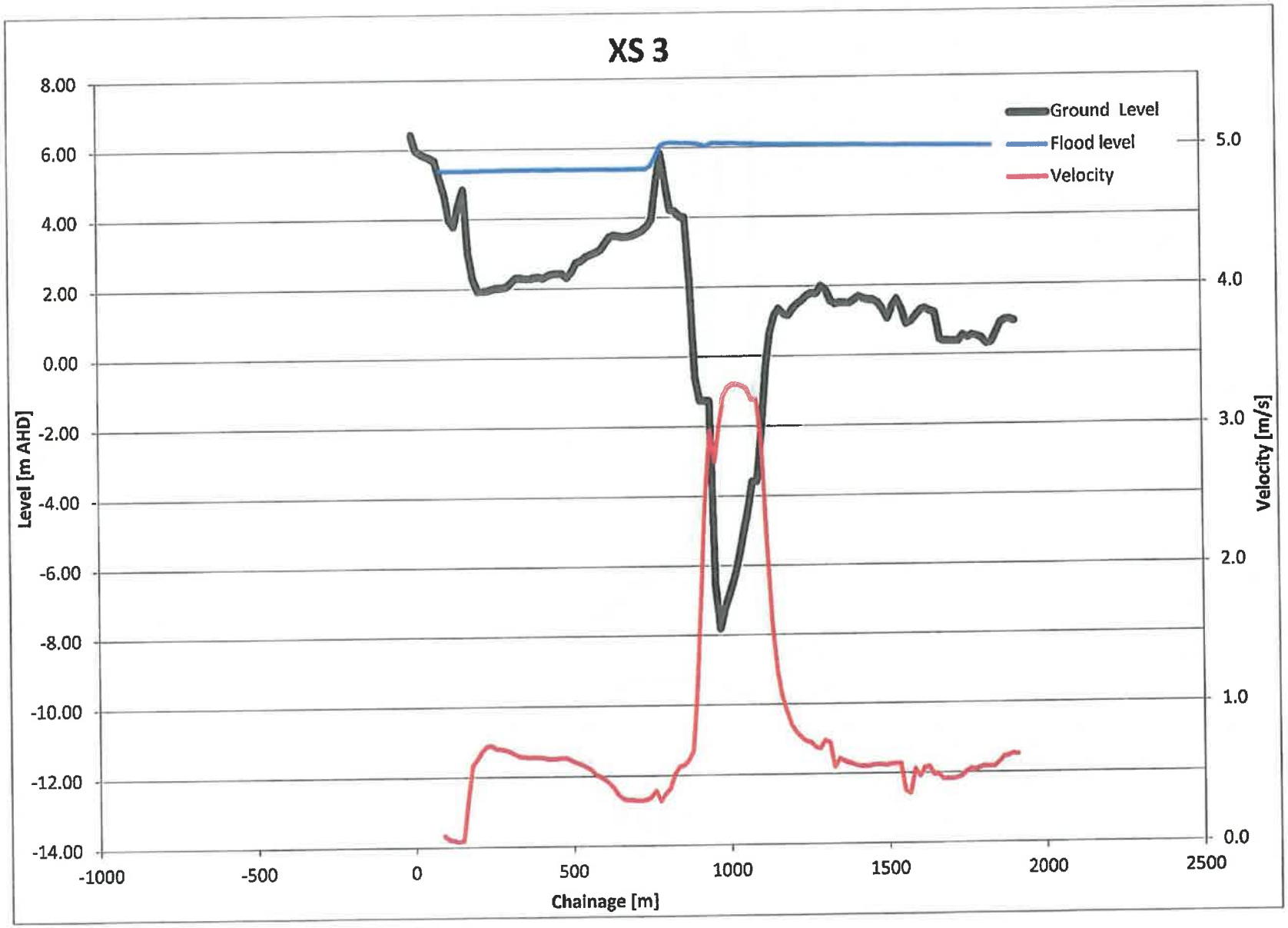
Level and velocity were extracted at the 7 XS shown on figure below:

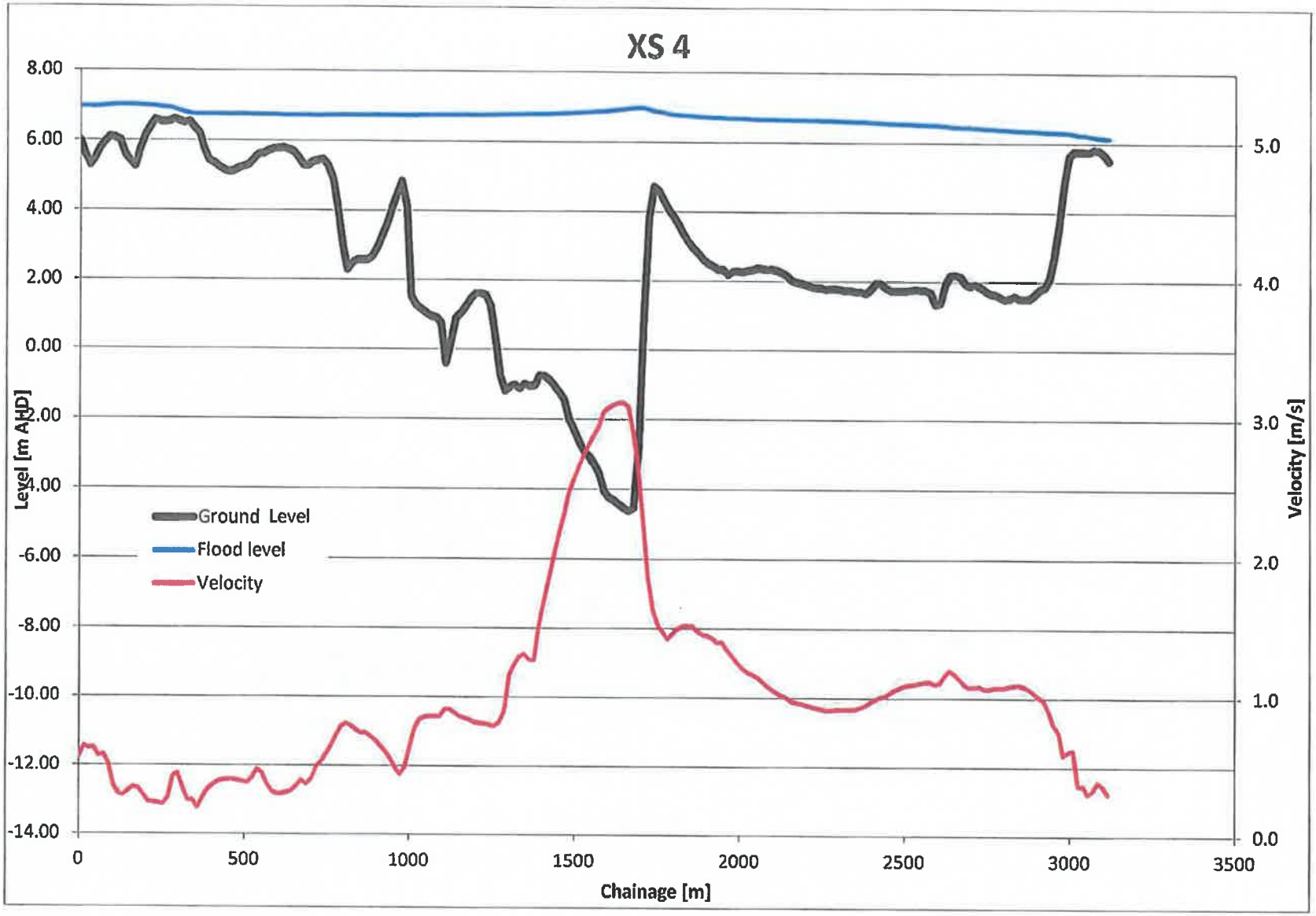
EMAILED INFORMATION
FROM GHD
(FLOW VELOCITIES)

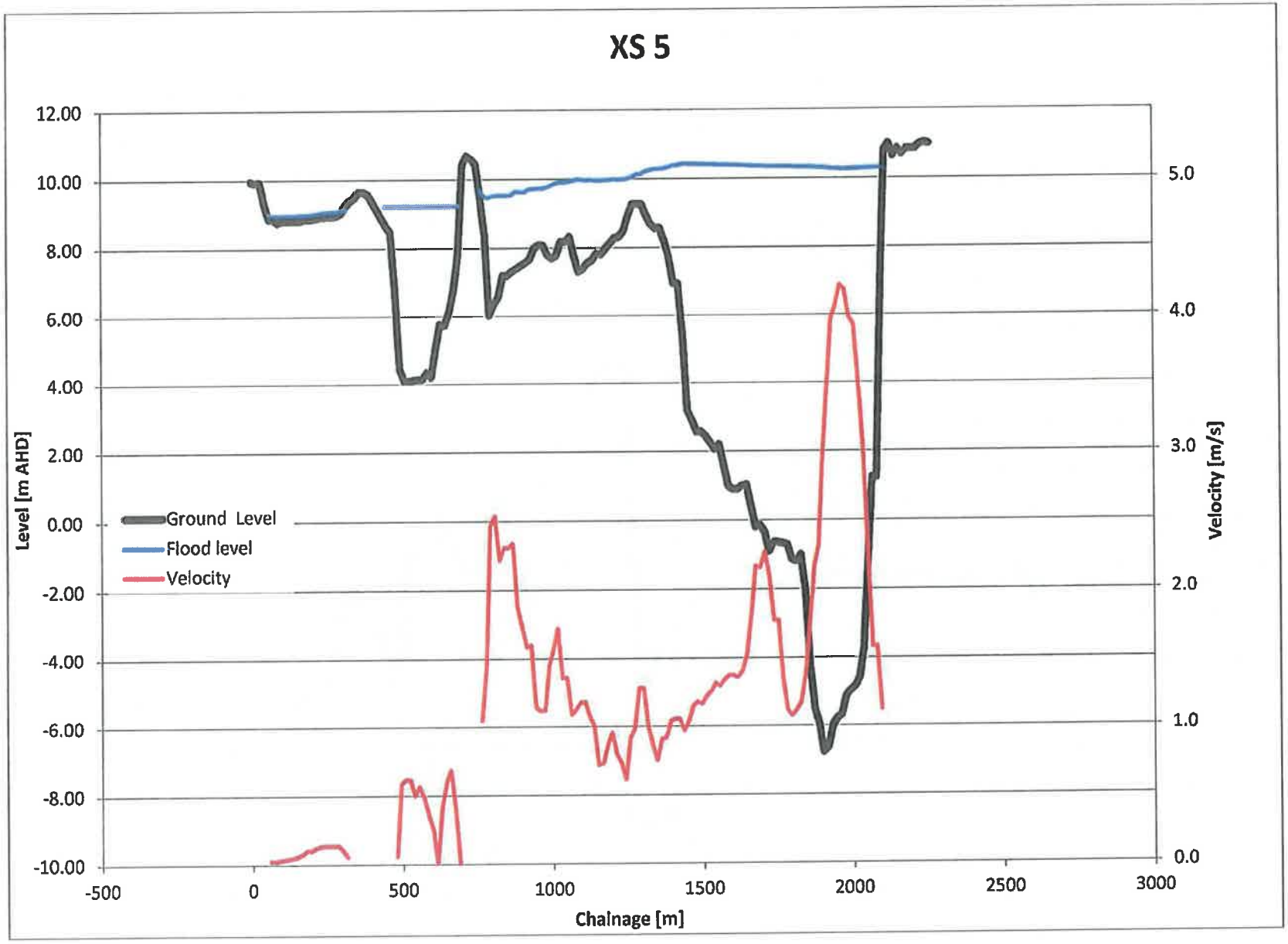
The Following results were obtained at each XS:




XS 2
Ground Level
Flood level
Velocity
Level [m AHD]
Velocity [m/s]
Chainage [m]
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
5.0
4.0
3.0
2.0
1.0
0.0
-1500
-1000
-500
0
500
1000
1500
2000


XS 3
Ground Level
Flood level
Velocity
Level [m AHD]
Velocity [m/s]
Chainage [m]
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
5.0
4.0
3.0
2.0
1.0
0.0
-1000
-500
0
500
1000
1500
2000
2500


XS 4
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
Level [m AHD]
5.0
4.0
3.0
2.0
1.0
0.0
Velocity [m/s]
Ground Level
Flood level
Velocity
0
500
1000
1500
2000
2500
3000
3500
Chainage [m]


XS 5
12.00
10.00
8.00
6.00
4.00
2.00
0.00
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-6.00
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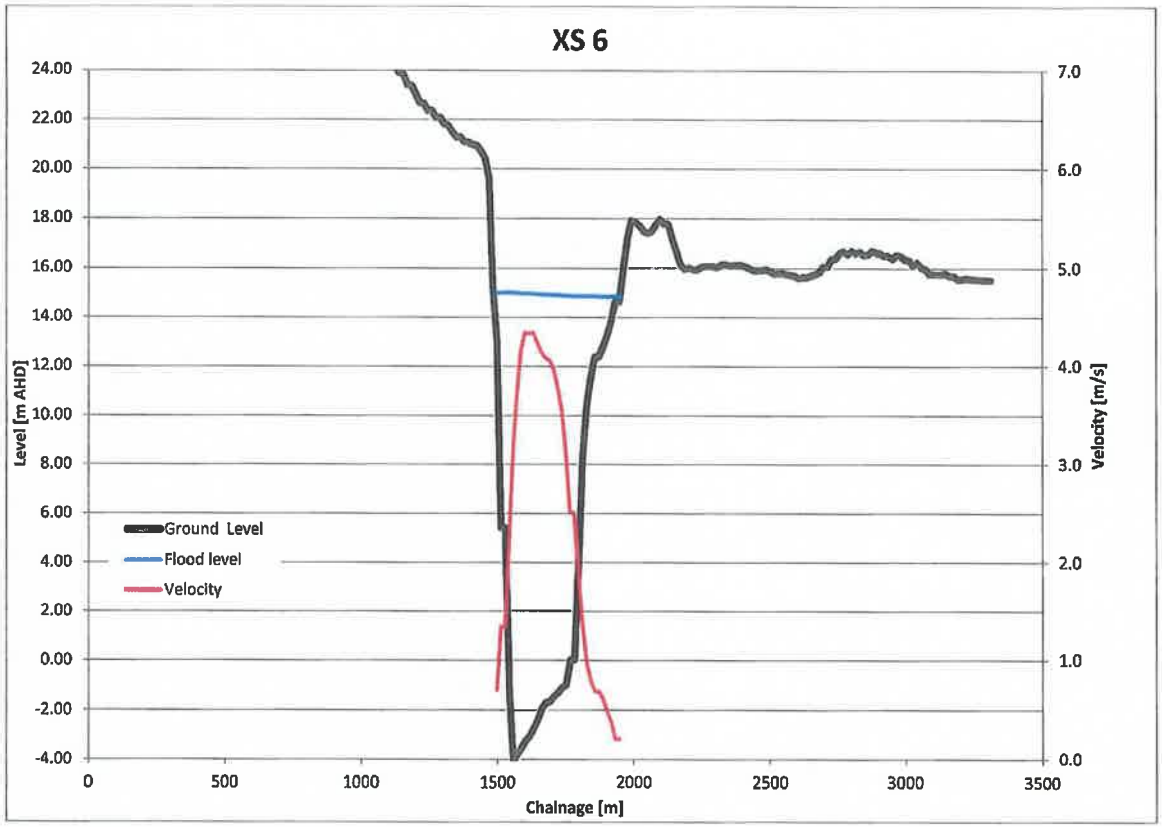
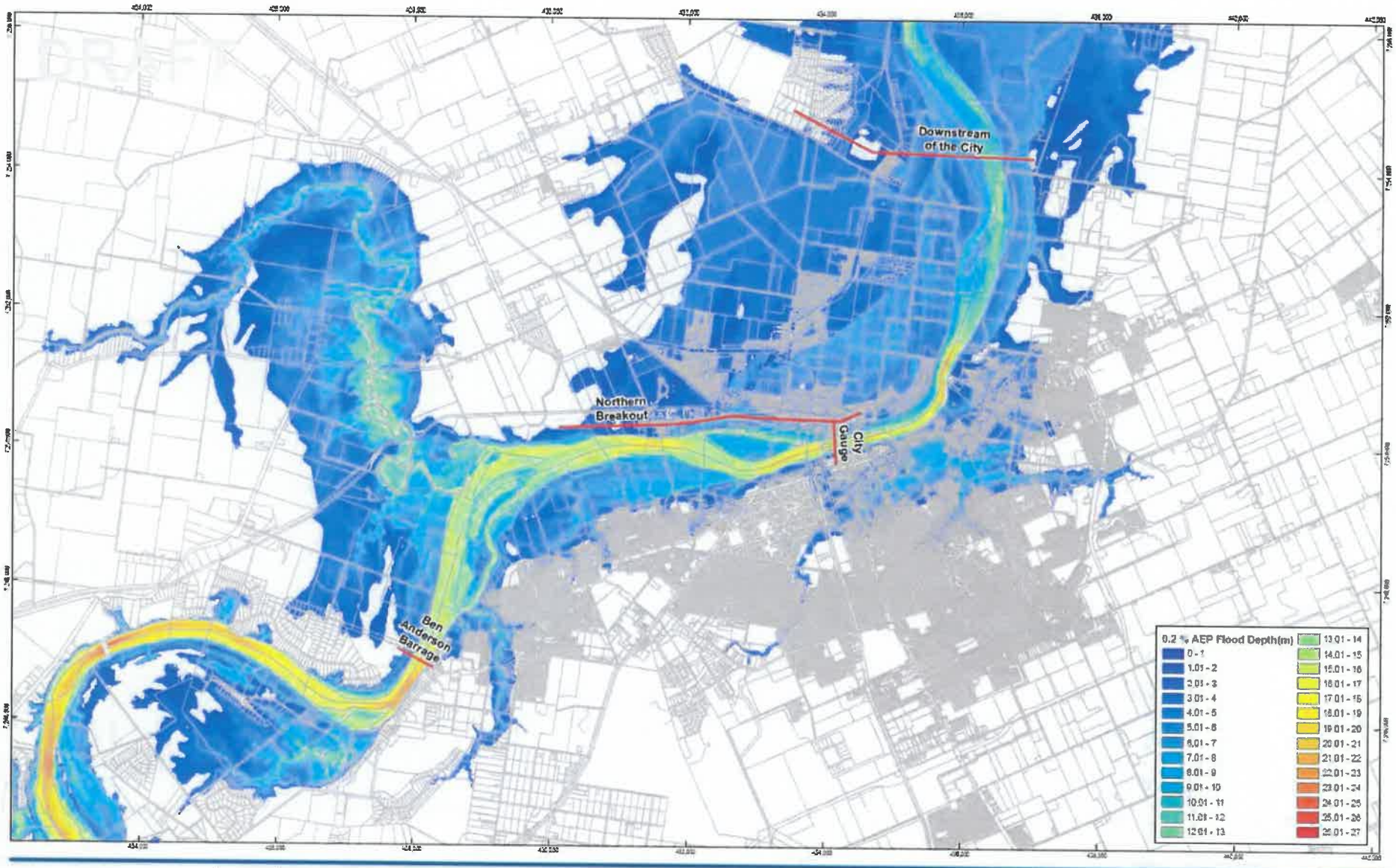
-10.00
Level [m AHD]
5.0
4.0
3.0
2.0
1.0
0.0
Velocity [m/s]
-500
0
500
1000
1500
2000
2500
3000
Chainage [m]
Ground Level
Flood level
Velocity


