BSC File No: PLN560005 Doc # 1027473
Contact: Matt Walker

12 November 2010

PGF000658

Mr Jim Clark
Department of Planning
Locked Bag 9022
Grafton NSW 2460

Dear Jim,

Planning Proposal to Rezone the remaining portion of land in Area 6, Bangalow

Following the removal of a portion of land within Area 6 by the Gateway determination (Ref: PP_2010_BYRON_001_00), it is understood that the associated consultant has been in contact with your Department to seek the lodgement of an additional planning proposal on this matter.

This letter and the attached planning proposal relate to this portion of land removed by the previous gateway determination for the various lands in Bangalow. In Accordance with Section 56 of the *Environmental Planning and Assessment Act 1979,* Council submits the enclosed planning proposal.

It is intended that the planning proposal be progressed as an amendment to the *Byron Local Environmental Plan 1988.* Should you have any enquiries please contact Matt Walker on 02 6626 7169.

Yours sincerely

R. S. Darney

Ray Darney
Executive Manager Environment and Planning

Enc: Gateway Planning Proposal – Area 6 Bangalow #1062497

Parcel 253520
26. 2010 24.1

GeoLINK
environmental management and design

9 November 2010
Ref No: 441551

The General Manager
Byron Shire Council
PO Box 219
MULLUMBIMBY NSW 2482

Attention: Matt Walker

Dear Matt,

Planning Proposal – Area 6 at Bangalow

Further to our previous discussions, please find enclosed a Planning Proposal relating to land known as Area 6 at Bangalow.

This land was originally included in a previous Planning Proposal that culminated in the gazettal of Byron Local Environmental Plan 1988 (Amendment No. 137). This land was subsequently withdrawn from that Proposal.

The enclosed Planning Proposal demonstrates that the land is suitable for residential zoning. Strategic planning for the area from 1983 identified that the flood-free land on this site would be suitable for such zoning. Flood mapping anomalies resulted in an incorrect area being nominated as flood-free. A more detailed study, contained as Appendix A in the attached Proposal, shows that an area of some 15ha within the previously mapped area is actually flood prone, whereas the 11.9ha proposed for urban zoning but located outside of the mapped area is actually flood-free.

If you have any queries, or require any clarification, please feel free to call me.

Yours sincerely
GeoLINK

Rob van Iersel
Principal / Senior Planner

ABN 79 896 839 729
ACN 101 084 557

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Area 6 Bangalow

Planning Proposal relating to land identified within the Bangalow Settlement Strategy as Area 6

Prepared for: Mr K & Mrs J Daly
Project Manager: Rob van Iersel
Ref: 441184
Date: November 2010

PO Box 9
Lennox Head NSW 2478
T 02 6687 7666

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Social Assessment

Introduction

This Planning Proposal has been prepared in relation to land known as Lot 1 DP 127485, located at Bangalow on the Far North Coast of NSW.

Illustration 1. The Site

Byron Local Environmental Plan 1988 (Amendment No 137) was gazetted on 30 August 2010. It implemented residential zoning for a number of sites at Bangalow, including part of Area 6, for residential purposes.

This Planning Proposal relates to an additional area within Area 6, as shown in Illustration 2, and proposes that this additional area be zoned 2(a) Residential zone.

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Information shown is for illustrative purposes only

Drawn by: RE Reviewed by: MVE Date: November 2010
Source of base data: Byron Shire Council

LEGEND

Area proposed for residential subdivision
1 in 100 yr flood line (2007 Flood Study)
Bangalow Settlement Strategy / FNC Regional Strategy Boundary

North

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Additional Area Proposed for Rezoning

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Area 6 - Planning Proposal
441419

Illustration 2

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Background - Chronology

The northern part of Lot 1 DP 127485 has been earmarked as a potential future urban site for decades. The chronology below demonstrates that the land has been considered suitable for future urban development consistently since the 1980s. It also indicates that flooding, particularly the extent of the 1 in 100 year flood, would be the determinant of the exact shape and extent of urban zoning. It is clear from the chronology, that the 1 in 100 year flood line was not scientifically established by Council in any of its mapping prior to the current Shire-wide LES.

Year	*Study / Plan*	*Comments*
1983	Byron Shire Environmental Study	Site identified for future medium density residential (see Illustration 3), as '*logical expansion of land adjacent to existing urban area*'. Suggested timeframe – between 1986 and 1991 (Table, pg 67). Study indicates detailed flood studies required: '*As yet no comprehensive studies have been undertaken to identify the extent of flooding…*' (p.22)
1986	Byron Shire Residential Development Strategy	Site mapped as a medium term '*proposed release area*' (see Illustration 4)
1988	Byron Local Environmental Plan 1988	Site zoned 1(d) Urban Investigation.
1991	Byron Shire Development Control Plan No. 12 – Bangalow	DCP prepared to '*supplement the Shire-wide Byron LEP 1988*' (s.1.5). Site identified as "Area F" (see Illustration 5). Specific guidelines for Area F: '*the road layout is to be a SW loop road extension from the existing cul-del-sacs of Charlotte and Thomas Streets. Development is to avoid the lower flood-prone areas which are to be rezoned to open space*' (s.3.3) Development Guidelines Map clearly shows Area F as extending outside of 1(d) zone, covering the area that is subject to this Planning Proposal. The Map states in relation to site: '*Proposed limit to residential development subject to detailed survey and determination of flood level'.*
1993	Draft Byron Residential Strategy	Schedule 1 (pg 10) lists the site as a potential urban site in the medium to long term, and notes access and flooding as being the key issues. The draft Strategy indicates that key issues, particularly 'physical hazards' will need to be identified and addressed in rezoning proposals (pg 16)

Year	*Study / Plan*	*Comments*
2003	Bangalow Settlement Strategy	Site mapped as Area 6 – a future urban growth area (see Illustration 6). The intention of the Strategy was to include the land above the 1 in 100 year flood line as being suitable urban land. No flood study or detailed flood mapping was undertaken as part of developing the Strategy.
2007	Rezoning Submission	A detailed rezoning submission was submitted to Byron Shire Council in March 2007 for consideration and inclusion into Council's Shire-wide Local Environmental Study. The submission included a detailed flood study, prepared by MRG Water Consulting Pty Ltd (see copy in Appendix A), that, for the first time, scientifically detailed the extent of flooding at the site and mapped the 1 in 100 year flood line. The study included consideration of the implications of climate change / sea level rise.
2008	Byron Shire Local Environmental Study	A draft LES was prepared for Byron Shire Council by Parsons Brinkerhoff in July 2008. The draft LES includes recommendations relating to specific areas, responding to previously lodged rezoning proposals. The subject site is address at section 7.6.6(d) (see extract in Appendix B). The draft LES notes "*..the flood study provided by the applicant is considered sufficient for this stage of the process and it is suggested that this could be the basis for the identification of the boundary of the residential zone*". Further, "*It should be noted that the boundary proposed by the applicant's flood study, which took into account both flooding and climate change, is preferred to the boundary identified in the adopted Strategies and the 1(d) area*". The resulting recommendation includes the map shown in Illustration 7.
2010	Byron Local Environmental Plan 1988 (Amendment No 137)	This LEP rezoned a number of sites at Bangalow, including part of the subject site. The original Planning Proposal included all of the land mapped as suitable in the draft LES referred to above. However, this was amended during the gateway process such that the rezoning area was consistent with the area mapped in the Far North Coast Regional Strategy.