XS 6
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
Level [m AHD]
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Velocity [m/s]
0
500
1000
1500
2000
2500
3000
3500
Chainage [m]
Ground Level
Flood level
Velocity

Dwayne Honor

From: Dwayne Honor
Sent: Thursday, 24 October 2013 5:32 PM
To: Robyn Laing
Subject: RE: Volume and Velocity Records of Burnett River Flood

Hi Robyn,
The flow rate for the northern breakout as per map below is about 2,725 m3/s (1% AEP) to 4,854 m3/s (0.5 % AEP). The January 2013 event is similar in magnitude to the 1% AEP.



1:50,000 @A3

0 1,000 2,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

Location of Flow and Level Measurement

Cadastre

Bundaberg Regional Council
Burnett River Flood Study

Job Number	41-24728
Revision	C
Date	17 Sep 2013

Location of Measurement Stations

Figure 10-2

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E brmail@ghd.com W www.ghd.com

Velocities are complex in North Bundaberg but in order to better understand the factors contributing to scour, local "nested' 2D hydraulic models were developed to simulate the impact of local features such as buildings and fences on local flow patterns and velocities. The below table is the statistical analysis from the nested model:

Description	Velocity
Property Maximum Velocity Mean	3.46 m/s
Property Maximum Velocity Std Dev	0.95 m/s
Lowest Property Maximum Velocity	1.82 m/s
Highest Property Maximum Velocity	5.77 m/s
1sigma	4.41 m/s
2sigma	5.35 m/s

Table 1 – Statistical Analysis of Flood Velocities, North Bundaberg, January 2013

The above information can be shared with the CRG.

Regards

DWAYNE HONOR
Manager Design
BET(Civil) BBA
Bundaberg Regional Council
PO Box 3130
Bundaberg QLD 4670
Tel: 1300 883 699
Fax: (07) 4150 5410
http://bundaberg.qld.gov.au/

BUNDABERG
REGIONAL COUNCIL

Ben Anderson Barrage- Flood Elevation

To. Rowan Bond, CRG members, Robyn Laing.

Subject: Memorandum, Table 1. Subject No 28 "River Works", Ben Anderson Barrage.

(Dated 28 October 2013).

Sent to Rob Calligaris.

From GHD.

Issue of concern:

Subject 28. "Removal of Ben Anderson Barrage".

Rowan,

the GHD response to this subject matter, "The removal of Ben Anderson Barrage", does not really address the area of my concerns, which is elevated river heights during times of flooding.

GHD claim:

"No significant hydraulic benefit, major implications for water supply".

In terms of the second point first, there is adequate water supply in train through the Paradise Dam/Walla Weir impoundments.

The only obstacle is delivery of the water, (which is eminently achievable), and a long entrenched regional mind set focused on why we cannot do without the Barrage.

In terms of the first point, "no significant hydraulic benefit", I believe that the GHD modelling study is incomplete in that it primarily focusing its attention on the 2010-2013 periods.

The study does not model the river from the base line as a pristine river. This is fundamental to gauging whether or not the Ben Anderson Barrage elevates flood levels.

I contend that it DOES elevate flood levels.

Allow me to explain why.

Firstly, by their very nature, ALL dams and weirs elevate the water levels from one impoundment to the next as we progress upstream.

If not, then they cannot function as independent impoundments.

In the case of Ben Anderson Barrage, (as in the case of Bingera Weir before Ben Anderson was built), there is a salt water estuary on the downstream side, fresh water on the up river side.

It is absolutely vital under these conditions, that the tidal salt water cannot enter the fresh water impoundment, or the impoundment and its entire water capacity becomes undrinkable and unusable for most crop irrigation..

So the wall to wall cement structure must stand proud and above the spring tide level.

For the Burnett, the highest astrological tide, (summer), occurred on 12/1/2013, 8:57 at a 3.52m tide. During winter the highest tide was a 3.44m tide.

So Ben Anderson has to have been built above these levels or it cannot function in a useful way.

The height of the structure protruding from these spring tide levels, to the top of the barrage itself is the elevated level of fresh water upstream of the barrage.

Unfortunately, my computer is in the sick bay, so I am unable to research the levels just now.

A secondary example might be Walla Weir, which I believe is further elevated than Ben Anderson?

My rationale is that each impoundment in tidal waters, on the upstream side, has an artificially elevated water height above the high tide levels caused by the structure installation itself.

It cannot function were it to be otherwise.

I contend this elevated river height cannot lessen during flood periods, and must in fact increase the water levels, compared to a pristine system.

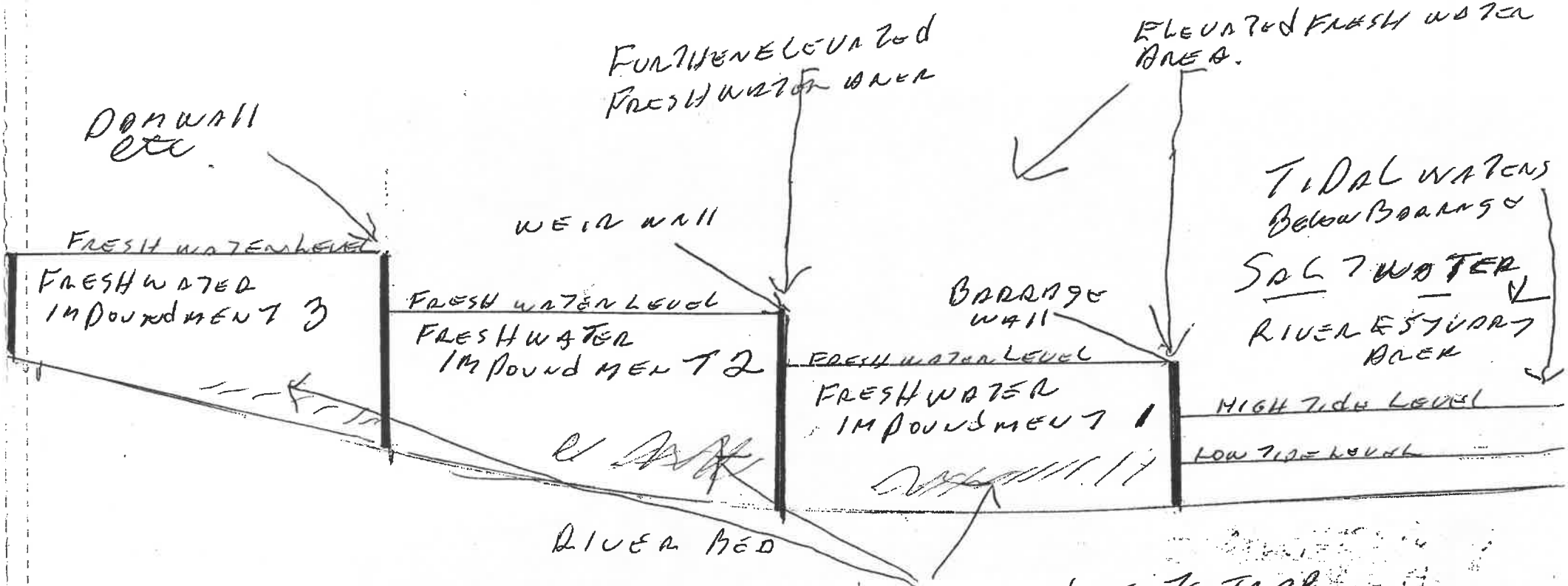
This, and not basing the model on a pristine river system, is the component that I believe is missing from the GHD findings regarding Ben Anderson barrage.

However there are a number of other salient points and ways that Ben Anderson Barrage contributes to flooding. I am happy to prepare a brief on these when my computer is fixed.

I am preparing a couple of very simple sketches to crystallise my point.

John Olsen

ROUGH SKETCH — RIVER SUCH AS BURNETT IN ADVANCED STAGES OF MODIFICATION. — EXAMPLE; SKETCH ONLY.

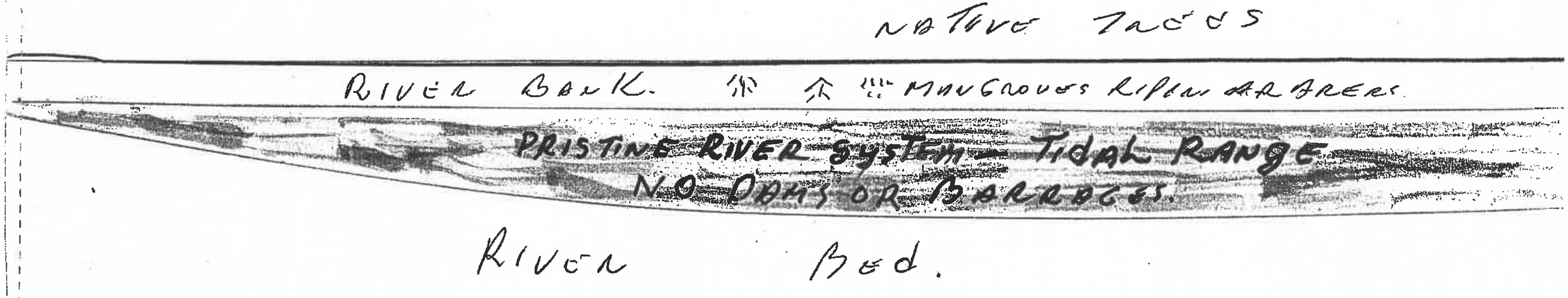


* OF ITSELF, THE MODIFIED SYSTEM CONTAINS DAM, WEIR AND BARRAGE WALLS WHICH ARE ELEVATED BY THEIR ENGINEERING DESIGNS. THIS MUST BE SO IN ORDER TO CATCH AND STORE INCREASED WATER LEVELS.

* IMPOUNDMENTS TRAP SEDIMENTS, DEBRIS, VEGETATION MATTER DURING DRY PERIODS. EXACERBATES SEDIMENT LOAD AND CAUSES HEAVY SILTATION.

SIMPLE SKETCH OF A PRISTINE RIVER

NO SHAPING OR CONTOURS – PRINCIPLE OF ONLY.



* THERE ARE NO DAM WALLS ACROSS THE RIVER TO ELEVATE RIVER HEIGHT.

~~Robyn Laing~~

From: ~~Robyn Laing~~
Sent: Thursday, 31 October 2013 1:42 PM
To: [redacted]
Subject: FW: Ben Anderson barrage

Follow Up Flag: Follow up
Flag Status: Completed

Rowan
Our Flood Consultants, GHD have supplied the following information in response to removal of Ben Anderson Barrage as a flood mitigation proposal.

Regards Robyn.

ROBYN LAING
Business Systems Facilitator
INFRASTRUCTURE & PLANNING
Bundaberg Regional Council
PO Box 3130
Bundaberg QLD 4670
Tel: 1300 883 699
Fax: (07) 4150 5410
http://bundaberg.qld.gov.au/

BUNDABERG
REGIONAL COUNCIL

From: Dan Copelin [redacted]
Sent: Thursday, 31 October 2013 12:07 PM
To: ~~Rob Calligaris; Robyn Laing~~
Cc: ~~Benjamin Regan; Dwayne Honor~~
Subject: Ben Anderson barrage

Members of the CRG,

I wish to provide the following information to contribute to the discussion on the Ben Anderson barrage. You will note in my memo outlining the list of options for the MCA that the barrage removal option will not be taken forward as part of GHD's MCA. We made this decision primarily based on hydraulic modelling of the impact of the barrage. We will have the opportunity to discuss this information further during today's meeting. This information is provided for discussion purposes only and further detail and explanation will be provided in the final Floodplain Risk Management Study Report.

In terms of the barrage's direct impact on water levels during a significant flood event:

As part of the Burnett River Flood Study (refer to Section 11 once the report is available), GHD conducted a sensitivity test on the hydraulic model whereby the Ben Anderson barrage (as well as the bridges in the town reach) were removed from the model. The change in flood level for the 2013 event was calculated. The below is a screenshot of these results, where the points are labelled with the change in flood level in metres:

As seen, the removal of the barrage (and bridges) only reduces flood levels by 1 or 2 cm. This is not a significant effect, and is not an effective method for mitigating flooding. The primary reason for this very small effect is that the barrage is a relatively low structure (crest level 2.1m AHD) and the 2013 flood level at the barrage was about 12m higher than the top of the structure (flood level ~14m AHD at that location). The barrage was therefore completely drowned and exerted no significant impact on peak flood levels. This is true for all significant floods. The barrage would have a more pronounced impacted during minor river flows (where the water level downstream of the barrage is not much higher than the crest), however these flows are generally below the threshold of damaging floods and reducing water levels in these situations will not deliver benefit to the community. The below figure from the flood study shows this effect, where only a minor perturbation in the water surface is evident at the barrage. Far more significant are the locations circled in red, where constrictions in the river cause a significant increase in flood levels upstream.

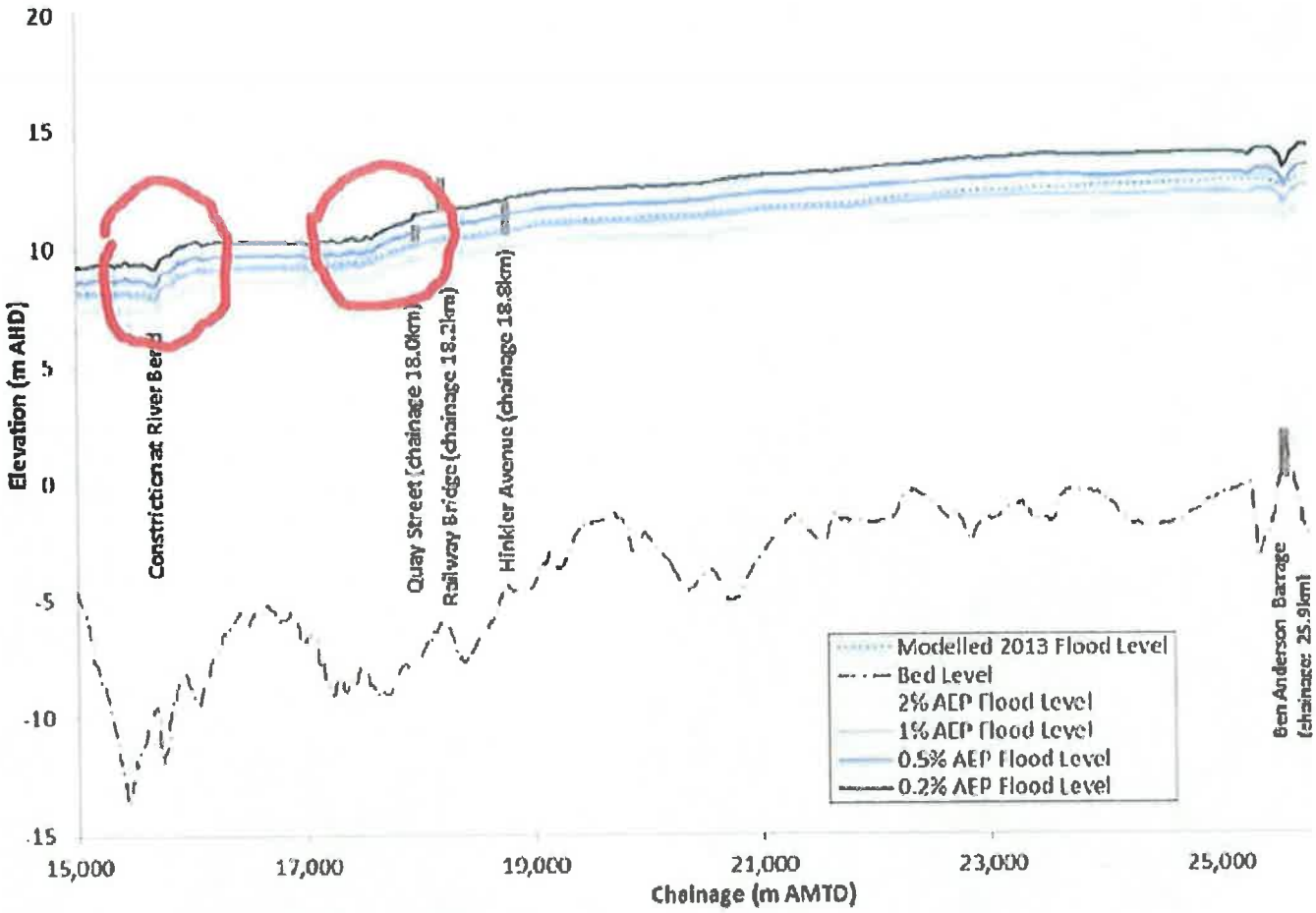


Figure 11-7 Design Event Flood Profiles along the Town Reach

In terms of the barrages impact on the accumulation of sediment in the town reach:

From very early records, it is known that the Burnett River is naturally very shallow in some locations and is heavily laden with sediment. It is also known that the river bed naturally changes over time due to the influence of tides and freshwater flooding, even without human interference. The Burnett River, as with other rivers in Queensland, has likely also been impacted by the clearing of land for agriculture. It is believed by some that man-made structures such as the Ben Anderson Barrage (built in 1974-75) have led to the accumulation of additional sediment and a reduction in river capacity through the town reach. There is certainly significant evidence (both anecdotal and from other sources such as aerial photograph) that intertidal mudflats (with accompanying mangrove growth) and sub tidal sediments have accumulated on the northern bank of the town reach over the period from 1942 to 2010. Whether this was due to the construction of the barrage or simply natural processes is a question that can be partially answered through engineering investigation.

In the past there have been two detailed hydraulic analyses (Queensland Government Hydraulics Laboratory, 1985 and 1994) of the impacts of the Ben Anderson Barrage on downstream sedimentation and channel depths. These studies were carried out in response to concerns that the barrage had caused a reduction in river depth in the town reach. While there were some limitations to these studies, the general finding was that the barrage had no significant impact on the accumulation of sediment downstream during both tidal and flood conditions. Based on these results, the observed accumulation of sediment in the town reach might be better explained by the lack of significant flood events between the time the barrage was constructed and 2010 or other natural or human-induced (i.e. soil loss due to agriculture) processes that have been occurring since before the barrage's construction.

Detailed surveys of the river bed from 2010, 2012 and 2013 show that recent flooding has removed significant quantities of sediment (up to 3m or more in places) from parts of the river bed, although some of the intertidal mudflats on the north bank remain. This supports the view that floods are the dominant factor contributing to the erosion and deposition of sediment in the Burnett River system. Further detailed investigations (geomorphological

and sediment transport studies using modern computer simulations that model the flow of water in 2- or 3-dimensions and include fine silts and muds) would be necessary to conclusively determine whether removing the dam, weirs and barrages (or some combination thereof) would indirectly mitigate flooding in populated parts of the Burnett River floodplain by reducing the accumulation of sediment. This is because the processes that govern the mobilisation and deposition of sediments (gravels, sands, silts, muds, etc.) are complex, and a change in one part of the river might have both positive and negative impacts on the capacity of the river in other locations.

However, based on the currently available evidence described above it is not anticipated that the barrage has any significant impact on the accumulation of sediment through the town reach. Conventional wisdom and experience at many other river impoundments suggests that the most significant impact on sedimentation is actually upstream of the structure, where reduced flow velocities are likely to increase the rate of accumulation. Given this fact, the removal of the barrage may have detrimental effects on the town reach and below due to the release of this accumulated material.

Other issues:

The other side of this issue, which isn't discussed here, is the potential cost of removing the barrage, which would have to be weighed against its benefits and the cost vs benefits of the other viable options under consideration. The substantial costs would include sourcing an alternate supply and constructing infrastructure to deliver water to Bundaberg, and sourcing additional supply to maintain the current level of water security during droughts. With the negligible benefits described above, we are confident that removal of the barrage is not a viable option for directly mitigating damaging floods.

Regards,

Dan Copelin
Civil Engineer - Waterways & Water Resources

GHD
[redacted]
WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

BURNETT RIVER FLOODPLAIN ACTION PLAN

COMMUNITY REFERENCE GROUP MEETING

TUESDAY 19 NOVEMBER 2013 – 4PM

COMMITTEE ROOM, BUNDABERG MAIN ADMINISTRATION OFFICE, 190 BOURBONG STREET, BUNDABERG

MINUTES

ATTENDANCE:

Rowan Bond (Chairperson), Kay Amsler, Helen Dayman, Rob Marshman, John Olsen, Barry Ehrke, John Lee, Jon Carman, Steve Cooper, Andrew Fulton (General Manager Infrastructure & Planning), Rob Calligaris (Council's Design Team Leader), Robyn Laing (Administration Support), Kevin Gutteridge (Queensland Reconstruction Authority Inspector) and Snr Sergent Grantley Marcus, (QPS Liaison Officer between Disaster Management and Minister for Local Government, Community Recovery & Resilience, Hon David Crisafulli).

APOLOGY:

An apology was tendered for Dwayne Honor (Council's Design Manager and Project Manager), and Mark Pressler.

CONFIRMATION OF MINUTES:

CRG MEMBERS JOHN LEE AND KAY AMSLER MOVED that the Minutes of the CRG Meeting held on 31 October 2013 be confirmed subject to inclusion of Pine Creek in the 2nd paragraph on page 5 referring to Option 38 – Regional Bridge Upgrades and these amended Minutes be made available on Council's website.

Rob Marshman attended the meeting at 4.08pm

The motion was put CARRIED.

BUSINESS ARISING FROM THE MINUTES:

Sunwater Notification – Paradise Dam:

It was agreed to note the following recommendation for the CRG Report to Council:

1. **Broaden the catchment of residents they currently notify when releasing water from Paradise Dam; and**
2. **Further promote the warning system both for both operational dam releases and catastrophic failure.**

Sedimentation:

It was agreed to note in these Minutes that, "a huge amount of sedimentation downstream of Ben Anderson Barrage and Bingera Weir had significantly further reduced the tidal prism thereby reducing the affect of the flushing of fine sediments from the tidal section of the river.

CRG Member, John Olsen had observed that the sedimentation and sand deposits upstream of Tomato Island is probably in the order of 1.5 metres higher than pre-flood. A number of other CRG Members commented stating they had witnessed this sedimentation."

CORRESPONDENCE FROM UDIA:

The Meeting noted that this correspondence mostly supported the current process being undertaken by the CRG. Rob Marshman stated that some members of the UDIA supported an upstream diversion channel and requested that a valuation on this option be prepared so he can provide an explanation to UDIA and ensure them that the CRG had considered this option.

Andrew Fulton (General Manager Infrastructure & Planning, Bundaberg Regional Council) attended the meeting at 4.35pm.

DAN COPELIN, GHD Flood Consultant joined the meeting by teleconference at 4.40pm.

Following discussion amongst CRG members, the Flood Consultant agreed to provide an explanation for elimination of all flood options (including the diversion channel to Elliott River). GHD Engineer, Dan Copelin agreed to provide a plan showing the route that such a diversion channel would likely take, high level costings and the size that would be required to drive flood water into it. It was noted that a very large sized channel was needed to convey only 3,000 cubic metres per second and that this option offered low benefit for the high cost involved. At the request of a CRG member, Dan Copelin agreed to provide a brief description of the output end and what that might mean for another stream or the community that lives in that area.

With the assistance of GHD, the Meeting resolved to provide a brief explanation for excluding flood resilience options from all ideas collated in the CRG Report to Council in December.

CRG Member, Kay Amsler referred to the Memo from GHD (dated 15 November 2013 and circulated separately to the Agenda) and the **Meeting noted that the second sentence, *"For the Givelda/Electra area, consideration needs to be given to an 'all weather' emergency only vehicle route through State Forest and private land in lieu of the Pine Creek Road crossing upgrades"* should be deleted from Option 39 and included in Option 38 Regional Bridge Upgrades in Table A1 - List of Options for Multi Criteria Analysis - Appendix A.** It was further noted that if the all weather access was not feasible, that this option would consider bridge upgrades.

Dan Copelin sought information from CRG members regarding the length of time these regional bridges over the Burnett River and Perry River were cut causing isolation. It was noted that regional bridges/crossings were cut for extended periods of time when flood waters from the Perry River combined with the Burnett River. The regional communities have had minimal access to Booyal Crossing during the last couple years. It was further noted that this crossing was untrafficable after releases from Paradise Dam.

Grantley Marcus left the meeting at 5pm.

CRG Member, John Bailey confirmed that Booyal Crossing had a history of flooding and required larger pipes to improve access. Andrew Fulton stated that preliminary design work had been undertaken to upgrade this crossing. **It was noted that Dan Copelin would contact Andrew Fulton regarding the preliminary design work already undertaken for upgrading this crossing.**

Steeve Cooper referred to Option 2 – East Levee and Floodgates ranked as number 1 in the multi criteria analysis. Dan Copelin briefly outlined some of the difficulties to be overcome with this option such as maintaining access to properties with the height of levee required on Quay Street East. This option also includes relocation of services and possibly land resumptions.

The matter of Saltwater Creek providing safe anchorage for boats was discussed. CRG Member, John Olsen stated that prior to construction of the rail/walking bridge across Saltwater creek, boats would tie up in Saltwater creek to provide protection against medium flooding and cyclones. This reduced safe anchorage has displaced something like 15 boats and the only area left upstream of Port Bundaberg is an area near Rubyanna behind Strathdee's (located between Fairymead Ferry and the Sailing Club - ½ km south of the residential area at the Port). The existing marina facilities do not provide cyclone anchorages. The Meeting acknowledged that the marinas were quite busy. CRG Member, Barry Ehrke stated that Skyringville Passage could be opened up to provide safe anchorage.

The application of rankings to the listed options was discussed and Dan Copelin explained that some options ranked lower even though they provided greater benefit because of the financial implications involved (ie Option 35 involves property resumptions and bridge footings). Some options did not provide increased benefits in line with rising costs.

CRG Member, Rob Marshman stated that there is a strong community argument for Option 35 (Town Reach widening – north bank) and it was noted that GHD would provide an explanation for eliminating this option.

CRG Member, John Carman stated that when the old Burnett River Bridge was built, the Burnett River was 1.5 spans wider than it is today. Reference was made to the build up downstream of Bundaberg Slipways. He suggested that the dredging associated with Option 31 (Widening at Millaquin Bend) may need to be extended. Dan Copelin advised that one of the main restrictions in the river is the land on which the Bundaberg Foundry occupies. John Carman asked if the flood mitigation works currently proposed for Bundaberg Foundry should be considered in conjunction with this study. Dan Copelin advised that it would require demolishing part of the main structure to achieve any benefit. Option 33 (from earlier GHD Memo dated 4-11-13) to widen the bank at the Foundry demonstrated modest benefits in reduced flood heights for North Bundaberg and caused adverse impacts elsewhere; hence its removal from the revised list of options.

Kay Amsler referred to the location of the Bundaberg Base Hospital and asked regarding levee options to raise flood immunity for the hospital. The Meeting was advised that many small levee options could be developed to help small areas of housing or the Bundaberg Base Hospital and that this project was concentrating on community wide options. The options to widen Millaquin Mill and dredging at the town reach will both reduce flood levels at the hospital. CRG Chair, Rowan Bond stated that people are concerned that Tallon Bridge is holding flood water back and increasing flood waters at the hospital. People are forgetting that the hospital was evacuated because the flood had impacted on their ability to deliver services and the operation of the hospital rather than evacuation of flooded hospital rooms. Dan Copelin commented by stating that the removal of Tallon Bridge in the flood model did not provide much benefit in flood

heights for a 2013 event. The removal of the abutment of the bridge changed the pattern of scouring and helped the surrounding properties only. However, Tallon Bridge may affect flood heights in a flood greater than 2013 should the flood water breach the bridge deck. During this discussion, CRG Member, John Lee tabled a photograph showing flood water swirling on the western side of Tallon Bridge.

CRG Member, Barry Ehrke commented on Option 2 (constructing a levee on Quay Street East) and stated that the benefit of this option is that the East levee would not be pushing floodwater somewhere else and that the East levee can stand alone as a flood mitigation project. However, the East levee on its own would not help anyone on the North side. It was noted that none of the levees on the North side are very good options (if not combined with other flood mitigation projects). The only levee that makes sense for the North side is Option 1 (North School hill) and this option would only offer benefit for a 2013 flood event or greater flood inundation. With regard to Option 10 (system of low level levees), whilst it would help with flooding up to a 2013 flood event, it may be detrimental in flooding events larger than 2013.

CRG Member, Rob Marshman referred to the equation of calculating the occurrence of a 100 year flood and stated that the use of terminology, 1 in 100 years or 1 in 50 years, is misleading. Dan Copelin agreed stating that whilst this terminology is used in the industry, his report will refer to probability percentages. Rob Marshman also pointed out that these options are considering peak flood heights and not flow velocities and that most damage was caused by scouring. He also raised the matter of weather patterns and whilst Dan Copelin agreed that climatic cycles influence flooding, it was beyond the scope of this project to deal with this sort of thing. He stated that a levee that is frequently topped is not something he would recommend as an engineer. Rob Marshman expressed concern regarding the complacency of the residents living behind the flood levee believing they were safe from flood inundation. Dan Copelin agreed with these comments stating that this was a significant risk. Other members commented on the merit of the North and East levee options.

With regard to Option 38 (Regional Bridge Upgrades), Dan Copelin advised that the cost of raising and lengthening bridges/crossings verus the level of protection provided for such cost would be taken into consideration. A bridge upgrade to achieve 10 year immunity along Pine Creek Road is expensive and the suggested alternative route may be a better option.

Andrew Fulton advised the Meeting that house raising (engineered to resist scouring) in Option 40 would offer some benefit.

CRG Member, John Lee felt that most of the North Bundaberg residents are prepared to rebuild but the main concern is home insurance and he asked what action could be taken to lower the risk to reduce house insurance premiums.

The probability of offering buy backs was discussed with Andrew Fulton and the Meeting acknowledged the logistical difficulties in implementing such schemes whilst CRG Members, Kay Amsler and Helen Dayman pointed out that there were a lot of homes upstream who would be just as entitled to this assistance.

Andrew Fulton stated that there was a responsibility to ensure North Bundaberg continues to be a liveable community.

CRG Members expressed preference for raising the flood evacuation route from North Bundaberg. The Meeting noted the Bundaberg Region's communities had benefited from improved education and awareness and that the information gained from this Flood Study would assist people to make better decisions and enable them to self help in future flood events.

Andrew Fulton suggested that the GHD Report include comment on the potential for Paradise Dam to be raised to provide some flood mitigation potential.

The CRG Chairman thanked Dan for his assistance and concluded the teleconference at 7pm.

RECOMMENDED FLOOD MITIGATION OPTIONS:

1. Option 38 - Regional Bridge Upgrades (or alternative access routes)
2. Combination of Option 39 - Bundaberg North Evacuation Route Upgrade and Option 10 – Low Level North Bundaberg Levees
3. Option 2 - East Levee & floodgate
4. Combination of Option 31 - Millaquin Bend Widening and Option 25 – Selective Dredging
5. Option 40 - Funding for house raising/restumping
6. Option 23 - Town Reach Dredging
7. Option 26 - Removal of Fairymead levee

RECOMMENDATION 1:

Council take steps to initiate an Overall 50 year Strategic plan for Rehabilitation of the Burnett River.

RECOMMENDATION 2:

Council initiate investigations for the removal of Ben Anderson Barrage and Bingera Weir.

RECOMMENDATION 3:

Council liaise with Sunwater regarding the release of emergency plans for a catastrophic failure of Paradise Dam and extending and improving the notification of such warnings (including operational dam releases).

RECOMMENDATION 4:

Council consider river works to reopen Skyringville passage to provide safe anchorage and possibly replenish sand at Moore Park (Option 30).

RECOMMENDATION 5:

Council approach the Insurance Council regarding the availability of affordable house insurance for properties within the Burnett River floodplain.

RECOMMENDATION 6:

Council make representations to the State Government to reintroduce compulsory flood searches when purchasing properties.

RECOMMENDATION 7:

Council take steps to restrict development of flood affected areas unless proven to be above flood inundation and not adversely affect flooding of other areas.

RECOMMENDATION 8:

Council request the State Education Department to introduce subjects in the school curriculum to teach children how to live with nature.

RECOMMENDATION 9:

Council undertake as its first priority, early flood warning mechanisms and evacuation plans including the successful communication thereof.

It was agreed to provide the CRG with a copy of GHD's final report to Council.

NEXT MEETING DATE:

It was agreed to hold the final CRG Meeting in the Bundaberg Office on Wednesday 4 December 2013 at 4pm.

This concluded the business of the Meeting at 8.30pm.