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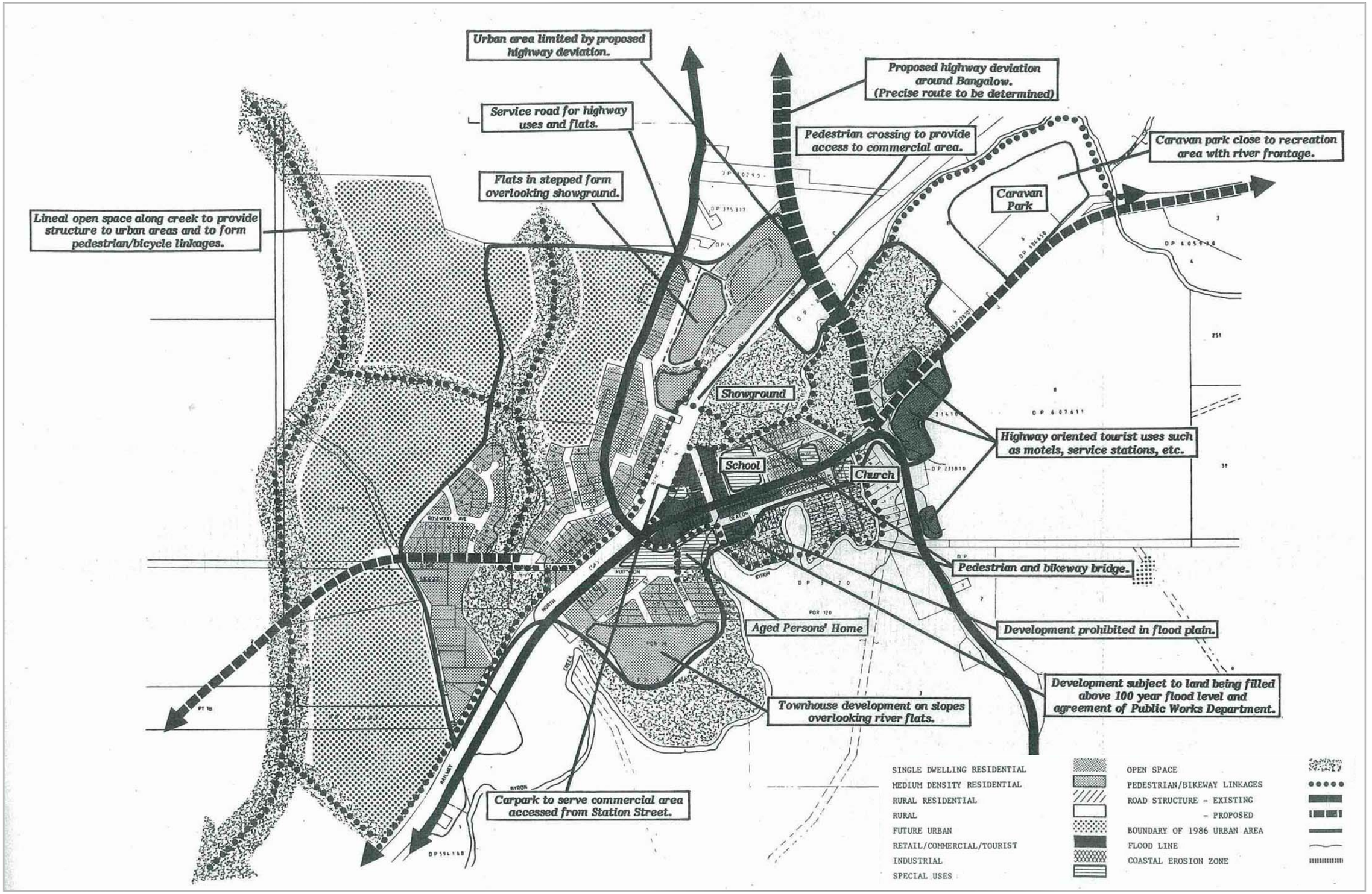
Source of base data: Byron Shire Council



North

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Area 6 - Planning Proposal
441419

Extract from 1983 Byron Shire Environmental Study

Illustration 3

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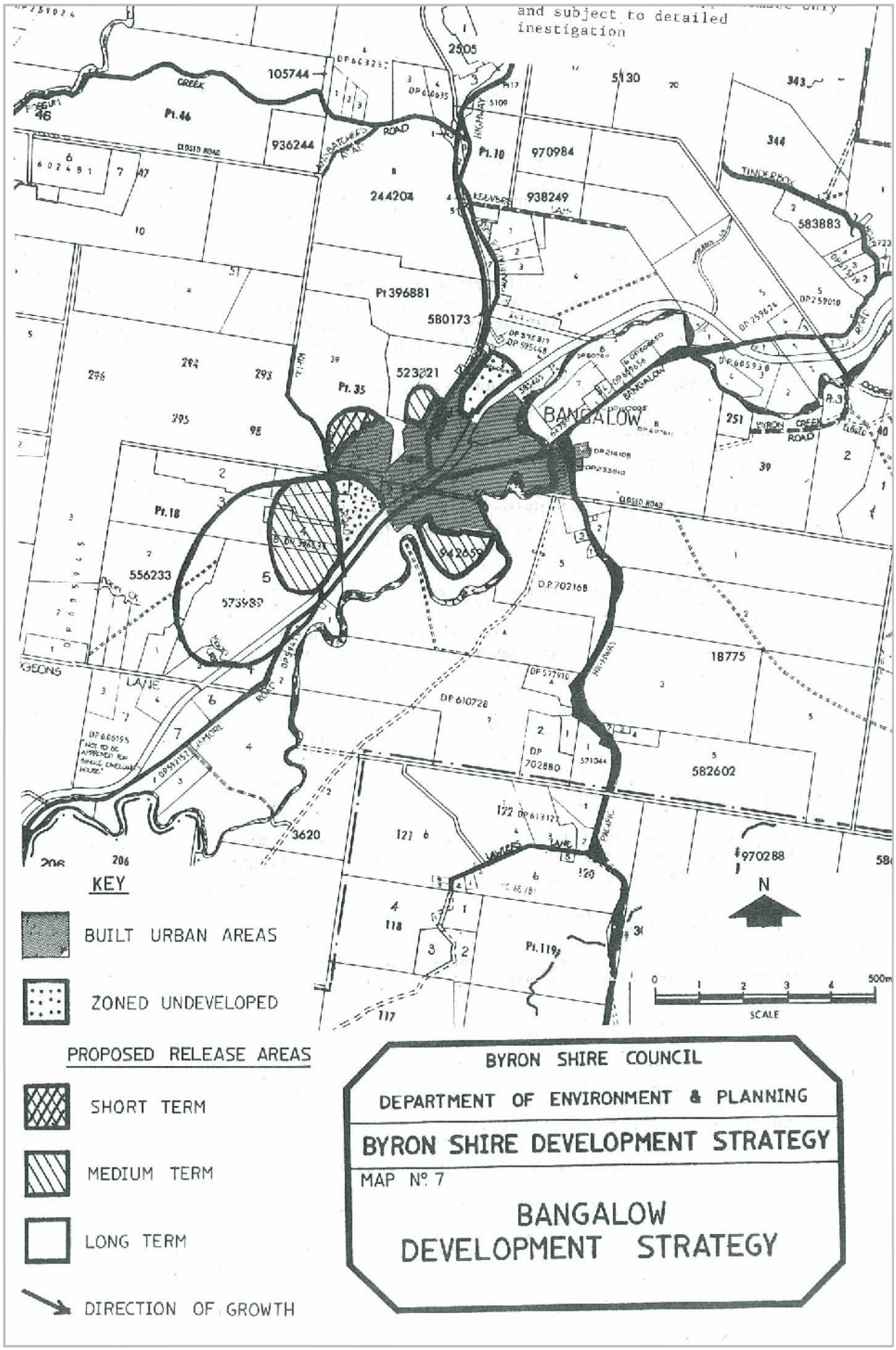
and subject to detailed
inestigation
BANGALOW
KEYS LANE
BYRON CREEK ROAD
CLOSED ROAD
KEY
BUILT URBAN AREAS
ZONED UNDEVELOPED
PROPOSED RELEASE AREAS
SHORT TERM
MEDIUM TERM
LONG TERM
DIRECTION OF GROWTH
N
SCALE
0 1 2 3 4 500m
BYRON SHIRE COUNCIL
DEPARTMENT OF ENVIRONMENT & PLANNING
BYRON SHIRE DEVELOPMENT STRATEGY
MAP Nº 7
BANGALOW
DEVELOPMENT STRATEGY