BURNETT RIVER FLOODPLAIN ACTION PLAN

COMMUNITY REFERENCE GROUP MEETING

WEDNESDAY 4 DECEMBER 2013 – 4PM

COMMITTEE ROOM, BUNDABERG MAIN ADMINISTRATION OFFICE, 190 BOURBONG STREET, BUNDABERG

MINUTES

ATTENDANCE:

Rowan Bond (Chairperson), Kay Amsler, Helen Dayman, John Olsen, Barry Ehrke, John Lee, Jon Carman, Steve Cooper, Andrew Fulton (General Manager Infrastructure & Planning), Rob Calligaris (Council's Design Team Leader), Dwayne Honor (Manager Design), Valerie Andrewartha (Administration Support), Kevin Gutteridge (Queensland Reconstruction Authority Inspector)

Rowan thanked everyone for attending and applauded them on reaching the target set in the Terms of Reference of having a report to Council by early December.

Cr. Mal Forman presented Certificates of Appreciation to the members of the CRG and thanked them for their hard work and dedication during the process.

APOLOGY:

Rowan Bond tendered apologies for Snr Sergeant Grantley Marcus, (QPS Liaison Officer between Disaster Management and Minister for Local Government, Community Recovery & Resilience, Hon David Crisafulli) and Rob Marshman, noting that Rob had submitted some points of discussion.

CONFIRMATION OF MINUTES:

CRG MEMBERS BARRY EHRKE AND HELEN DAYMAN MOVED that the Minutes of the CRG Meeting held on 19 November 2013 be confirmed, subject to the changes below – and the Minutes be made available on Council's website.

Kay requested that the numbering of the recommendations be altered so that the current Recommendation 9 was moved to Recommendation 1. Kay requested that record be taken that she strongly supported the prioritisation of the early flood warning mechanisms and evacuation plans recommendation.

Andrew Fulton advised that GHD has been engaged to undertake a study with respect to this issue. He advised that the report contains recommendations with respect to this issue with additional work to be undertaken on this issue upon presentation of the final Report in May 2014.

John Olsen raised concerns regarding levy walls and persons who live on the river. He wanted to ensure that these people were not left out of the issues/fixes.

It was moved that Recommendation 9 be moved Recommendation 1. **Kay Amsler moved this motion with no seconding motion – the motion failed.**

John Carmen requested that on Page 1 under the heading 'Sedimentation' that the paragraph read as follows:-It was agreed to note in these Minutes that, "a huge amount of sedimentation downstream of Ben Anderson Barrage and Bingera Weir had significantly ***further*** reduced the tidal prism thereby reducing the affect of the flushing of fine sediments from the tidal section of the river.

The motion was put CARRIED.

GENERAL BUSINESS

Telephone conference call made to Don Copelin and Rowan opened the floor to questions.

John Lee

- concerned about backflow back into North Bundaberg; was its Dans opinion that the water eventually all goes back out to sea.
  Dan advised that additional modelling has been undertaken in this respect and advised that the east levy is not pushing water elsewhere in any of the scenarios. Dan also advised that the option of dredging the river further downstream have been investigated, including dredging from the port to the barrage. Ultimately, significant volumes of materials would need to be disposed of. An alternative option may be the widening of the Millaquin bend which would provide a better outcome than dredging that area of the river.

John Carmen

- questioned whether the garden chanel, low level levy and widening of millaquin bend would increase the flooding in areas like Perry Street.
  Dan advised that it would, however is currently running models with these types of scenarios. Dan also advised that if 2 or more of these options were constructed at the same time, some cost savings could be provided.
  Andrew Fulton advised there some costings have been provided and are currently being reviewed, with the aim to have all outstanding costings provided by next week.

Kay Amsler

- wanted to know what the environmental impacts would be of the Skyringville opening.
  Dan advised that there is some discussion in his report on this topic.

John Olsen

- discussed the removal of a section of rock at Skyringville to allow water to make its way naturally through and how he felt that the first major rain event would achieve a significant difference in the sediment level. John believes that this area could potentially resolve some significant safety issues for boaties and the like (especially in the case of tidal surge) during flood events.

Barry Ehrke

- does not believe that undertaking works at Skyringville passage would cause significant environmental issues due to the fact that the wall was man made in the first instance.

Further discussion regarding the Skyringville passage and options was undertaken.

John Carmen

- would the Skyringville passage have any effect on flood waters reaching the sugar stock piles.
  Dan suggested that it would make a difference of approximately 0.3 metres.

Helen Dayman

- how much consideration was being given to the weighting as opposed to cost values; are other issues such as environmental and safety being taken into account as much as costing is.
  Dan advised that generally it is cost versus benefit.

Rowan Bond on behalf of Rob Marshman

- Rob questioned that if weightings were to change, what effects would it have on the overall picture. For instance, if environment were to increase to 5% or personal safety to receive higher weighting but not more than economic impact, would there be wholesale changes to the options as a result.
  Dan responded by advising that weightings do not necessarily determine priorities, but had ran models with some altered weightings and reported same in his report to the group.

Rowan Bond

- advised the group that there was some concern in the media that the MCA ratings are priority ratings, to which he has confirmed is not the case.

Helen Dayman

- further MCA rankings after weightings were altered – discussion undertaken with respect to projects that continued to rate in the top 8, in particular rural bridges. Dan advised that rural bridges to not contribute to flood reduction, only to movement of people etc. Discussion was also undertaken with respect to rural evacuation routes and construction/maintenance of same.

Rowan Bond

- raised concerns with respect to businesses and homes outside of the east levy with regard to the velocity of water coming down from the levy.
  Dan advised that there would be nominal increases in water levels but little change in velocity across the face of the levees.

Rowan, on behalf of the CRG thanked Dan for his time, professionalism and patience during this period.

Barry Ehrke

- wanted it noted that he had no issue with any correspondence from him being made a public record. Rowan Bond advised the same.

Andrew Fulton advised that the CRG report would be distributed to Councillors confidentially next week and with same to meet on 16 December to discuss. Rowan invited members of the group to attend this meeting. Members were also welcome to attend Council's Ordinary Meeting on 17 December 2013 where the report would be formally adopted by Council.

Helen Dayman enquired as to when the results can be reported back to the community. Andrew Fulton advised that this could occur once it has been adopted by Council (after 17 December 2013).

It was noted that the Report will be forwarded to the Minister as requested, after adoption by Council.

Helen also questioned whether further community meetings would be undertaken, to which Rowan advised that it is anticipated that these should occur end January/Februry next year.

CRG REPORT TO COUNCIL:

Rowan Bond tabled the report and opened the table to feedback.

Kay Amsler questioned why 7.7.1 (early warnings and responses) did not mention 'first priority'.

It was moved by Kay Amsler and
Seconded by John Carmen that 7.7.1 (Page 19) of the report be altered to read:-

> 7.7.1 The CRG received many suggestions regarding concerns with lack of warning to communities (both urban and rural) which resulted in issues ranging from isolation to actual threat to life and property. The CRG considers that early warning systems being in place ***should be considered Council's first priority and*** are critical to safety and together with community education, allow people to make informed decisions on what they need to do to protect themselves. It is also acknowledged that the people requiring protection may not be part of the local community (backpackers and tourists for example) and therefore not be familiar with local strategies.

Kay Amsler moved that the amendment be made.
John Carmen seconded the motion. PASSED

Barry Ehrke moved to that the report be adopted (with changes above)
Steve seconded motion to adopt report as amended.

It was **unanimously agreed to adopt report** with the amendment noted above.

Other
Steve Cooper read a thanks to Rowan for his support and works undertaken. The group agreed and thanked Rowan for all of his hard work and dedication.

Rowan thanked and acknowledged the support of Council Officers during this process.

Andrew Fulton advised that both he and Council were very happy with the performance and outputs of the Group and thanked them on Councils behalf.

Kev Gutteridge spoke on behalf of the Minister and commended the group as a whole and Rowans leadership of same. Thanks was given on behalf of the Minister.

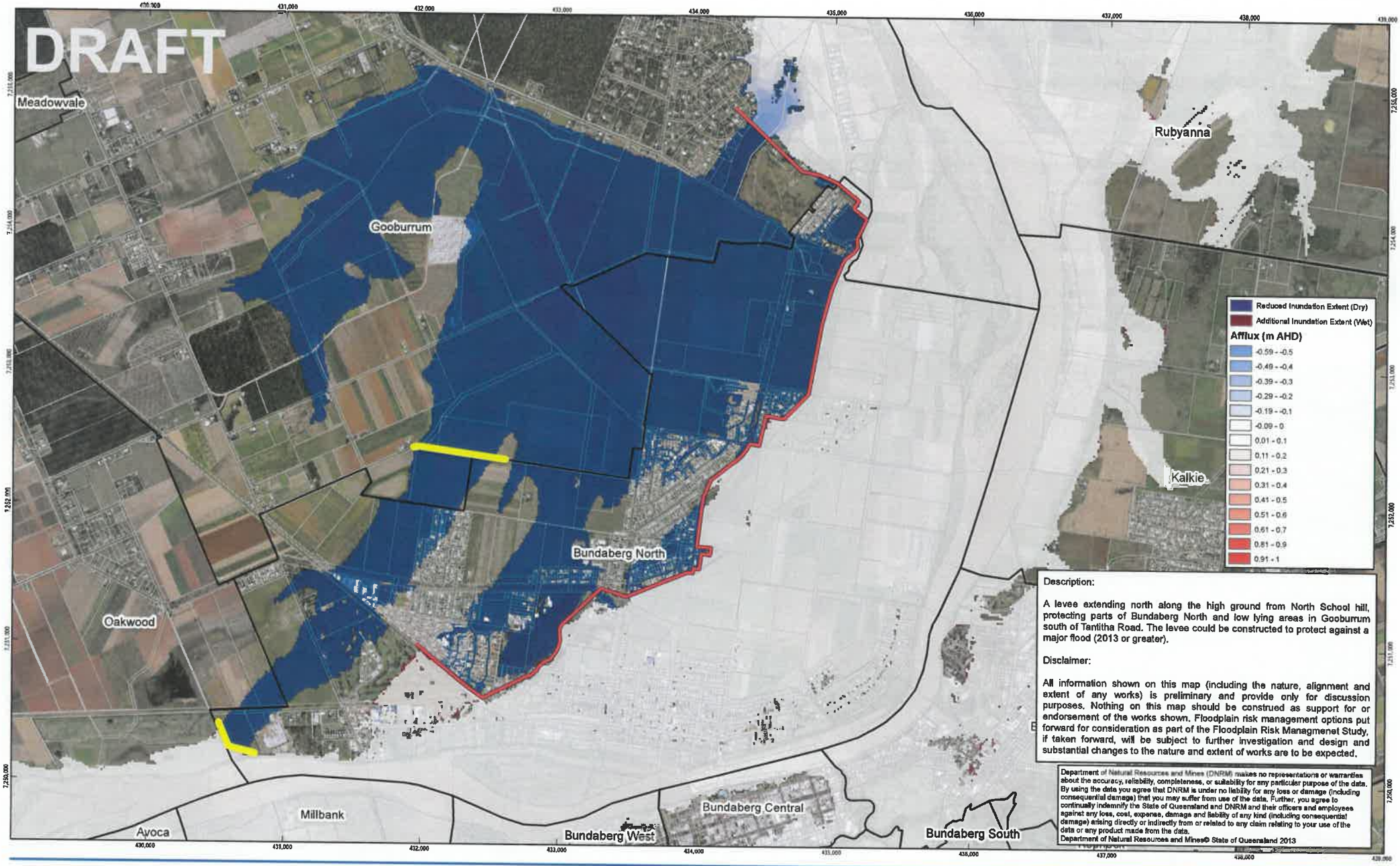
It was noted that the electronic copy of attendance sheets are to be removed from the web as they contain signatures.

This concluded the business of the Meeting at 6.25pm.

APPENDIX 5

Afflux Maps associated with

options contained in this Report



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0 250 500 750 1,000 1,250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- North Levee (Indicative Alignment)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

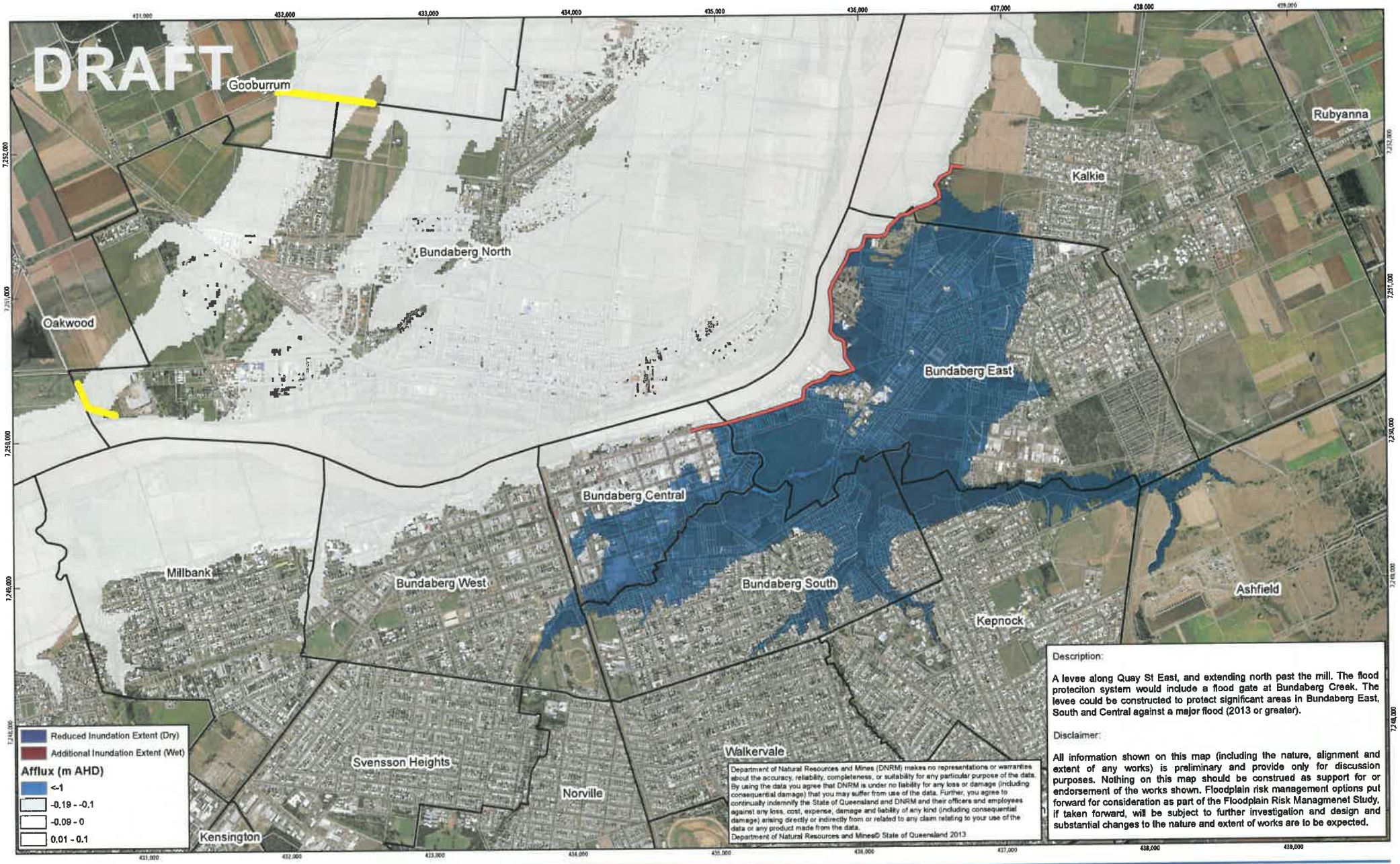
Job Number	41-26909
Revision	A
Date	15 Nov 2013

Preliminary MCA Mitigation Option 01 North Levee - Afflux

G:\41\26909\GIS\Maps\MXD\01_MCA_Options_Afflux\41126909_001_MCA_NorthLevee.mxd

Data source: GHD - Afflux, Levee Alignments/2013; DNRM: Cadastre/2012; BRC: Imagery, Locality/2013.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- East Levee (Indicative Alignment)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	15 Nov 2013

Preliminary MCA Mitigation Option 02
East Levee - Afflux

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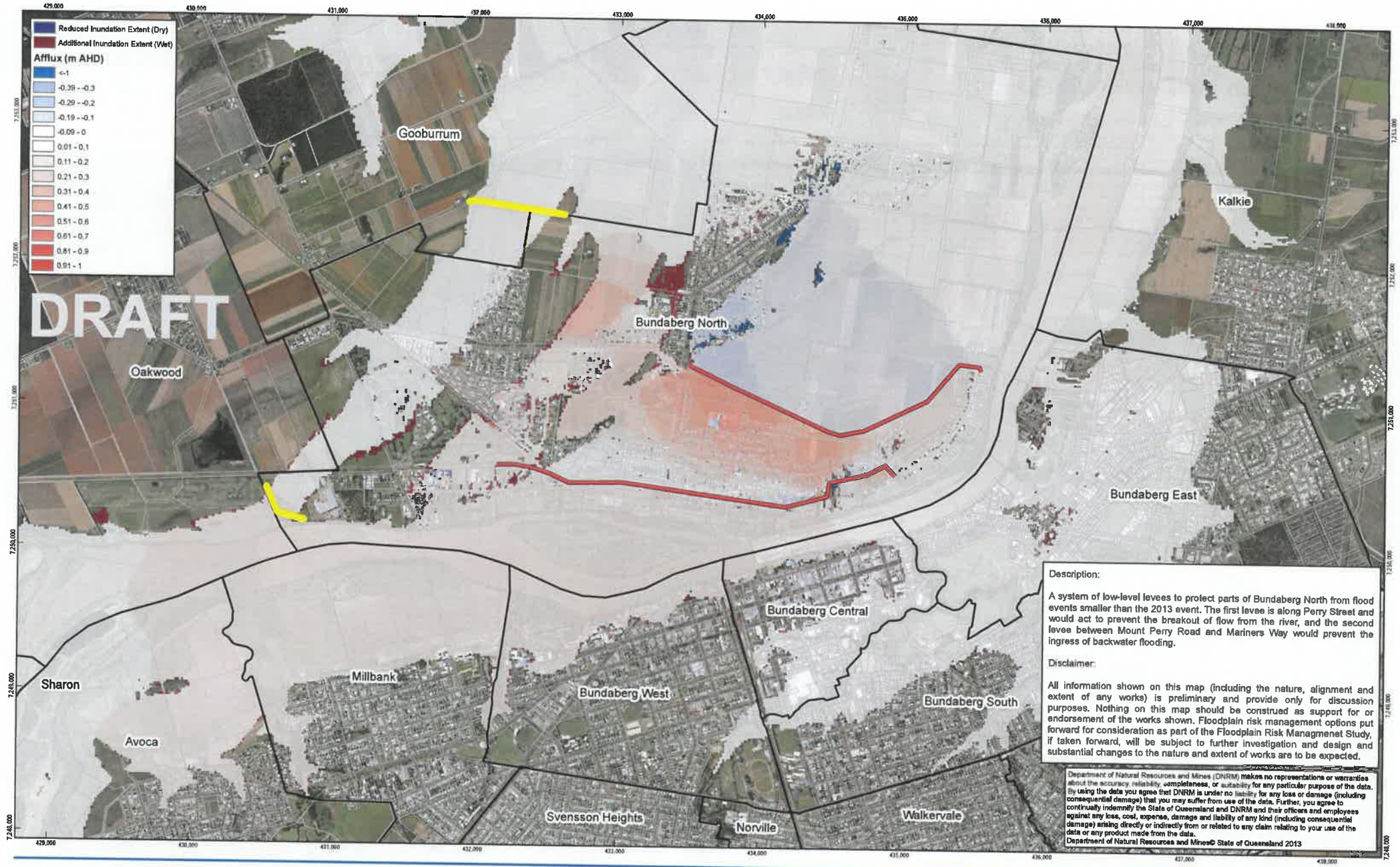
145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A system of low-level levees to protect parts of Bundaberg North from flood events smaller than the 2013 event. The first levee is along Perry Street and would act to prevent the breakout of flow from the river, and the second levee between Mount Perry Road and Mariners Way would prevent the ingress of backwater flooding.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Low Level North Bundaberg Levees (Indicative Alignment)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	15 Nov 2013

Preliminary MCA Mitigation Option 10
Low Level North Bundaberg Levees - Afflux

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Data source: GHD - Afflux, Levee Alignments/2013; DNRM: Cadastre/2012; BRC: Imagery, Locality/2013.

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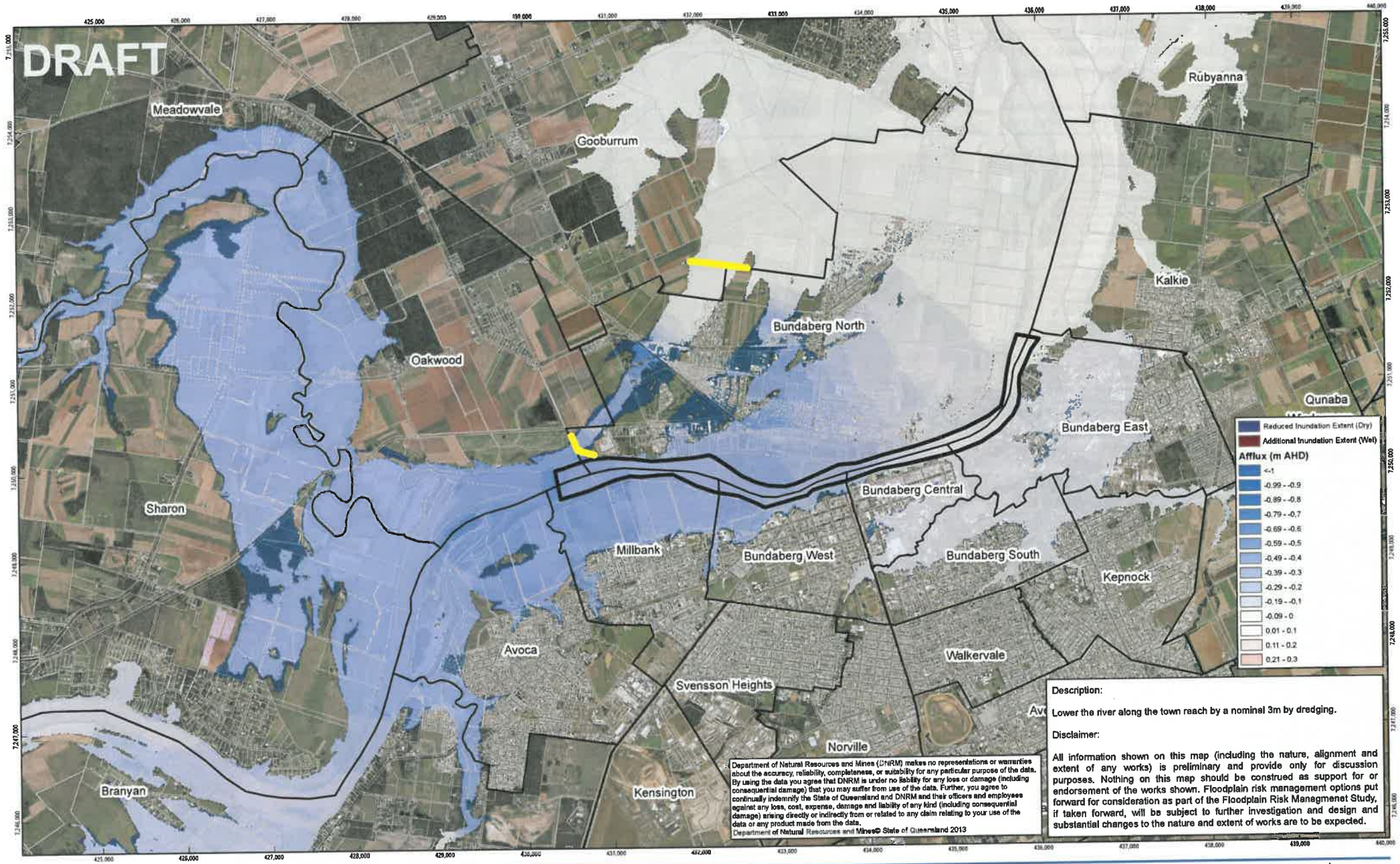

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND
- Cadastre
- Localities
- Town Reach Dredging Extents (Indicative Alignment)
- Technology Park and Batchlers Rd Levees (Seperate Project)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	15 Nov 2013

Preliminary MCA Mitigation Option 23
Town Reach Dredging - Afflux

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Data source: GHD - Afflux, Levee Alignments/2013; DNRM: Cadastre/2012; BRC: Imagery, Locality/2013.

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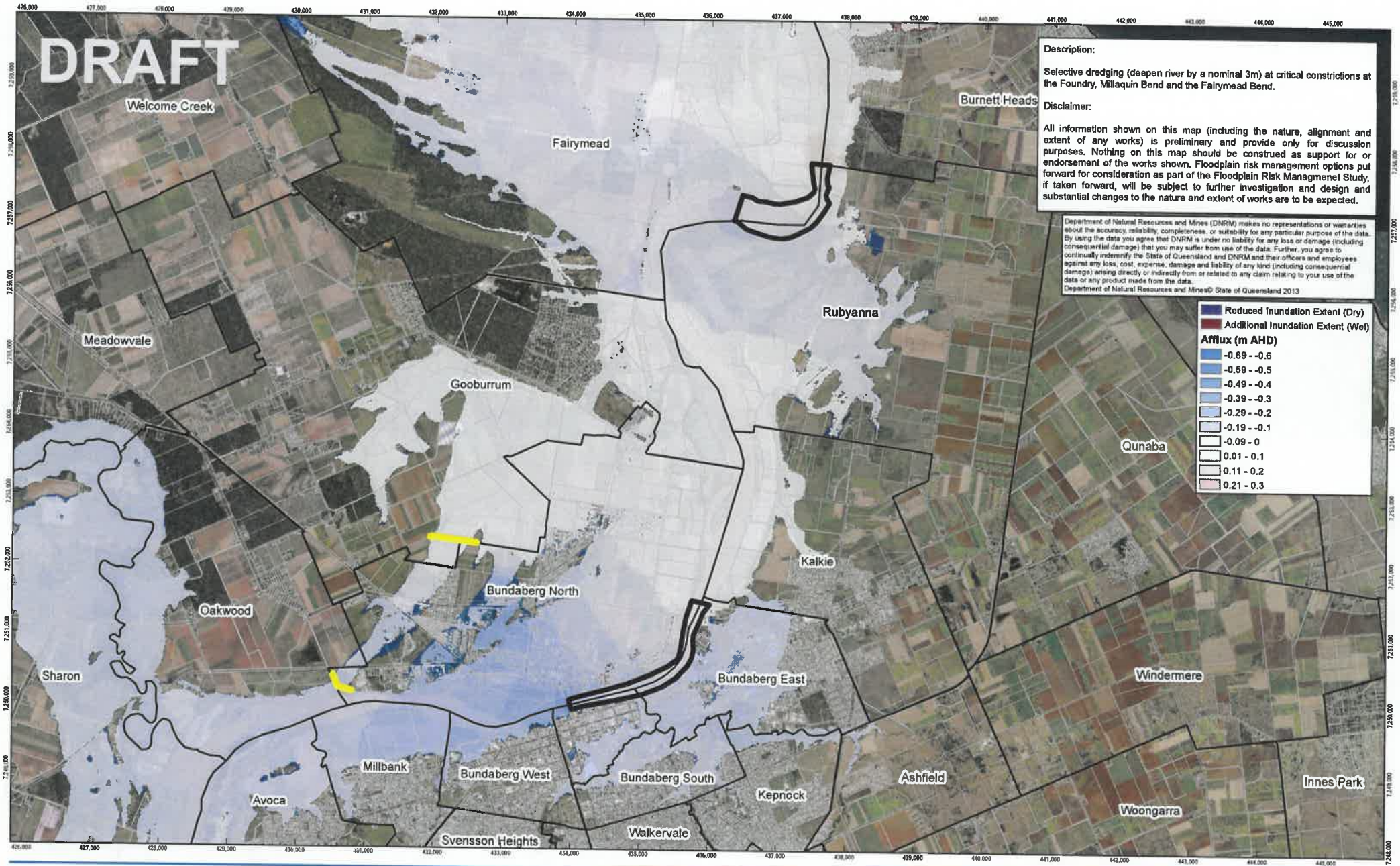

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Millaquin & Fairymead Bends Selective Dredging Extents (Indicative Alignment)
- Technology Park and Batchlers Rd Levees (Seperate Project)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	15 Nov 2013

Preliminary MCA Mitigation Option 25
Millaquin & Fairymead Bends Selective Dredging - Afflux

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Data source: GHD - Afflux, Levee Alignments/2013; DNRM: Cadastre/2012; BRC: Imagery, Locality/2013.

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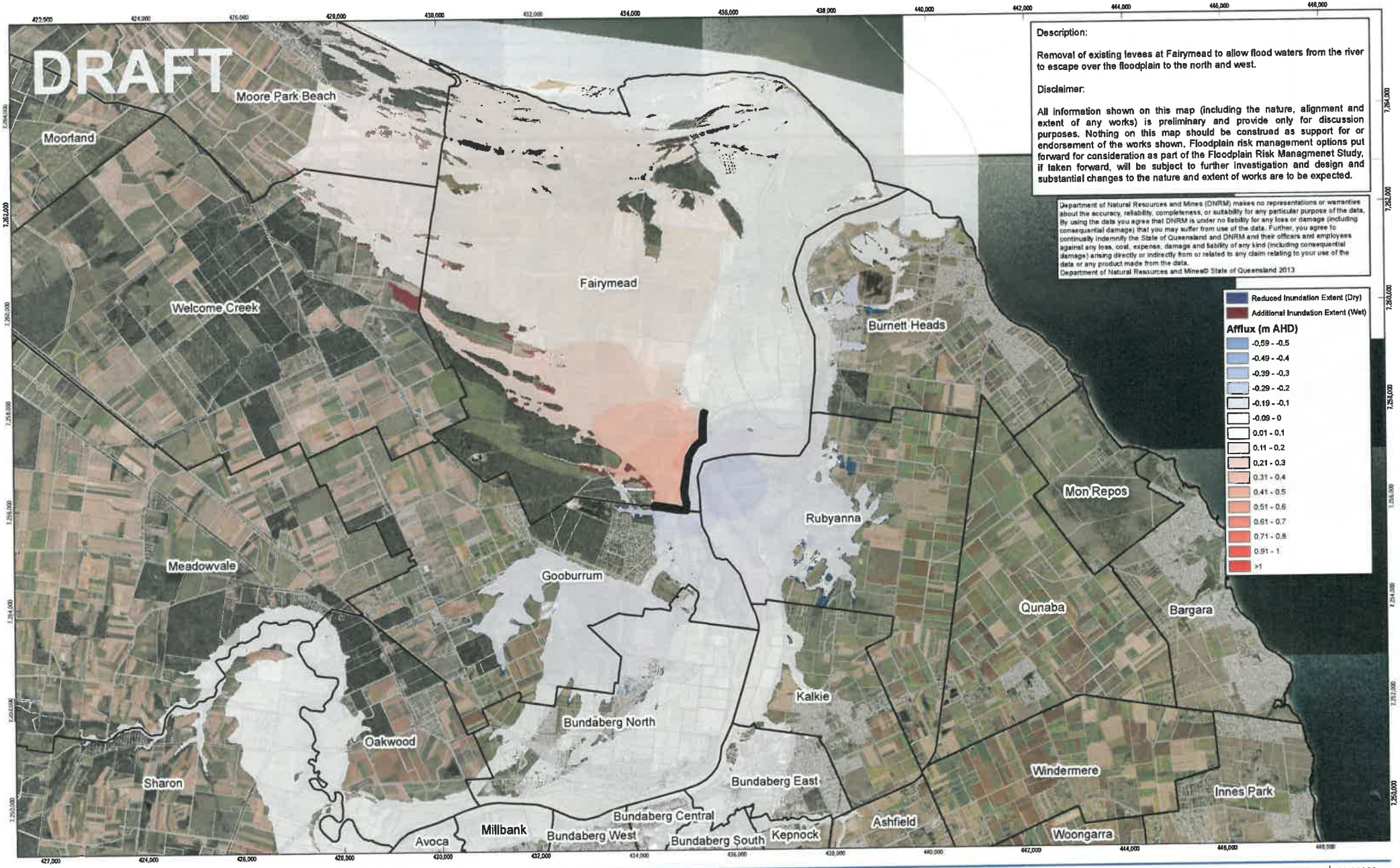

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND
Cadastre
Localities
Fairymead Levees (Indicative Alignment)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	15 Nov 2013

Preliminary MCA Mitigation Option 26
Removal of Fairymead Levees - Afflux

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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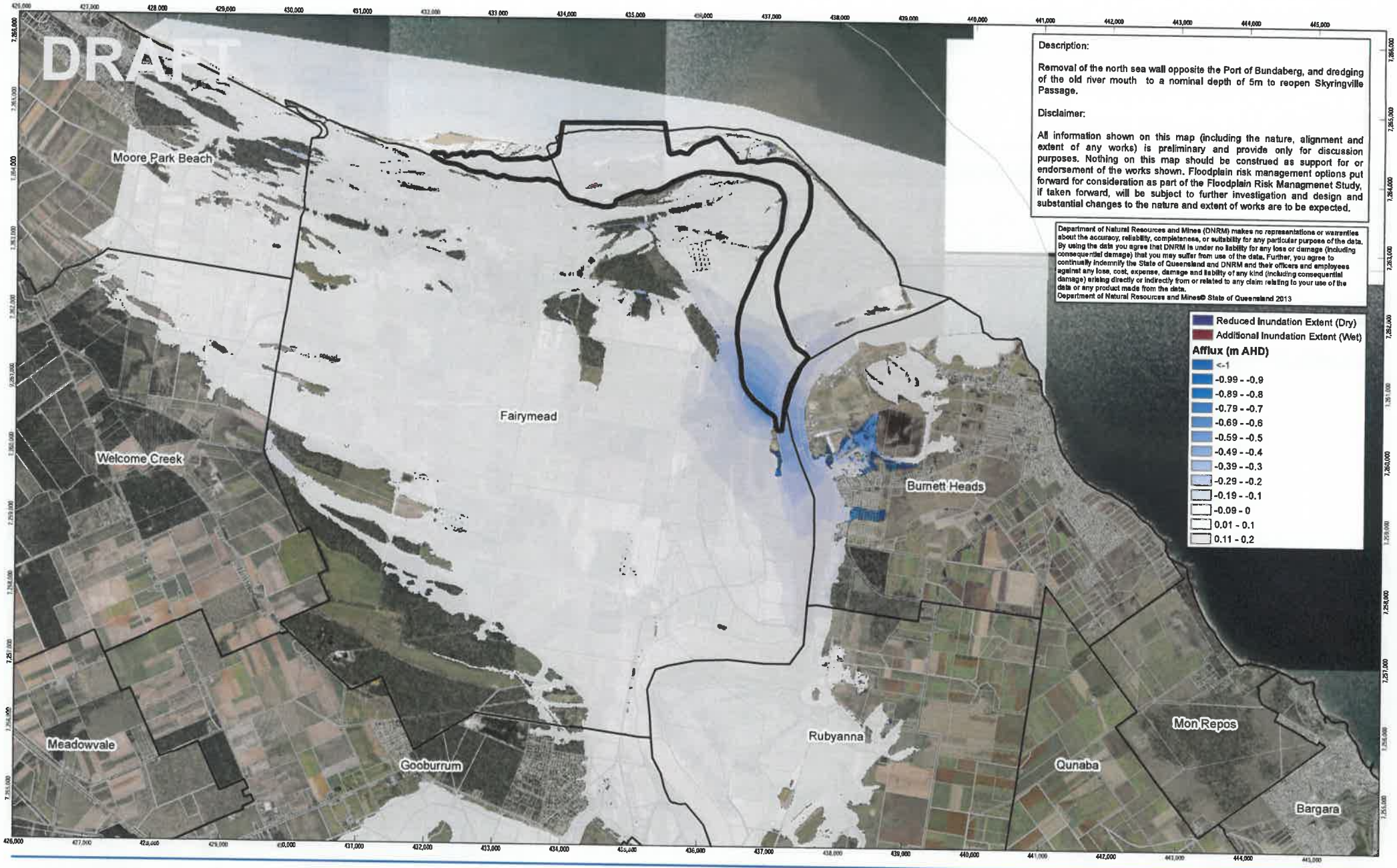