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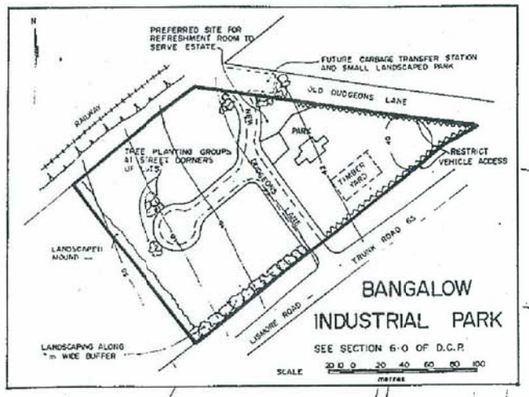
Source of base data: Byron Shire Council

BYRON SHIRE COUNCIL
BANGALOW DEVELOPMENT CONTROL PLAN
DEVELOPMENT GUIDELINES MAP A



PROPOSED BY-PASS ROAD

HOUSING AREA "D"

SITE FOR ADDITIONAL RESERVOIR

RESERVOIR

SUGGESTED RAINFOREST SPECIES PLANTING BESIDE BY-PASS

POTENTIAL RELEASE AREA "E"

FUTURE OPEN SPACE TO LINK TO EXISTING PADDY'S CREEK OPEN SPACE

RAILWAY

PRIVATE OPEN SPACE IN GALLIES

PRIME AGRICULTURAL LAND

HOUSING AREA "C"

LOW DENSITY CLUSTER HOUSING

PLAYING FIELD

RECREATION GROUNDS

BOWLING CLUB

OPEN SPACE USE OF AREA WITHIN MAJOR NOISE IMPACT OF BY-PASS

SHOWGROUND

FUTURE SPORTSFIELD

RESTRICTED ACCESS AND LANDSCAPE BUFFER

CONSERVE REMNANT TREES AS NUCLEUS OF RAINFOREST GROVE

APPLICATION FOR RESIDENTIAL SUBDIVISION OR DEVELOPMENT TO BE ACCOMPANIED BY NOISE IMPACT REPORT (SEE CL 3·3 AREA 'B')

HOUSING AREA "B"

GATEWAY SITE TOURIST & COMMUNITY INFORMATION FACILITY

CONSERVE HOUSE AS VISUAL FOCUS

SUGGESTED RAINFOREST SPECIES PLANTING BESIDE BY-PASS

PROPOSED BY-PASS ROAD

24m WIDE BUFFER PLANTING & LANDSCAPE CORRIDOR ALONG NORTHERN BOUNDARY

OPEN SPACE ALONG CREEK CORRIDOR GENERALLY DELINEATED BY BANK BUT INCLUDING SOME 'FLOOD-FREE AREA

BUFFER PLANTING

RETAIN ACCESS TO RURAL HOLDING AND CONSOLIDATE ACCESS STRIP IN OVERALL STAGED DEVELOPMENT

DEVELOPMENT TO BE STAGED SO THAT NO RESIDENTIAL LOTS ARE RELEASED UNTIL 2 YEARS AFTER PLANTING OF SEDGEROAFT BUFFER

NEIGHBOURHOOD PARKS

PREFERRED ACCESS POINTS

POTENTIAL CLUSTER HOUSING

POTENTIAL SITE FOR COMMUNITY FACILITIES

FUTURE OPEN SPACE

SEWER PUMP STATION P.S. 2

OPEN SPACE

L.E.P. 1(d) ZONE BOUNDARY

FUTURE BOTANIC GARDENS

CLUSTER HOUSING

HOUSING AREA "A"

FUTURE ROAD ACCESS

RAIL UNDERPASS AND INTERSECTION TRAFFIC CONTROL

POTENTIAL RELEASE AREA "F"

POTENTIAL PLAYING FIELDS

PROPOSED LIMIT TO RESIDENTIAL DEVELOPMENT SUBJECT TO DETAILED SURVEY AND DETERMINATION OF FLOOD LEVEL

RAINFOREST REMNANT

POTENTIAL RELEASE AREA "J"

FUTURE ACCESS TO AREAS FOR POTENTIAL URBAN RESIDENTIAL EXPANSION

SITE FOR FUTURE WATER-SUPPLY RESERVOIR

EXISTING ORCHARD

SEWAGE TREATMENT WORKS

BANGALOW INDUSTRIAL PARK 200 m SEE INSET TOP LEFT HAND SIDE

IAN PICKLES
CONSULTANT TOWN PLANNER
BALLINA PH 64732

SCALE 1:5000
metres

KEY:

INDICATIVE ONLY, FOR REFINEMENT IN PREPARATION AND ASSESSMENT OF D.A.

- PROPOSED OPEN SPACE PUBLIC OR PRIVATE
- PROPOSED ROADS
- PROPOSED BIKEWAY / WALKWAY
- AREAS MOST SUITABLE FOR CLUSTER HOUSING AND/OR SMALL LOTS
- BOUNDARY OF PROPOSED CONSERVATION AREA (SEE SECTION 4·2C AND 4·3·4 OF D.C.P.)
- BOUNDARY OF EXTENDED HERITAGE PRECINCT (SEE SECTIONS 4·2B AND 4·3·3 OF D.C.P.)
- RESTRICTED ACCESS TO R.T.A. CONTROLLED ACCESS ROAD

INDICATIVE ONLY

- EXISTING TREES TO BE RETAINED AS FEATURES WITHIN NEW DEVELOPMENT, OR LANDSCAPE BUFFERS

North

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Bangalow Settlement Strategy Mapping

Illustration 6

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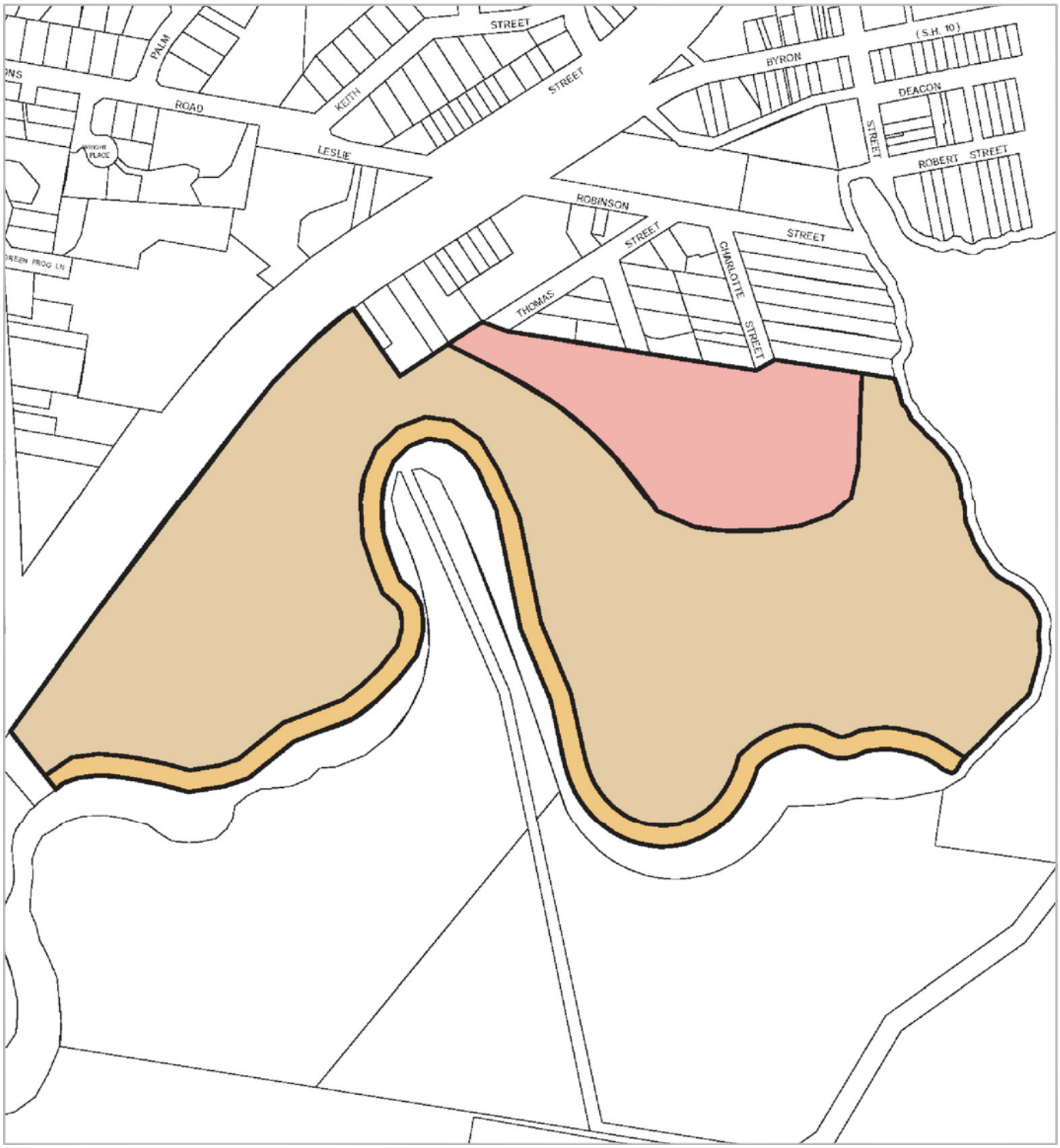
Source of base data: Byron Shire Council

Information shown is for illustrative purposes only



LEGEND

- R2 Low Density Residential
- RU2 Rural Landscape or RU1 Primary Production
- E2 Environmental Conservation

North

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Draft Byron LES Mapping

Area 6 - Planning Proposal

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Illustration 7

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Part 1 Proposal Objective

To enable the future urban development of that part of Lot 1 DP 127485 that is currently zoned 1(aH) General Rural (Hatched), where above the 1 in 100 year flood inundation level, for low-density residential housing.

Part 2 Explanation of Provisions

Amend the Byron Local Environmental Plan 1988 Zoning Map in accordance with the proposed zoning map shown in Illustration 8. Land within Lot 1 DP 127485 currently zoned 1(aH) General Rural (Hatched), where above the 1 in 100 year flood inundation level, to be zoned 2(a) Residential (R2 Low Density Residential).

Part 3 Justification

Section A - Need for the planning proposal

1. Is the planning proposal a result of any strategic study or report?

Bangalow Settlement Strategy 2003

This Planning Proposal follows decades of various planning strategies that have nominated the flood-free part of this land as being suitable for residential development; as summarised in the Background / Chronology set out above.

In particular, the site was nominated in the Bangalow Settlement Strategy 2003. This strategy was prepared to meet the requirements of Clause 38 of the *North Coast Regional Environmental Plan*, which is now *State Environmental Planning Policy (North Coast Regional Environmental Plan)*.

In the strategy, the subject land was identified as Area 6 (of nine areas identified as potential future use areas for village expansion). In relation to Area 6, the Strategy identifies the key constraints as being flooding, access to Lismore Road, the loss of agricultural land and visual impacts. Building on the previous strategic planning undertaken by Byron Shire Council, it was understood in the Strategy that the final extent of residential area would be determined by a detailed flood study, to identify the flood-free land on the site.

The strategy makes the following recommendations regarding the future development of Area 6:

- *Area 6 is suitable for residential development* ***on flood free land****, subject to resolution of access and use of neighbouring rural land currently in the same ownership* (author's emphasis).

  The mapping originally inserted into the Bangalow Strategy came from the original 1983 Byron Shire Environmental Study and was an approximation of the 1 in 100 year flood line, based purely on anecdotal evidence provided by the land owner.

  The flood-free land within that mapped area was rezoned to residential by the recent gazettal of Byron Shire Local Environmental Plan 1988 (Amendment No 1 37). This Planning Proposal now relates to the additional flood-free land.

  The neighbouring rural land in the same ownership (i.e. the residue of the land following rezoning) will generally fall into two parts – a northern part, directly adjoining the land proposed for rezoning, and a southern portion, separated by a tight bend in Byron Creek. The northern part could be used partly for the provision of public open space associated with the Byron Creek riparian area. The remainder of this northern residue could be split into two larger rural lots, each to be attached to a lot within the residential area, to provide for two lots that could be used for low-scale food production, or other semi-rural purposes. Details of these proposals would be developed at DA stage.

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Source of base data: Byron Shire Council

North

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Proposed Rezoning

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Area 6 - Planning Proposal
441419

Illustration 8

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The southern residue portion will be retained by the current owner, who intends to continue low-scale cattle grazing. The presence of Byron Creek, and the northern residue area, will provide sufficient buffer area between this grazing land and the new residential lots to minimise noise or other potential land use conflicts.

- *A new road access to Lismore Road would protect the amenity of existing residents in the Thomas Street area. It would also facilitate traffic flow for trips to the western parts of Bangalow, to Lismore or to the Bangalow industrial area.*

  Direct access from Lismore Road is not possible. Such access could only be located within flood prone land and it is considered that the filling of land to provide flood free access would result in increased flood levels elsewhere in the locality. In any case, the Roads and Traffic Authority has indicated that they would not support any additional intersections on the Lismore Road in this area.

  Access can only be provided, therefore, from Thomas Street and Charlotte Street, through the adjoining residential land that was subject to Byron Local Environmental Plan 1988 (Amendment No. 137). In that regard, rezoning of the subject section of land will provide for an orderly and efficient subdivision layout, achieving the connection of Charlotte and Thomas Streets through the development, as required by DCP No. 12 (see Background / Chronology above).

  Preliminary conceptual design indicates a potential yield in the order of 12-14 lots in this section of the site, which would generate somewhere in the order to 120-140 vehicles per day based on RTA published guidelines. Whilst this additional traffic will have some impact on existing residents in Thomas and Charlotte Streets, this additional load will be 'split' between the two streets and will therefore will remain relatively low in each street.