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Skyringville Passage Extent of Works (Indicative)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	15 Nov 2013

Preliminary MCA Mitigation Option 30
Reopening of Skyringville Passage - Afflux

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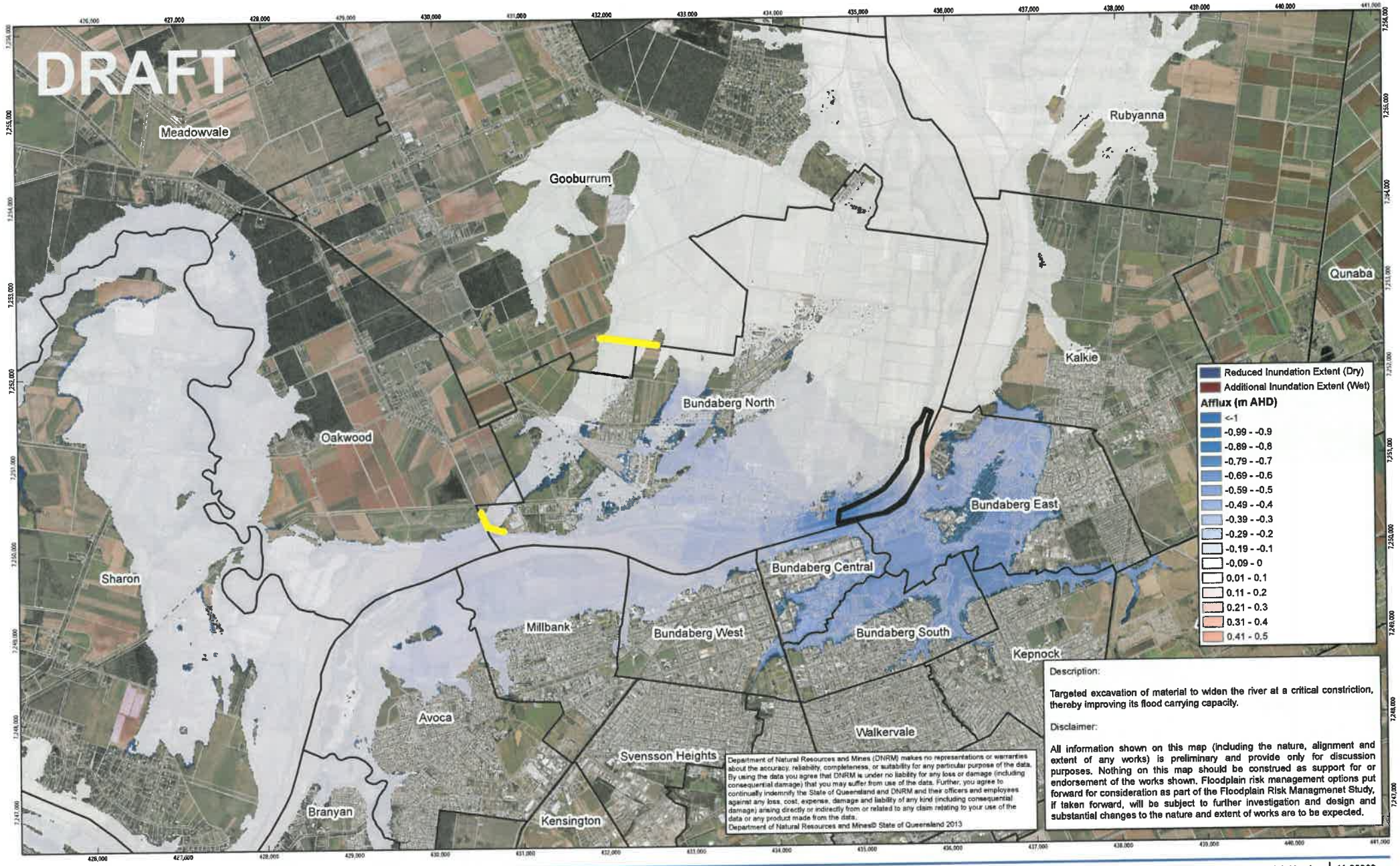
Data source: GHD - Afflux, Levee Alignments/2013; DNRM: Cadastre/2012; BRC: Imagery, Locality/2013.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND
- Cadastre
- Localities
- Millaquin Bend Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	15 Nov 2013

Preliminary MCA Mitigation Option 31
Millaquin Bend Widening - Afflux

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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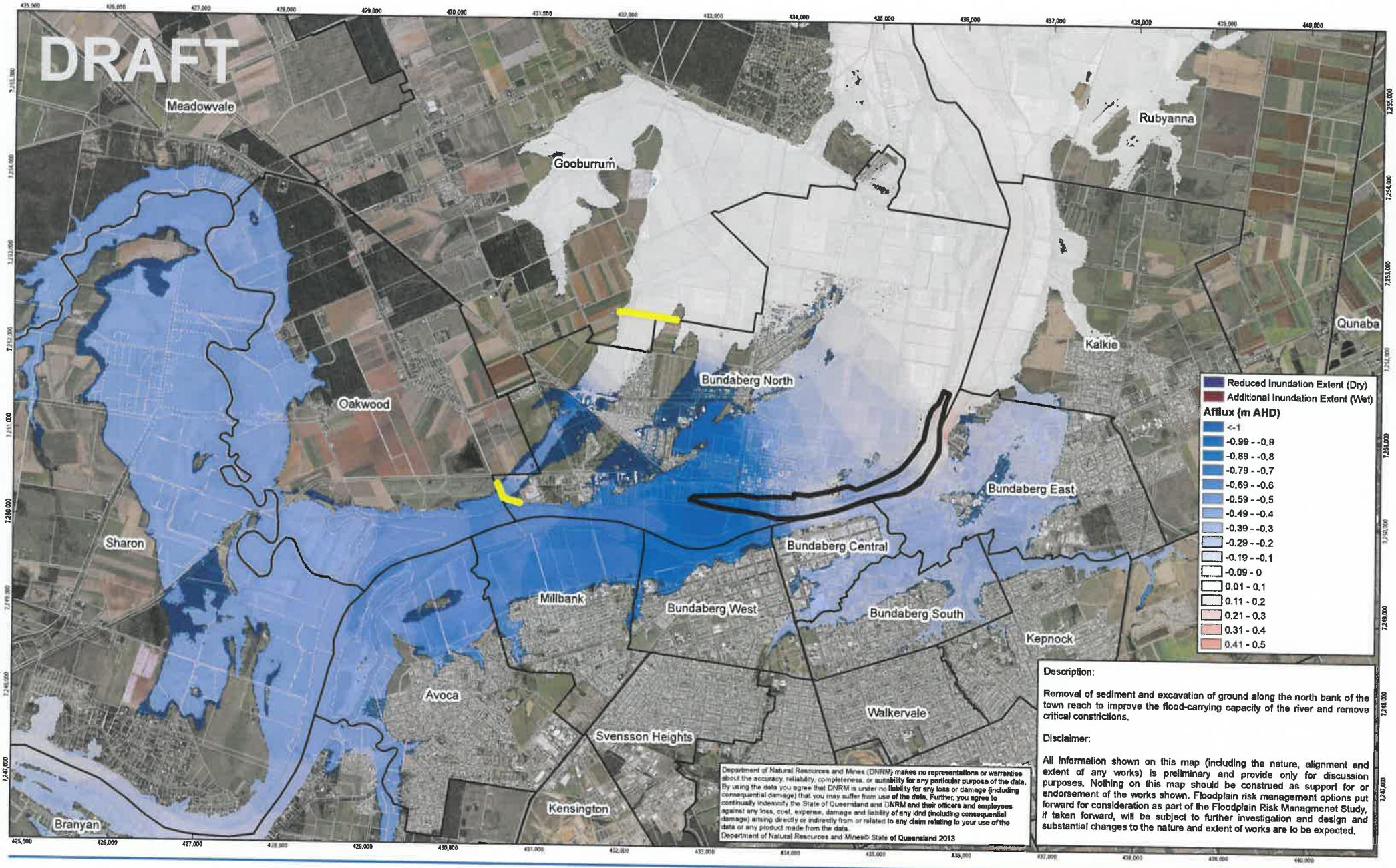

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Town Reach Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	15 Nov 2013

Preliminary MCA Mitigation Option 35 Town Reach Widening - Afflux

G:\41\26909\GIS\Maps\MXD\01_MCA_Options_Afflux\New Extent\26909_035_MCA_TownReachWidening.mxd

Data source: GHD - Afflux, Levee Alignments/2013; DNRM: Cadastre/2012; BRC: Imagery, Locality/2013.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

APPENDIX 6

Revegetation Fact Sheet

4. Revegetation

Introduction

Riparian vegetation can contribute many benefits to a watercourse, including erosion control, bank stability, buffer zones, a food source, the control of light and heat, the provision of shade and shelter, the management of unwanted aquatic plants and the provision of essential habitat.

Riparian vegetation plays an important role in stabilising the stream banks and preventing bank erosion. Bank vegetation decreases water velocities near the bank and dampens turbulence by suppressing eddies. However, to be effective, the vegetation must extend to at least the low water level, otherwise flow will undercut the root zone.

Grasses and sedges are effective at both low and high velocities, being capable of withstanding much higher flow velocities than woody species such as trees. Plant roots also increase the shear strength of the bank soils.

Riparian and floodplain vegetation acts as an effective buffer between developed lands and their associated watercourses. Riparian vegetation functions as a source of leaves and small and large woody debris. However, in urbanised areas of Brisbane, street tree plantings include deciduous trees such as Jacaranda *(Jacaranda mimosaefolia)* and Golden rain tree *(Koelreuteria elegans)*. Widespread planting of deciduous species and the reticulated stormwater systems in urban areas consequentially result in a significant increase in the volume of leaf litter being transported into Brisbane's watercourses.

Shading produced by trees assists in the control of heat and light and can also be used as a management strategy to control the growth of aquatic plants. However, it is noted that it may take five to ten years for a canopy to be developed over a creek. Obviously this depends on the tree species and the width of the creek. During this canopy development time extra maintenance such as weed control may be required.

It is important that local politicians, interest groups and the local community are all aware that during this often long canopy development phase the revegetated channel may look messy and weed infested. Natural Channel Design should always be seen as a long-term management technique, not a short-term fix.

The provision of habitat by riparian vegetation is a key benefit for aquatic and terrestrial organisms. The vegetation may be of periodic importance as a refuge habitat during occasions of environmental adversity as well as function as corridors for wildlife movement between forest remnants (Arthington and Catterall 1990).

Interaction with Natural Channel Design

In Natural Channel Design, the long-term stability of the channel is primarily related to the suitability of the channel geometry to the given hydrological conditions. In major watercourses, such as river systems, the channel and overbank vegetation may only play a minor role in the long-term stability of the channel. However, in minor creeks and streams, vegetation can significantly influence both the short-term and long-term stability of a watercourse.

Natural Channel Design is primarily concerned with two aspects of vegetation; the revegetation phase immediately following the channel construction, and the long-term maintenance of channel and floodplain vegetation. The key to the appropriate integration of a natural channel into an existing developed or urbanised valley is the development of a watercourse that has long-term stability with minimal maintenance requirements, i.e. self maintaining.

Watercourse maintenance usually relates to the following factors:

(i) weed control
(ii) flood control
(iii) fire control
(iv) habitat management and conservation

Occasionally, vegetation maintenance is required for human safety and pest control reasons.

Relating vegetation density Manning's roughness

Many difficulties exist when trying to relate the desired planting densities to the hydraulic engineering roughness (termed Manning's n or Manning's roughness). To assist in this matter, reference may be made to Appendix C – 'Manning's Roughness', in particular, Table C.5

Significance of vegetation type

There are basically five types of vegetation that can be used in and along a watercourse. Each of these forms of vegetation have different characteristics that affect soil erosion and water flow in different ways. To design and maintain the vegetation along a watercourse it is important to understand the features of each form of vegetation.

The basic vegetation types are listed below in Table 4.1

Table 4.1 Vegetation types and characteristics

Vegetation type	Erosion control	Bank stability	Hydraulic effects
Aquatic plants	Provide good stability to the low flow channel	Can assist bank stability by protecting the toe of the bank These plants can become inflexible as plant density increases. This can cause channel flow to be deflected into the channel bank causing bank erosion.	Usually cause little flow resistance if the water depth is greater than the plant height, i.e. plant height is less than the bank height. Thick stands of reeds can effectively block a channel and aggravate upstream flood levels.

Table 4.1 Vegetation types and characteristics (cont)

Vegetation type	Erosion control	Bank stability	Hydraulic effects
Ground covers	The most effective form of soil erosion control. These plants control only soil scour (erosion of the surface layer), not the mass movement of soil resulting from bank failures. To be effective, ground cover plants should be flexible and continuous. Isolated, clumped plants can aggravate soil erosion. Plants with a matted or fibrous (hairy) root system are the best, especially in sandy soils.	Usually ineffective in the provision of bank stability These plants usually have a shallow root system and thus can only provide stability to the surface soil layer. They can help to stabilise the bank during the early stages of revegetation	Generally have little effect on flood levels. Some plants, such as Lomandra, can grow to a height of around 1 metre, and thus may choke small channels.
Shrubs and woody weeds	Can provide effective erosion control if the branches prevent high velocity water from contacting the soil. Soil erosion can occur around the edge of isolated plants caused by flood waters accelerating around the plant.	These plants can significantly increase bank strength depending on the height of the bank and the depth of the root system Unlikely to prevent undermining of the bank unless the shrubs are located close to the toe of the bank.	These plants have the greatest potential to affect the hydraulics of the watercourse and increase upstream flood levels. Avoid the planting of shrubs in areas where flood control is important.
Single trunk trees	Usually provide little protection against soil erosion. Some plants have root systems that survive when exposed to air. The root system of these plants can control toe erosion.	Trees provide the main form of bank reinforcement. They are needed to stabilise the bank, especially when toe erosion occurs and when the bank becomes saturated during a flood event.	Grouped trees can significantly affect flood levels if their spacing is less than 5 times their trunk diameter Generally well-spaced trees with branches above the flood level provide little hydraulic interference.
Multi-trunk trees	As for single trunk trees	As for single trunk trees	Grouped trees can significantly affect flood levels. Well-spaced trees with branches above the flood level can still provide significant hydraulic interference.

Channel vegetation

There are limits to the role that vegetation alone can play in controlling erosion. Although vegetated watercourses in the natural environment appear to be stable and experience extremely low erosion rates, it should be noted that these conditions of stability have evolved over many years.

The long-term objective of vegetation as an erosion control measure is the establishment of a ground cover that will be self-maintaining and thus be able to provide long-term (sustainable) erosion control. Ideally, plants should be native to the area, must be good soil binders, crowd out weeds, and form a good ground cover. Unfortunately, in urban areas, some of the most successful erosion control plants are weeds!

Channel vegetation can be divided into four categories (Figure 4.1):

(i) in-stream or aquatic vegetation
(ii) toe vegetation
(iii) middle bank vegetation
(iv) upper bank vegetation

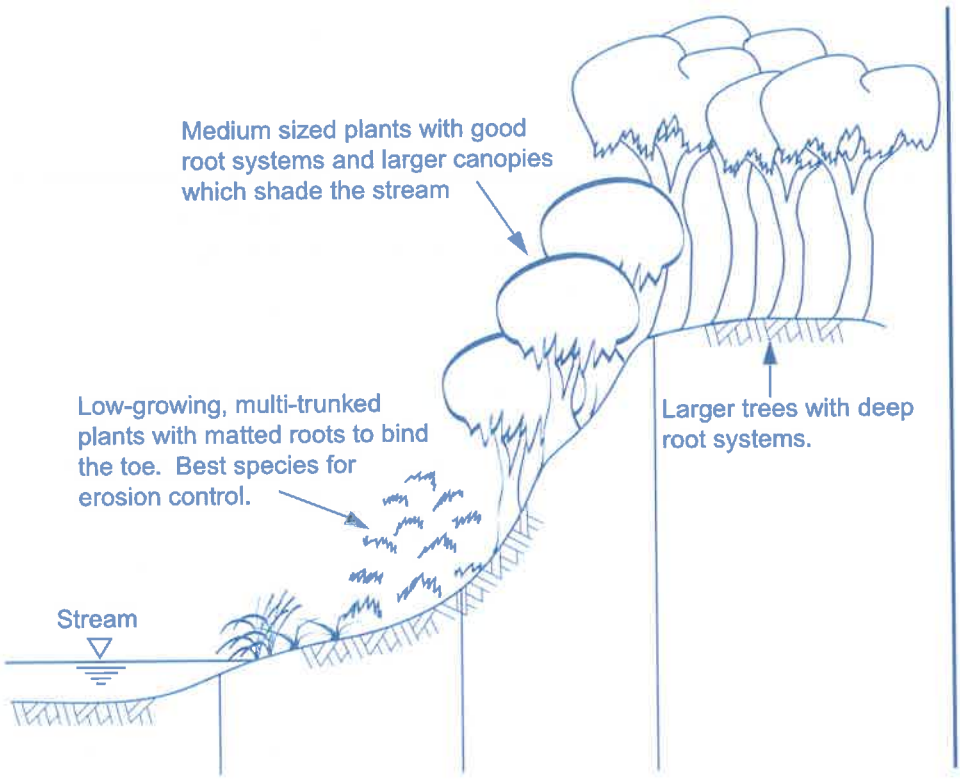


Figure 4.1 Categories of channel vegetation

Species such as reeds and sedges, with a dense network of fibrous or matted roots, are more efficient in the control of soil erosion than those with a sparse network of woody roots.

If trees are removed from a steep or high bank, then appropriate consideration needs be given to the long-term stability of the bank. It may take around five years before the old

tree root system within the bank begins to deteriorate. As the tree roots lose their strength, sheer stresses in the bank can fracture the roots resulting in sudden bank failures (land slips).

If, due to flood control reasons, the trees or shrub that were located on or near the watercourse bank cannot be replaced, then the bank may need to be benched or batter at a flatter grade to compensate for the long-term removal of the essential root reinforcement of the bank.

Floodplain vegetation

The impact of trees on the hydraulic roughness of a floodplain depends on the flow velocity; the shape and size of the trunk and canopy (if below flood level); and the number, arrangement, and spacing of trees. When the flow velocity is high, an obstruction such as a tree exerts a sphere of influence that is much larger than the width of the obstruction because the obstruction affects the flow pattern for considerable distance on each side.

The sphere of influence for flow velocities that generally occur in channels that have gentle to moderately steep slopes is about three to five times the width of the obstruction. Therefore, if the trees are spaced more than five times there truck diameter, then they gradually begin to act as independent obstructions. At a spacing of around ten times the trunk diameter the trees may be considered as totally independent obstructions.

The impact of trees on flood levels depends on the depth of water. Riparian trees located in relatively deep water along the edge of the channel can have a much greater impact on flooding than trees planted along the outer edges of the floodplain.

A summary of the hydraulic requirements for trees in floodplains is provided in Table 4.2.

Table 4.2 Vegetation in floodplains

Vegetation type	Floodplain planting requirements
Ground cover plants	Suitable in most areas of a floodplain.
Shrubs and woody weeds	Avoid in flood control areas. May be used in backwater areas and in areas of tree grouping where flood flows are mainly designed to flow around the vegetation not through it.
Trees	In flood control areas use smooth, single trunk trees with branches above the flood level. **Tree spacing less that 5 times the trunk diameter:** Considered as group plantings. Likely to have high restrictions to flood flow. Trees should be planted in rows parallel with the flow direction to minimise hydraulic affects. **Tree spacing between 5 and 10 time the trunk diameter:** Questionable benefit of planting trees in rows unless flood control is critical. Soil erosion may occur around individual trees if located in high velocity floodplains. Erosion may be controlled with selected planting of sedges around the base of the tree. **Tree spacing greater than 10 times the truck diameter:** No hydraulic benefit obtained by planting in rows. Soil erosion likely to occur around individual trees if located in high velocity floodplains. Erosion may be controlled with selected planting of sedges around the base of the tree.
Grouped trees	Tree spacing less than 5 times the truck diameter, or trees at wider spacing surrounded by shrubs. In flood control areas, grouped trees are only suitable in backwater areas, or adjacent to open, grassed floodplains where floodwaters can readily bypass the trees.

Planting patterns and hydraulic constraints

In urban areas of Brisbane there may be conflicts between ecologically preferred re-vegetation and flooding issues. This has lead to restrictions being placed on the revegetation of some floodplains.

It is generally shrub species and multi-branch trees that have the greatest influence on channel roughness and that may constrain the ecologically desirable planting pattern. The following discussion illustrates some general principles to address these issues.

When making estimations of hydraulic roughness, it is necessary to include consideration for regrowth of vegetation on cleared channel sides and overbank areas because this can significantly increase the resistance factor within one or two growing seasons. Understorey vegetation grows readily after removal of any shade-producing canopy.

A row of trees roughly aligned with the current can offer much less resistance to flow than perpendicular blocks of vegetation yet retained much of the shade and visual harmony of an uncleared bank. Further reduction in flow resistance may be obtained by pruning limbs that protrude below normal flood height.

The desired planting pattern would closely relate to the natural vegetation community structure for the area, with tall trees, an understorey of small trees and shrubs and a sparse herb layer. Where the canopy does not over-hang the stream bank, reeds, rushes and sedges could be planted.

In areas where hydrological constraints do not allow rehabilitation with dense vegetation, alternative planting patterns are planned.

Brisbane City Council (1995) details that the spatial patterns of species distribution follows two strategies. One strategy is planting parallel to the stream bank. This conforms with plant-water relations and produces least impact on water flow. The second strategy aims for planting in clumps with sparse connections between the clumps. Clumping vegetation has the effect of increasing the number of habitats for wildlife and allows migration between clumps. The location of these clumps will need to take account of the probable high flow paths to minimise their hydraulic impact.

Plans for rehabilitation, while using these two strategies as fundamental to the plan, also should consider the following points:

(i) Maximise the availability of habitat by considering the topography of the stream bank, floodplain and surrounding bushland, e.g. *Melaleuca* wetlands could be planted on lowlands as well as point bars or where the channel bank slopes gently into the channel bed and would be subject to frequent inundation.

(ii) The stream morphology may constrain planting, e.g. in a meander, it may be necessary to stabilise one bank with sedges and shade the opposite bank.

(iii) Problems due to ponding and appropriate selection of species for such areas.

(iv) Proximity to bridges. Trees with root systems which are susceptible to being undercut such as Eucalypts, should not be planted in such locations.

(v) Proximity to stormwater drains. Discharge of stormwater requires a consideration of water velocity and water quality. Use of a discharge structure and wetland filter may be required.

(vi) Access for maintenance equipment.

Group plantings

Group planting may be considered to be trees with a spacing less than 5 times the truck diameter or trees at a wider spacing but planted amongst shrubs and other understorey plants.

Grouped trees can provide significantly more ecological benefit than the equivalent number of widely spaced trees located across the floodplain. If the watercourse channel flows approximately parallel with the flood flow, then where hydraulically allowable, grouped trees should be located within the riparian zone as well as the high bank area as shown in Figure 4.2.

If the watercourse channel meanders across the floodplain, then care should be taken to avoid grouped plantings in areas were flood waters pass from one side of the channel to the other, as shown in Figures 4.3 and 4.4.

Floodplain vegetation should be selected and landscaped so as to require low maintenance. This would include group placement and sufficient density of shrubs and trees to avoid mowing. When grasslands are provided that require mowing, they should be placed in large enough areas and interconnected to permit easy mowing.

Planting around major hydraulic structures

In critical flood control areas, vegetation that may interfere with flood waters should not be located within the following areas:

(i) upstream of a bridge or culvert within a radius equal to the total bridge or culvert opening width;
(ii) downstream of a bridge or culvert within the zone defined by a 1 in 4 expansion of the outlet jet and for a distance equal to three times the flood water depth;
(iii) between the bridge or culvert opening and the bypass floodplain;
(iv) any areas judged necessary by hydraulic modelling.

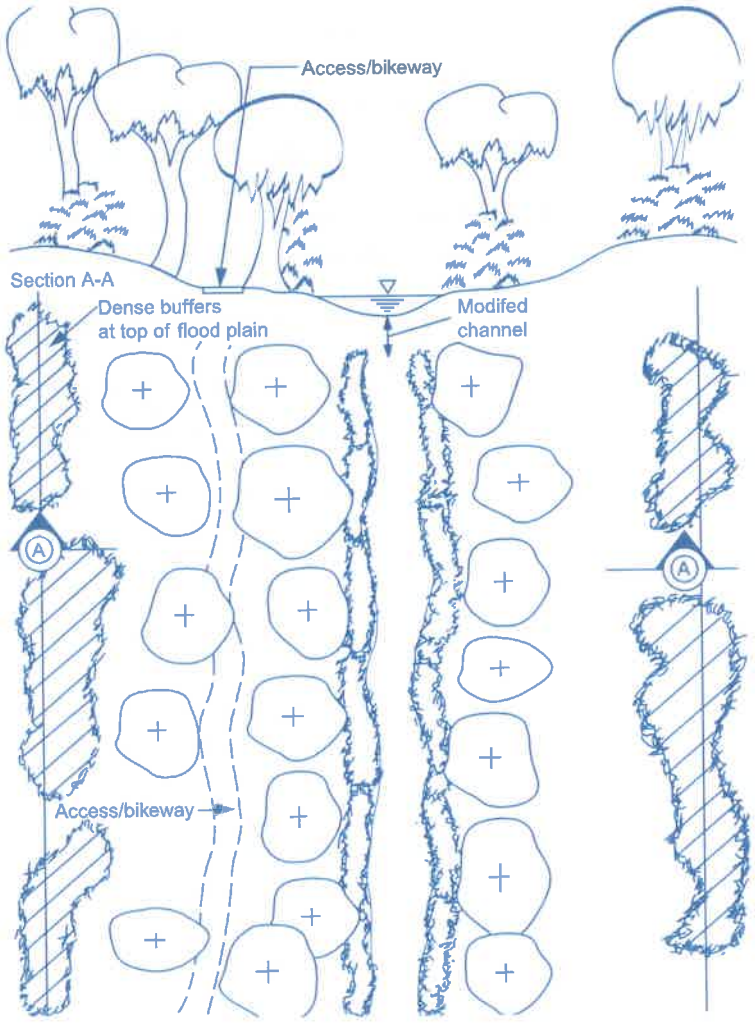


Figure 4.2 Floodplain vegetation along a straight channel

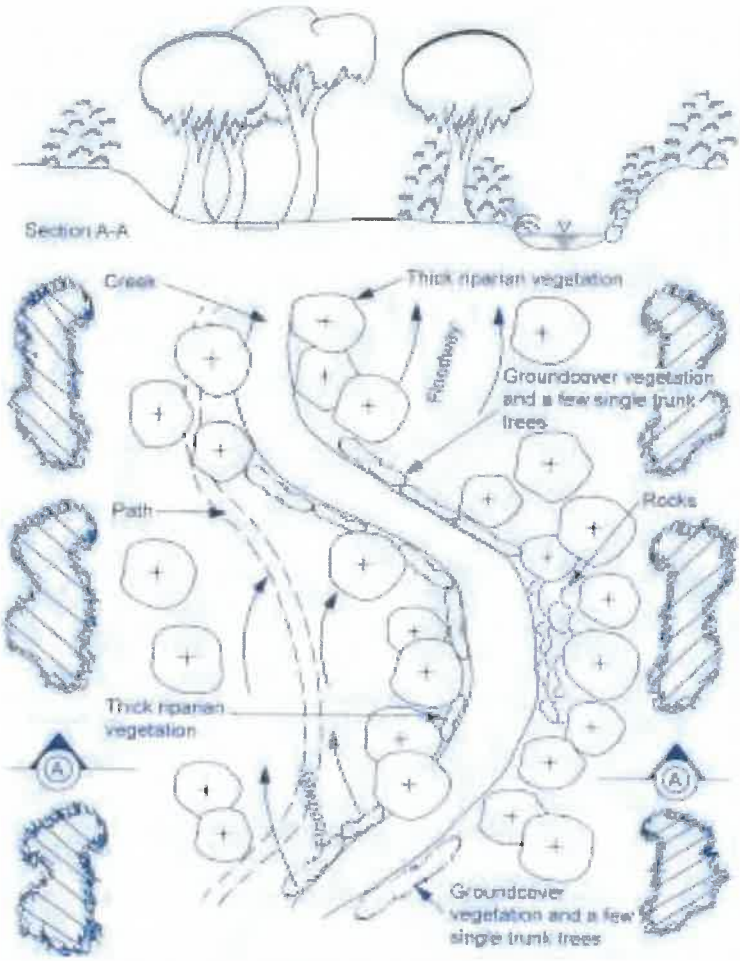


Figure 4.3 Floodplain vegetation along a channel meandering

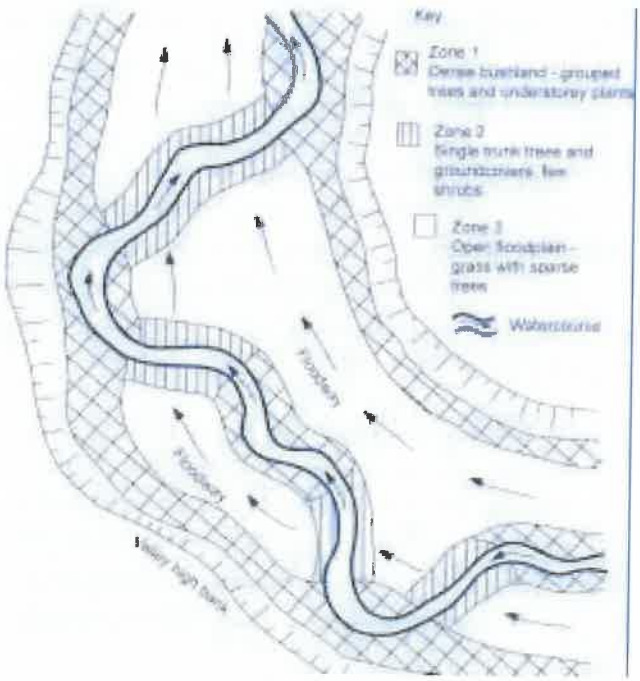


Figure 4.4 Floodplain vegetation densities along a meandering channel

Species for revegetation in Brisbane

Given the previously identified constraints associated with riparian vegetation and the effect on channel roughness and consequently flood frequency, the following section provides an analysis of those characteristics of vegetation that are required as to have a minimal impact on the effect of the roughness coefficient and subsequently the flooding frequency.

The species described in the following section were assessed as having the potential for use in waterway channel and floodplain rehabilitation projects in Brisbane. Assessment was based on:

(i) the influence of vegetation on channel roughness and hydrology;

(ii) ability to withstand and rapidly recover from inundation by floodwaters and battering by bed load and gravel;

(iii) ecological validity;

(iv) form of root system;

(v) ease of propagation by seed or division, and growth rates;

(vi) growth habit;

(vii) physiological adaption to flooding and to soil type;

(viii) appropriateness to various locations and problems within Brisbane; and

(ix) dominance of the species within the riparian zone.

Along undisturbed streams there is a diversity of riparian species present ranging from groundcovers and shrubs to trees, all of which have differing habits and root structures and contribute in various ways to stream stability. Riparian floristics also vary at catchment-wide and local scales.

Whilst the majority of the species detailed are both common and widespread in Brisbane, previous land use practices have severely restricted their current distribution. However, species distribution needs to be considered before undertaking any rehabilitation work so that those species best adapted to a particular site and indigenous to that part of the catchment are used. Locally collected seed should be used, where practicable, to maintain genetic integrity.

The following species are divided into principal locations within the riparian zone, obviously species occurrence and vegetation community composition is dependant on numerous more parameters than just proximity to mean water level within a given waterway. For example, a floodplain area may be predominately composed of Melaleuca woodland community with patches of standing water surrounded by Carex and Juncus species or alternatively a closed forest notophyll-type community.

Species of vegetation which have been determined as suitable for planting on the bank toe (Figure 4.1) within Brisbane's Waterways are detailed in Tables 4.3 & 4.4.

The species of vegetation which have been determined as suitable for planting on the middle bank area (Figure 4.1) are detailed in Tables 4.5 & 4.6.

The vegetation suitable for planting on level ground at the top of bank and the upper section of the bank (Figure 4.1) are detailed in Tables 4.7 & 4.8.

The vegetation suitable for planting on lowlands where flooding is expected and water may be retained are detailed in Tables 4.9 & 4.10.

Whilst the key objective of waterway rehabilitation projects is to establish a mixture of vegetation forms i.e. ground covers, climbers, shrubs and trees to give maximum structural diversity, this is not always achievable in flood sensitive locations. In general, planting schemes should be kept simple with a view to establishing ground cover/herb layer and a dense tree canopy.