- *Development of Area 6 should be the catalyst for the provision of open space, such as community gardens and playing fields, walkways and environmental repair along Byron Creek.*

  Since much of the site is below the 1% flood planning level and will not be built on, there will be a large amount of potential open space for various activities. This detail will be further explored at DA stage.

  In particular, there is approximately 15.8 ha of flood-prone land that was included in the original mapping of potentially suitable land. This area, to the south-west of the recently zoned land, was mapped as potential urban land in the Byron Local Environmental Plan 1988, in the Bangalow Settlement Strategy 2003 and in the Far North Coast Regional Strategy.

- *NSW Agriculture's land classification system indicates that the land is prime agricultural land. However due to the small land area involved and its proximity to the village centre, and the physical limit to expansion of the village at Byron Creek, development of this land to define the village would be an appropriate use of potential agricultural land. This issue needs to be resolved with NSW Agriculture and DIPNR.*

  The proximity of the land to existing residents, with little or no opportunity for buffering, restricts the scope of agricultural pursuits on the site, given the potential for future land use conflicts. The presence of Byron Creek can provide a buffer between the southern residue land, which will remain rural with low-scale cattle grazing, and the future development area. Using part of the northern residue area for semi-rural purposes could make some use of the agricultural potential of the land in a manner that minimises conflicts, given that uses would need to be, by virtue of available area, quite small in scale.

  It is noted that all of the Bangalow Village (i.e. the residentially zoned land) is surrounded by Regionally Significant Farmland. This is addressed further below, however, it is noted that, where this Planning Proposal suggests approximately 11.9 ha of this Regionally Significant Farmland be zoned for residential purposes, approximately 15.8 ha of land, currently identified in local and regional planning strategies as potential urban land, will not be pursued because it is flood-prone. Effectively, therefore, this Planning Proposal provides a 'land swap' that will ensure the maintenance of the existing quantum of agricultural land.

- *Estimated residential lot yield of 1(d) (Investigation Zone) land is approximately 45 lots. This may be reduced following detailed site analysis and assessment of visual impact and access.*

  Very preliminary concept design confirms that the yield of around 45 lots should be achievable, assuming the whole of the site is available – i.e. the part recently zoned by way of Amendment No. 137 together with the land proposed for rezoning herein. This would, of course, be confirmed as part of the DA process following rezoning, based on detailed site and contextual analysis.

Far North Coast Regional Strategy

As outlined above, the site is directly adjacent to an area mapped in this strategy as a 'Proposed Future Urban Release Area'. The delineation of the extent of that area was based on the mapping supplied by Byron Shire Council, which came directly from the Bangalow Settlement Strategy.

In relation to the mapped areas, the Strategy makes some allowance for minor variations to ensure that new development will be consistent with the intent of the Strategy, to provide for appropriate urban growth.

In this case, it was clearly the intention of the Far North Coast Strategy to adopt the findings and recommendations of the Bangalow Strategy (and the strategic planning that lead to the Bangalow Strategy). In relation to Area 6, the intention of all of the preceding strategic planning was to provide for urban growth on flood free land.

Rezoning of the additional area, as suggested by this Planning Proposal, can therefore be considered to be consistent with the intent of the Far North Coast Regional Strategy.

It is also noted that there is an area of approximately 15.8 ha that is identified in the Strategy that has now been demonstrated to be flood-prone. This area will not be pursued for residential zoning, effectively 'balancing-out' the current proposal.

Northern Rivers Farmland Protection Project

The Farmland Protection Project seeks to protect important farmland from urban and rural residential development by mapping farmland and developing planning principles (p.4). All of Lot 1 DP 127485 is mapped as 'Regionally Significant Farmland'.

Future settlement areas identified in relevant strategies are not shown on the Farmland Protection maps. Rather, the report recommends that land identified in an agreed council settlement strategy can be considered for urban or rural residential rezoning even if it is mapped as significant farmland.

In considering this issue, the Farmland Project Report (at Section 4.4), suggests that Council's can consider regionally significant farmland for future urban use if all of the following apply:

- *the proposed new urban area or use would form part of the urban areas of Lismore, Murwillumbah, Kyogle, Casino or Ballina and no viable alternative land is available in proximity to those towns, or it would form a minor 'rounding-off' on the edge of an urban centre which would make good planning sense given the nature of the locality;*

  The rezoning of this area would form a 'minor rounding-off' on the edge of Bangalow, as originally intended in the Bangalow Settlement Strategy, 2003 and the strategic planning that preceded that Strategy. As described above, the Strategy determined that urban development of flood-free land in this locality would provide a logical extension of the urban area. Had mapping been undertaken in accordance with detailed flood information, the proposed rezone area would have been mapped.

  It is also noted that a flood-prone part of the site, with area of approximately 15.8 ha, has been included in both the Bangalow Settlement Strategy and the Far North Coast Strategy. That area is also mapped as Regionally Significant Farmland and, in the absence of the flooding constraint, would ordinarily not be prevented from residential rezoning because of the Farmland project. This Planning

Proposal suggests residential zoning for 11.9 ha of flood-free land not mapped in the Strategies, which can be viewed as a 'land-swap' for the flood-prone land in the Strategies, adding further weight to the argument that the proposal forms a minor 'rounding-off' of residential land on the edge of the Bangalow Village.

It is considered therefore that urban use of this regionally significant farmland makes good planning sense in the circumstances.

- *it would be adjacent or close to an existing zoned urban area;*

  As shown in the illustrations to this Planning Proposal, the site is directly adjacent to an existing zoned urban area.

- *it would not significantly undermine the integrity of a regionally significant farmland area by creating wedges or spikes of urban development;*

  The current proposal provides for a minor, and logical, extension to the zoned area. It will not undermine the integrity of the remaining parcel, particularly given that a slightly larger area of land, mapped within adopted urban strategies, will not be pursued for urban use because it is flood prone.

- *it would not compromise local or regional agricultural potential by alienating agricultural infrastructure or agricultural transport routes, or decreasing 'critical mass' for any existing agricultural industry;*

  The rezoning of this land will have virtually no impacts on agricultural use or agricultural potential of the remainder of the parcel. The land is used for low-scale cattle grazing. Rural land will remain between the urban zone and the creek, allowing for internal 'passage' between grazing sites, including flood-free land for refuge for the cattle.

- *it would not create impacts which would compromise the agricultural use of nearby regionally significant land; and*

  The proximity of the land to existing residents, with little or no opportunity for buffering, currently restricts the scope of agricultural pursuits on the site. The presence of Byron Creek can provide a buffer between the southern residue land, which will remain rural with low-scale cattle grazing, and the future development area. Using part of the northern residue area for semi-rural purposes could make some use of the agricultural potential of the land in a manner that minimises conflicts, given that uses would need to be, by virtue of available area, quite small in scale.

- *it would not be located in an area where there was an identified risk of land use conflict near an existing agricultural enterprise;*

  There is no history of land use conflicts in this locality. The agricultural pursuits are low-scale cattle grazing. As highlighted above, the presence of Byron Creek can effectively separate agricultural pursuits from urban uses, providing an improved situation.

- *it would not involve filling part of a floodplain unless consistent with a floodplain management plan prepared in accordance with the Floodplain Management Manual.*

  There would be no filling within the floodplain.

Given the circumstances of mapping in this case, it is considered that urban use of the subject land would be acceptable.

2. *Is the planning proposal the best means of achieving the objectives or intended outcomes, or is there a better way?*

Amending the Byron Local Environmental Plan 1988 Zoning Map so that land within Lot 1 DP 127485, where above the 1 in 100 year flood inundation level, is zoned 2(a) Residential (R2 Low Density Residential) is the best and neatest way of utilising the land for village expansion.