Table 4.3 Emergent/Herb Layer plants suitable for planting on bank toe

Carex appressa	Philydrum lanuginosum
Crinum pedunculatum	Themeda triandra
Echinochloa telmatophila	Triglochin procera
Juncus usitatus	Triglochin striatum
Lomandra longifolia	

Table 4.4 Trees suitable for planting on bank toe

Acmena smithii	Leptospermum polygalifolium
Callistemon viminalis	Waterhousia floribunda

Table 4.5 Herb Layer plants suitable for planting on middle bank area

Crinum pedunculatum	Themeda triandra
Lomandra longifolia	

Table 4.6 Trees suitable for planting on the middle bank area

Acmena smithii	Ficus fraseri
Alphitonia excelsa	Ficus macrophylla
Aphananthe philippinensis	Flindersia australis
Araucaria cunninghamii	Flindersia bennettiana
Argyrodendron trifoliolatum	Flindersia schottiana
Castanospermum australe	Grevillea robusta
Casuarina cunninghamiana	Jagera pseudorhus
Cryptocarya glaucescens	Mallotus philippensis
Cryptocarya triplinervis	Melaleuca bracteata
Dissiliaria baloghioides	Melaleuca quinquenervia
Elaeocarpus obovatus	Melia azedarach
Eucaltptus microcorys	Polyscias elegans
Eucalyptus siderophloia	Toona australis
Eucalyptus tereticornis	Waterhousia floribunda

Table 4.7 Herb Layer plants suitable for planting on level ground at the top of bank and upper section of bank

Cymbopogan refractus	Lomandra longifolia
Dianella caerulea	Themeda triandra

Table 4.8 Trees suitable for planting on level ground at the top of bank and upper section of bank

Alphitonia excelsa	Eucalyptus tereticornis
Aphananthe philippinensis	Flindersia australis,
Araucaria cunninghamii	Flindersia bennettiana
Argyrodendron trifoliolatum	Flindersia schottiana
Castanospermum australe	Grevillea robusta

Table 4.8 Trees plants suitable for planting on level ground at the top of bank and upper section of bank (cont)

Casuarina cunninghamiana	Hymenosporum flavum
Corymbia citriodora	Jagera pseudorhus
Corymbia intermedia	Lophostemon confertus
Corymbia tessellaris	Lophostemon suaveolens
Cryptocarya glaucescens	Mallotus philippensis
Cryptocarya triplinervis	Melaleuca quinquenervia
Dissiliaria baloghioides	Melia azedarach
Elaeocarpus grandis	Polyscias elegans
Elaeocarpus obovatus	Toona australis
Eucalyptus microcorys	Waterhousia floribunda
Eucalyptus siderophloia	

Table 4.9 Herb Layer plants suitable for planting on lowlands, where water may be retained

Carex appressa	Themeda triandra
Crinum pedunculatum	Triglochin procera
Cyperus difformis	Triglochin striatum
Echinochloa telmatophila	Philydrum lanuginosum
Juncus usitatus	Scirpus mucronatus
Lomandra longifolia	

Table 4.10 Trees suitable for planting on lowlands, where water may be retained

Callistemon salignus	Lophostemon suaveolans
Eucalyptus propinqua	Melaleuca bracteata
Eucalyptus tereticornis	Melaleuca quinquenervia
Leptospermum polygalifolium	

Plants used for erosion control

Some herbaceous species within Brisbane can provide erosion protection by forming a mat-like root system that physically covers creek banks. Individual species are suitable for differing locations where the plants have access to groundwater. Table 4.11 details those herbaceous species that have been recorded in Brisbane waterways with these characteristics.

Table 4.11 Herbaceous species with attributes for bank protection

Carex appressa	Lomandra longifolia
Cyperus difformis	Phragmites australis
Juncus usitatus	

The matrush Lomandra *longifolia* is a very effective stabiliser. It grows in clumps and has a dense branching rhizome system which acts as a soil binder and promotes soil stability. The matrush is hardy, both in direct sunlight and shade and can be planted to prevent soil erosion at the mean water line on the steepest parts of banks and on mid slopes. It is generally planted at one metre centres, or at half metre centres in critical locations. It regenerates prolifically in moist sites. Rushes *(Juncus usitatus)* and sedges *(Carex appressa, Cyperus difformis)* are the most useful species in streams which change height quickly and which do not have a wide range of continuous flows, such that most of the marginal vegetation is not submerged for long.

Woody vegetation

A common misconception is that trees prevent creek erosion by binding the soil particles together, when it is well known that tree roots are easily exposed if subject to medium to high velocity flows.

Trees typically only stabilise a creek by providing structural strength to the banks. However, when masses of weather-resistant tree roots are exposed these roots can prevent high velocity flows from reaching the underlying earth bank. In these cases the trees and shrubs do provide significant erosion protection for the creek banks.

Successful bank stabilising tree species have root systems that can withstand exposure without drying out and capable of forming a dense mat over the creek bank as a physical erosion barrier. The roots must also be long enough to pass below the level of active bank erosion. Table 4.12 details tree species which have been recorded as exhibiting these characteristics which and which are endemic to the Brisbane local area.

Table 4.12 Tree species with attributes for bank protection

Acmena smithii	Elaeocarpus obovatus
Aphananthe philippinensis	Ficus fraseri
Callistemon viminalis	Ficus macrophylla
Castanospermum australe	Leptospermum polygalifolium
Casuarina cunninghamiana	Waterhousia floribunda
Cryptocarya triplinervis	

Trees greatly influence the stability of creeks not subject to meandering or changing catchment conditions, but they have only limited long-term influences on creeks responding to changing catchment conditions caused by urbanisation.

Shrubs and trees are valuable for erosion protection especially when they can be planted densely. When planted sparsely, they can result in enhanced erosion due to eddying effects. Thin trunked species such as River Lilly Pilly *(Acmena smithii)*, Weeping Bottlebrush *(Callistemon viminalis)*, or similar species will reduce the eddying effect. A recommended density would be of the order of one tree/shrub every one to four square metres *(Raine and Gardiner, 1995)*. Although trees and shrubs can sometimes be used for protection of actively eroding sites regularly exposed to flow (Table 4.12), they are generally more valuable for strengthening the bank and protecting it from collapse.

Some species such as River Oak *(Casuarina cunninghamiana)* have strong fibrous root systems and can provide excellent bank stabilisation. They produce a dense mulch from needle drop and are generally hardy but may be restricted by extremely wet conditions. The toxic effect of the needle mulch may however suppress ground cover.

Callistemons and *Melaleucas* can be used on the lower slopes of banks from just above mean water level. Hard Quandong (Elaeocarpus obovatus) and Tallowwood *(Eucalyptus microcorys)*, once established along a waterway regenerate rapidly and provide the foundation for highly stable tree cover higher up the bank. River Bottlebrush such as *Callistemon viminalis* and *C. salignus* can grow when flooded. *C. viminalis* is a riparian zone species, often found with the root zone partly submerged. *C. salignus* grows on higher ground and tolerates flooding. The bottlebrush root system is quite dense and is effective in protecting the bank. *Melaleuca quinquenervia* and *Eucalypt* species are not suitable for planting on actively eroding gully sites as their root systems may be undermined. Undercutting may be prevented if the bank is stabilised with herbaceous groundcover type vegetation such as *Lomandra longifolia*.

APPENDIX 7

Photographs

of Ben Anderson Barrage

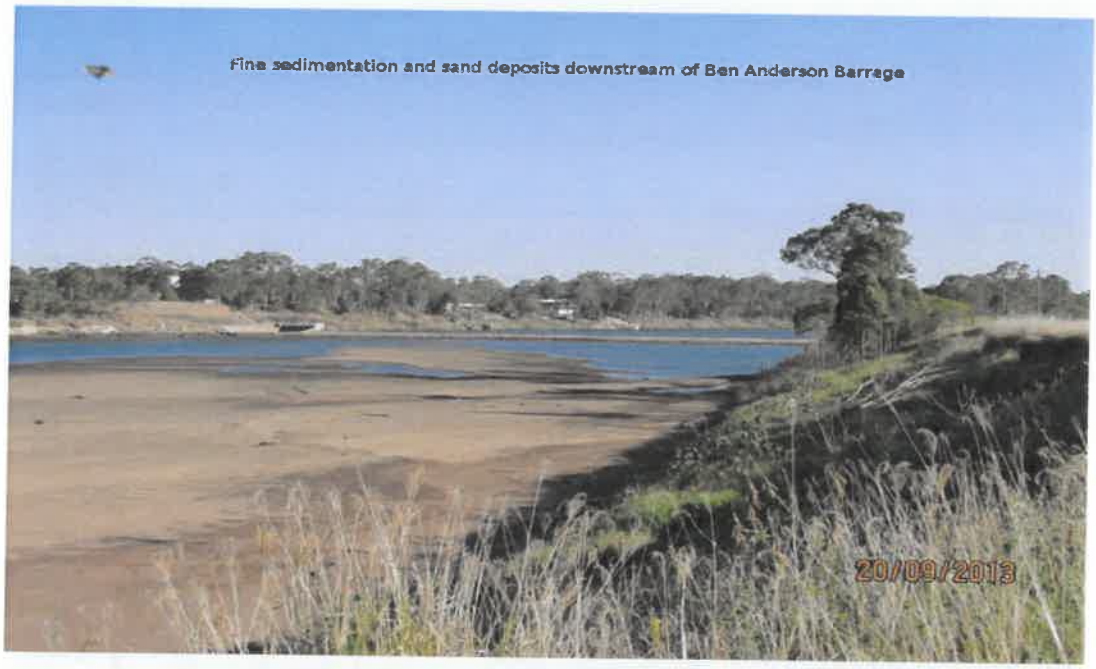
and

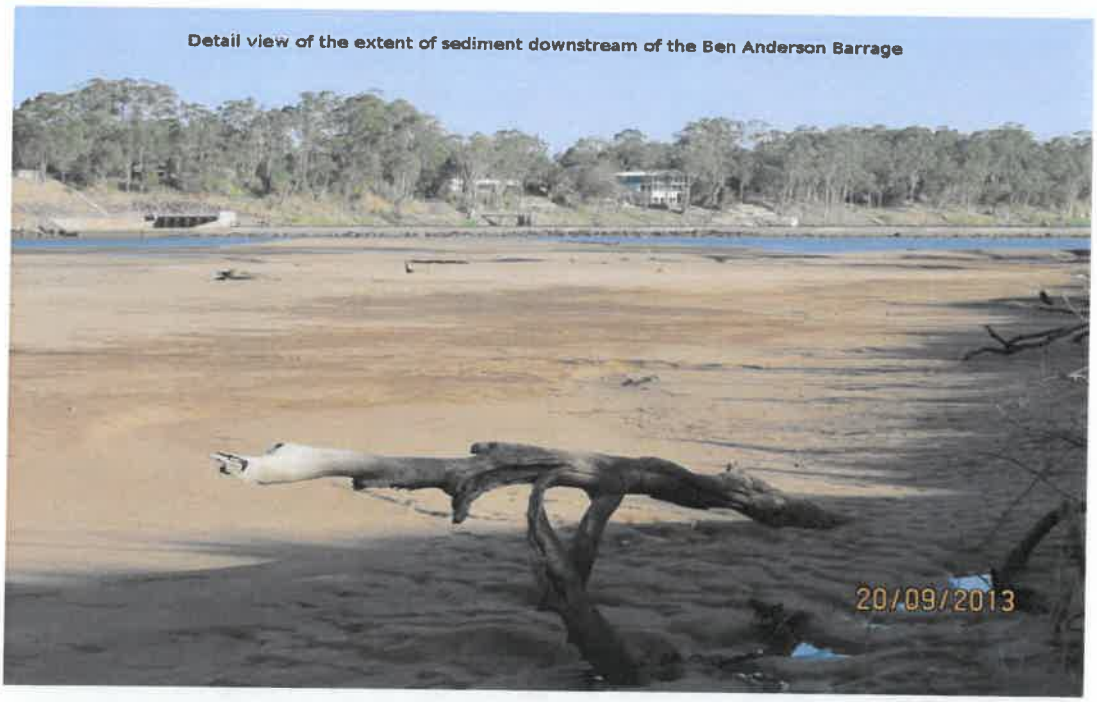
Bingera Weir

Appendix 7

Photographs depicting the condition of, and sedimentation surrounding the Ben Anderson Barrage and Bingera Weir

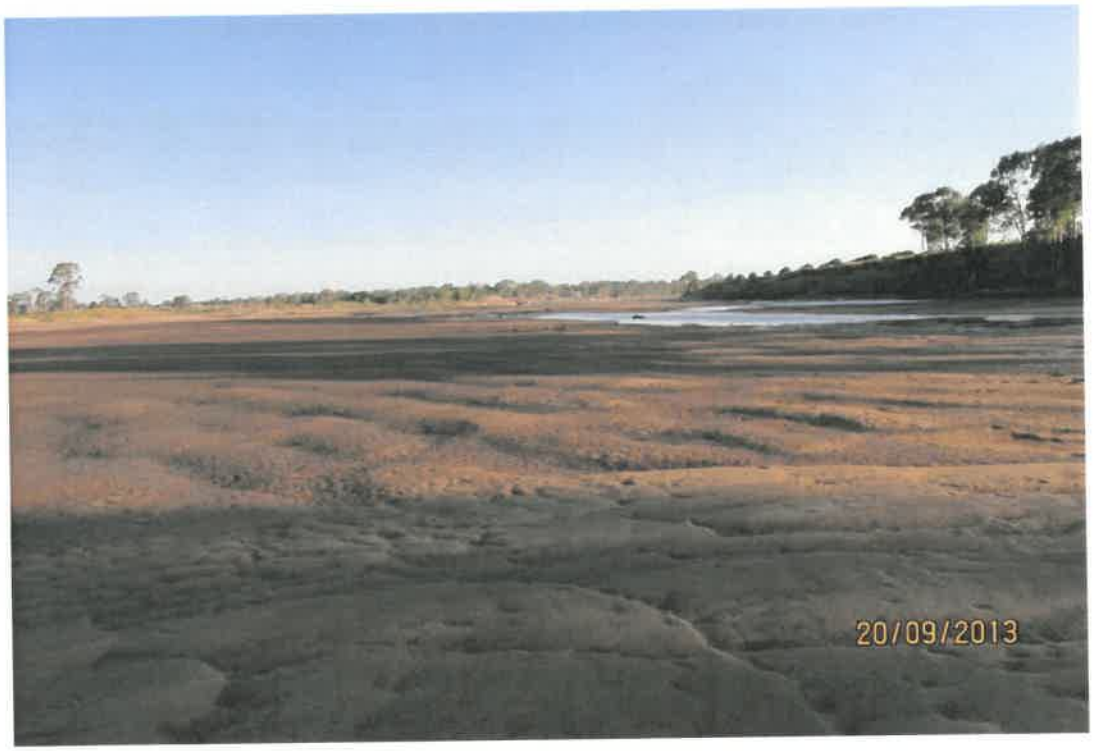
Recommendation 7.2
(Source John Olsen)





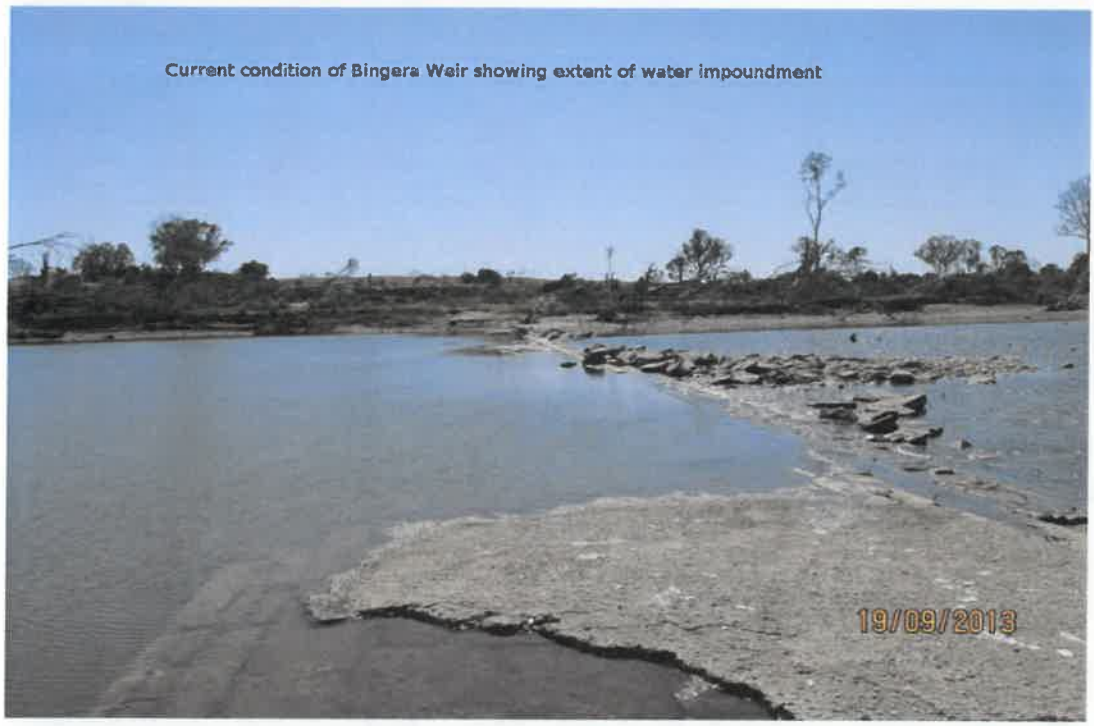
Appendix 7

Photographs depicting the condition of, and sedimentation surrounding the Ben Anderson Barrage and Bingera Weir



Appendix 7

Photographs depicting the condition of, and sedimentation surrounding the Ben Anderson Barrage and Bingera Weir



Appendix 7

Photographs depicting the condition of, and sedimentation surrounding the Ben Anderson Barrage and Bingera Weir