3. *Is there a community benefit?*

The Bangalow Settlement Strategy 2003 (and the strategic planning that preceded it) was prepared to balance overall community benefit outcomes with the need to provide for sustainable expansion of the village population. Notwithstanding the mapping discrepancies discussed above, the Strategy considered that the flood-free land on this site would provide overall community benefit as urban land, providing additional housing options / diversity in a manner that minimises environment, social and economic impacts.

It may also be possible, in this case, to provide for community uses (e.g. passive open space, community gardens) within the residue of the northern part of the land, which will retain its rural zoning.

Such community benefits would be explored at development application stage.

Further, rezoning of the site would provide a net community benefit as the rezoning will contribute to Council's housing targets as set by the Far North Coast Regional Strategy.

Section B - Relationship to strategic planning framework

4. *Is the planning proposal consistent with the objectives and actions contained within the applicable regional or sub-regional strategy?*

As identified above, the Far North Coast Regional Strategy adopted the mapping provided by Byron Shire Council for the Bangalow Settlement Strategy 2003. In relation to Area 6, the Bangalow Strategy clearly sought to identify the flood free land on the site as being suitable for the minor expansion to Bangalow Village. The mapping undertaken at the time was rudimentary in this regard and a subsequent detailed flood study has more clearly identified the extent of flood free land.

Despite the mapping anomaly, therefore, the proposed rezoning of this small area is consistent with the objectives of the Far North Coast Regional Strategy.

5. *Is the planning proposal consistent with the local council's Community Strategic Plan, or other local strategic plan?*

As discussed above, despite the mapping anomaly, the proposal is consistent with the *Bangalow Settlement Strategy 2003*.

6. *Is the planning proposal consistent with applicable State Environmental Planning Policies?*

Several State Environmental Planning Policies (SEPPs) would apply to future development on the site. These are identified and discussed below.

SEPP 44 Koala Habitat Protection

The subject land does not contain any koala food trees. It would not, therefore, be considered potential koala habitat as defined in this SEPP.

SEPP 55 Remediation of land

The risk of land contamination is low given the history of land uses on the site. The current landowner has a long history of association with the subject land, and has provided a statement outlining that, to the best of his knowledge, no chemicals have ever been used on the part of the site subject to rezoning.

SEPP Major Development

This SEPP consolidates criteria and identifies development, which are 'State Significant'.

The development of the site post rezoning would not be categorised within this SEPP as a project to which Part 3A of the Act applies, nor would it be categorised as Regional Development.

SEPP Rural Lands

This SEPP provides for the protection of agricultural land that is of State or regional significance. The site proposed to be rezoned is mapped as regionally significant farmland. The SEPP contains specific provisions that relate to the assessment of a development applications over rural land. It does not contain provisions for rezoning applications.

The SEPP contains the following rural planning principles:

a) *the promotion and protection of opportunities for current and potential productive and sustainable economic activities in rural areas.*
b) *recognition of the importance of rural lands and agriculture and the changing nature of agriculture and of trends, demands and issues in agriculture in the area, region or State.*
c) *recognition of the significance of rural land uses to the State and rural communities, including the social and economic benefits of rural land use and development.*
d) *in planning for rural lands, to balance the social, economic and environmental interests of the community.*
e) *the identification and protection of natural resources, having regard to maintaining biodiversity, the protection of native vegetation, the importance of water resources and avoiding constrained land.*
f) *the provision of opportunities for rural lifestyle, settlement and housing that contribute to the social and economic welfare of rural communities.*
g) *the consideration of impacts on services and infrastructure and appropriate location when providing for rural housing.*
h) *ensuring consistency with any applicable regional strategy of the Department of Planning or any applicable local strategy endorsed by the Director-General.*

The proximity of the land to existing residents, with little or no opportunity for buffering, would limit the scope of agricultural pursuits on the site, given the potential for future land use conflicts. The presence of Byron Creek can provide a buffer between the southern residue land, which will remain rural with low-scale cattle grazing, and the future development area. Using part of the northern residue area for semi-rural purposes could make some use of the agricultural potential of the land in a manner that minimises conflicts, given that uses would need to be, by virtue of available area, quite small in scale.

7. *Is the planning proposal consistent with applicable Ministerial Directions (s. 117 directions)?*

Directions made under section 117 of the *Environmental Planning and Assessment Act 1979*, issued on 1 July 2009, which are relevant to the site, are identified and addressed in Table 1, below.

Table 1 Section 117 Directions

Direction No.	*Objective*	*Consideration*
No. 1.2 – Rural Zones	A planning proposal must not rezone land from a rural zone to a residential, business, industrial, village or tourist zone. A planning proposal may be inconsistent with the terms of this direction only if the relevant planning authority can satisfy the Department of Planning that the provisions of the planning proposal that are inconsistent are: (a) justified by a strategy which: (i) gives consideration to the objectives of this direction; (ii) identifies the land which is the subject of the planning proposal (if the planning proposal relates to a particular site or sites), and (iii) is approved by the Director-General of the Department of Planning.	This planning proposal does seek to rezone land that currently has a rural zoning to a residential zoning. However, this inconsistency is justifiable in accordance with 5(a). As highlighted above, strategic planning undertaken since 1983 has identified the flood-free component of the site as a potential future residential area. This potential has been confirmed by Council's Shire-wide Local Environmental Study (PB, 2008), prepared to support Council's proposed Shire-wide LEP (see Illustration 7). The LES assesses the site for its suitability for urban development and concludes that a residential zoning is appropriate.
No. 1.5 – Rural Lands	A planning proposal must be consistent with the Rural Planning Principles listed in *SEPP Rural Lands*. A planning may be inconsistent with the terms of this direction only if the relevant planning authority can satisfy the Department of Planning that the provisions of the planning proposal that are inconsistent are: (a) justified by a strategy which: (i) gives consideration to the objectives of this direction; (ii) identifies the land which is the subject of the planning proposal (if the planning proposal relates to a particular site or sites), and (iii) is approved by the Director-General of the Department of Planning.	See above. The proposal is consistent with the Rural Planning Principles and Rural Subdivision Principles listed in SEPP Rural Lands.

Direction No.	*Objective*	*Consideration*
No.3.1 – Residential Zones	To ensure the orderly and economic use or development of residential land. This direction provides that residential zones should contain a range of provisions ensuring appropriate servicing, appropriate density controls, the provision of housing choice etc.	The existing 2(a) zone within the Byron LEP provides for these things and the rezoning of the site to 2(a) will be consistent with the requirements of this direction. Similarly, the provisions of the proposed Byron Shire-wide LEP, and the proposed R2 Low Density Residential zone, would also provide appropriate provisions.
Direction No.3.4 – Integrating Land Use and Transport	To ensure that urban structures, building forms, land use locations, development designs, subdivision and street layouts achieve the following planning objectives: ▪ improving access to housing, jobs and services by walking, cycling and public transport ▪ increasing the choice of available transport and reducing dependence on cars ▪ reducing travel demand including the number of trips generated by development and the distances travelled, especially by car ▪ supporting the efficient and viable operation of public transport services ▪ providing for the efficient movement of freight.	The subject site is located on the urban fringe of Bangalow and the site adjoins existing residential areas. The existing residential area is serviced by public transport and contains a pedestrian / cycleway connection to the village centre of Bangalow. The proposed development will allow for an extension to these services.
No. 4.3 – Flood Prone Land	To ensure that development of flood prone land is consistent with the NSW Government's Flood Prone Land Policy and the principles of the Floodplain Development Manual, 2005. To ensure that the provisions of an LEP on flood prone land is commensurate with flood hazard and includes consideration of the potential flood impacts both on and off the subject land.	A detailed flood study has been prepared for the subject site (see Appendix B). The 1% AEP flood level, as identified within this flood study, has been adopted as the appropriate flood planning level for the development of the site. This flood planning level forms the boundary of the land to be rezoned.
No. 4.4 – Planning for Bushfire Protection	To protect life, property and the environment from bush fire hazards, by discouraging the establishment of incompatible land uses in bush fire prone areas. To encourage sound management of bush fire prone areas.	The subject site is not mapped as bushfire prone land.
No. 5.1 – Implementation of Regional Strategies	Planning proposals must be consistent with a regional strategy released by the Minister for Planning.	As addressed in detail above, it is considered that the proposed rezoning of the subject site is consistent with the Far North Coast Regional Strategy.

Direction No.	*Objective*	*Consideration*
No. 5.3 – Farmland of State and Regional Significance on the NSW Far North Coast	To ensure that the best agricultural land will be available for current and future generations to grow food and fibre. To provide more certainty on the status of the best agricultural land, thereby assisting councils with their local strategic settlement planning. To reduce land use conflict arising between agricultural use and non-agricultural use of farmland as caused by urban encroachment into farming areas.	The site is identified as being regionally significant farmland. As identified above, the site subject to this proposal was not included in the original mapping of the Bangalow Strategy because flood data was not available. The Strategy, however, clearly intended to apply to all flood-free land on this site. The Farmland Protection Project report indicates that, in certain circumstances, urban zoning of regionally significant farmland can be considered where it is not included in an existing Strategy map. The considerations are addressed above. Given the circumstances of this case, particularly that the Strategy maps an area of regionally significant land that is flood prone and therefore not suitable for urban development, it is considered that urban zoning as suggested is appropriate.

Section C - Environmental, social and economic impact

8. Is there any likelihood that critical habitat or threatened species, populations or ecological communities, or their habitats, will be adversely affected as a result of the proposal?

An ecological assessment of the site has been conducted and was considered in the assessment that was associated with Byron Local Environmental Plan 1988 (Amend No. 137).

The assessment examined all of the land and concluded that, while there are some important riparian areas within the residue, the land proposed to be rezoned does not contain any areas of conservation value.

This view is supported in the Byron Shire Local Environmental Study (PB, 2008). In relation to this site, the LES notes that flooding and drainage are the main constraints. Its states: "*Other environmental concerns associated with the site can be addressed at the DA stage*". This would indicate that ecology does not present a significant constraint to development.

9. *Are there any other likely environmental effects as a result of the planning proposal and how are they proposed to be managed?*

Flooding

Byron Creek is located along the southern boundary of the site. The site is subject to flooding from this creek, with previous anecdotal flood information providing the rational for the zone boundary between the existing 1(d) and 1(a) parts of the site.

A detailed flood study has been undertaken by MRG Water Consulting Pty Ltd to assess level of flood risk on the site. This flood study is contained in Appendix A.

The flood study has established a 1 in 100 year ARI 'Flood Planning Level' (FPL) relevant to the site, based on detailed modelling of the flood behaviour of Byron Creek. This FPL is somewhat consistent with the previous understanding of flood levels on the site, and aligns relatively closely with the current 1(a) / 1(d) zone boundary, with the exceptions noted above. This Planning Proposal relates to an area of flood-free land located in the 1(a) zone. A similar sized area is located within the 1(d) land but is shown in the flood study to be flood-prone.

The Byron LES (PB, 2008) concludes that the MRG Water Consulting flood study "*is considered sufficient for this stage of the process and it is suggested that this could be the basis for the identification of the boundary of the residential zone*".

Contamination

The subject land has historically been used for cattle grazing. The land has been in the Daly family for at least 80 years. The current land owner grew up on the property, and has managed it for some 37 years. He has previously provided an affidavit to the effect that, to the best of his knowledge, no chemicals have previously been used on the part of the site proposed for development. A copy of this statement is contained in Appendix C. Given this detailed site knowledge, there is a very low likelihood of any soil contamination being present on the site.

Bushfire

Bushfire prone lands mapping provided by Byron Shire Council indicates that the site is not mapped as bushfire prone land. The requirements of the NSW Rural Fire Service "Planning for Bushfire Protection" (Planning NSW 2001) therefore do not apply to the proposal.

An area of category two bushfire-prone land and associated buffer is located to the south of the subject site, but this does not protrude onto the subject property.

10. *How has the planning proposal adequately addressed any social and economic effects?*

A social impact assessment was previously carried out for the proposed development. A copy of this assessment is included in Appendix D.

An increase of between 35 and 45 lots (i.e. the anticipated 'total' development of the land, including previously zoned area and current proposal) does not constitute significant change in terms of a social impact on the village of Bangalow. It represents between a 4.8 and 6.4 percent increase in population (based on the population figure for Bangalow village of 1250 people (Book of Bangalow, Aug 2006), and based on 2 people per household (based on the Byron Shire Council average according to the ABS).

The population increase could contribute to the economic strengthening of the Bangalow Village, increased usage of the public transport network, and a more coherent and physically complete neighbourhood.

The increase in population, and associated increase in demand for current services and amenities may be a catalyst for change with regard to improving the public service network of schools, hospitals, and community facilities in the longer term.

The Byron Shire LES (PB, 2008) notes that a more detailed SIA would be required at DA stage. It also notes that: "*the economic implications are considered positive. The proposed development would not only provide job opportunities during the construction phase, but will bring additional revenue into the local businesses and area once established*".

Section D - State and Commonwealth interests

11. Is there adequate public infrastructure for the planning proposal?

The proposed rezoning is likely to result in an increase of between 12 to 14 lots (i.e. 12 – 14 households) and therefore will not result in a significant increase in demand for infrastructure. The existing provision of infrastructure servicing Bangalow is generally capable of catering for the additional population. Where there are potential shortfalls in existing services, such as education or health, it is anticipated that the additional population could contribute to the ability to provide for increases in services.

12. What are the views of State and Commonwealth public authorities consulted in accordance with the gateway determination?

This section of the planning proposal will be completed following consultation with the State and Commonwealth Public Authorities identified in the gateway determination. This section will summarise any issues raised by public authorities not already dealt with in the planning proposal, and will address issues as required.

Part 4 Community Consultation

As discussed in Section 3.3.3 of this report, consultation has previously been carried out in accordance with Byron Shire Council's *Draft Social Impact Assessment Development Control Plan* and *Draft Social Impact Assessment* Policy, as part of conducting a social impact assessment for the proposed development.

In accordance with *A Guide to Preparing Local Environmental Plans* (Department of Planning, 2009) the gateway determination will specify the community consultation that must be undertaken on the planning proposal.

Conclusion and Recommendations

This proposal to extend the village of Bangalow to include the northern part of Lot 1 DP 127485 is a direct result of the Bangalow Settlement Strategy 2003 and the local strategic planning that preceded that Strategy. All of that work confirmed that the flood-free component of the site is suitable fir future urban use.

An anomaly in mapping resulted in some flood-free land being excluded from the Bangalow Strategy and Far North Coast regional Strategy mapping, with another, similarly sized, area of flood-prone land included in the mapping.

An analysis of potential environmental constraints, including flooding, contamination, bushfire and ecology has been carried out. The results of this analysis have been used to confirm that rezoning of this additional area forms a suitable boundary to the proposed village expansion area.

The proposal objective, to enable the future urban development of that part of Lot 1 DP 127485 that is currently zoned 1(aH) Rural, where above the 1 in 100 year flood inundation level, for low-density residential housing, is therefore considered suitable. It is recommended that the Byron Local Environmental Plan 1988 Zoning Map be amended so that, where above the 1 in 100 year inundation level, land within Lot 1 DP 127485 is zoned 2(a) Residential (R2 Low Density Residential).

This conclusion has been supported by the Local Environmental Study undertaken to support the Byron Shire Council's Shire-wide Local Environmental Plan (PB, 2008).

That LES considered the proposed residential zoning of the land and provides the following recommendation:

"*It is recommended to zone Lot 1 DP 127485 Lismore Road, Bangalow to R2 Low Density Residential, RU1 Primary Production or RU2 Rural Landscape and E2 Environmental Conservation*"

Rezoning of the area of the site above the 1 in 100 year floodline is all that is required as part of this Gateway Process.

Rob van Iersel

Principal / Senior Planner

Appendix A

Flood Study

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MRG WATER CONSULTING PTY LTD

DETAILED FLOOD STUDY REPORT

Lot 1 DP 127485
LISMORE ROAD, BANGALOW

MARCH 2007

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Job No: 1162

Report Name	Date	Revision No.
Detailed Flood Study Report for Lot 1 DP 127485, Lismore Road, Bangalow	28 February 2007	1162/Rev 1
Detailed Flood Study Report for Lot 1 DP 127485, Lismore Road, Bangalow	30 March 2007	1162/Rev 2

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1.0 INTRODUCTION

MRG Water Consulting Pty Ltd was commissioned by Keith and Joan Daly to prepare a detailed flood study report for the proposed residential development at Lot 1 on DP127485, Lismore Road, Bangalow. The location of the proposed development is shown on Figure 1 below.

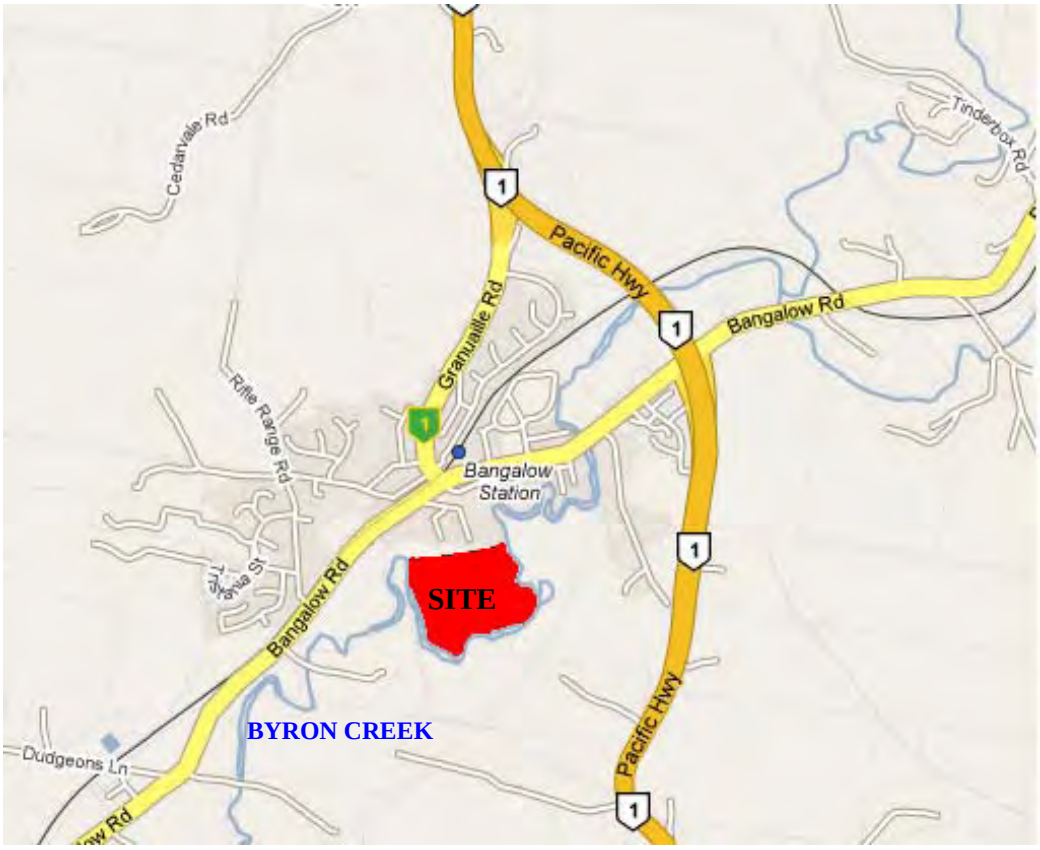


Figure 1 – Locality Plan

The site is used for rural purposes and is covered with grass and very few trees. The site slopes towards Byron Creek which forms the eastern, southern and western boundary of the site. Heavy vegetation lines the banks of Byron Creek.

It is proposed to develop the site as residential allotments. Two previous attempts have been made to determine the inundation and extent of the 1 in 100 year ARI flood (Q100). These previous reports have generally relied on historical information and no hydrologic or hydraulic modelling has been undertaken as a part of these.

The purpose of this report is to calculate the existing 100 year Average Recurrence Interval (ARI) and Probable Maximum Flood (PMF) design water levels across the site. This will be done by using a calibrated hydrologic and hydraulic model of the site and upstream catchment.

2.0 HYDROLOGY

2.1 RAFTS HYDROLOGIC MODEL

To calculate the discharge hydrographs in the waterway, a RAFTS hydrologic model was set up for the site and the upstream catchment.

RAFTS is a non-linear routing hydrologic model that calculates flood hydrographs from storm rainfall hyetographs. It can be used for the analysis and management of both urban and rural watersheds and the design of flood storages and river analysis works. RAFTS can also assist with the design of smaller urban drainage systems, on-site detention systems and large detention basins. A schematic representation of the RAFTS model layout for the site and upstream catchment is presented in Figure 2.

In setting up the RAFTS model it was found that the total upstream catchment was comprised of approximately 2560 hectares. Of this 65.66 ha was urban area, and the remaining 2494.34 ha was pervious rural area. Lag times between nodes were determined using a travel velocity of 0.3 m/s which was multiplied by the travel length of the creek.

Details of the RAFTS modelling and parameters can be found in Appendix B of this report.

3.0 HYDRAULIC MODELLING

3.1 GENERAL

To calculate the water levels for the existing site a MIKE11 hydraulic model was set up. MIKE11 is a professional engineering software package for the simulation of flows, rivers, channels and other water bodies. It is a dynamic, one-dimensional modelling tool for the detailed design, management and operation of both simple and complex river and channel systems.

The MIKE 11 model extended from the upstream property boundary to 565 m downstream of the site. Detailed cross section survey was provided by Canty's Surveyor's and maps showing 1m contours across the site were provided by Byron Shire Council. This survey data was used to extract cross sections along the waterway. Figure 3 shows the location of the MIKE 11 model cross sections on the site.

The calibrated discharge hydrograph from Subcatchment G in the RAFTS model was used as the upstream boundary condition of the model. The discharge from across the site was applied to the model between cross sections 2000 and 3487. The discharge hydrograph from Subcatchment J was applied to the model at cross section 3271.

Details of the MIKE11 modelling can be found in Appendix C of this report.

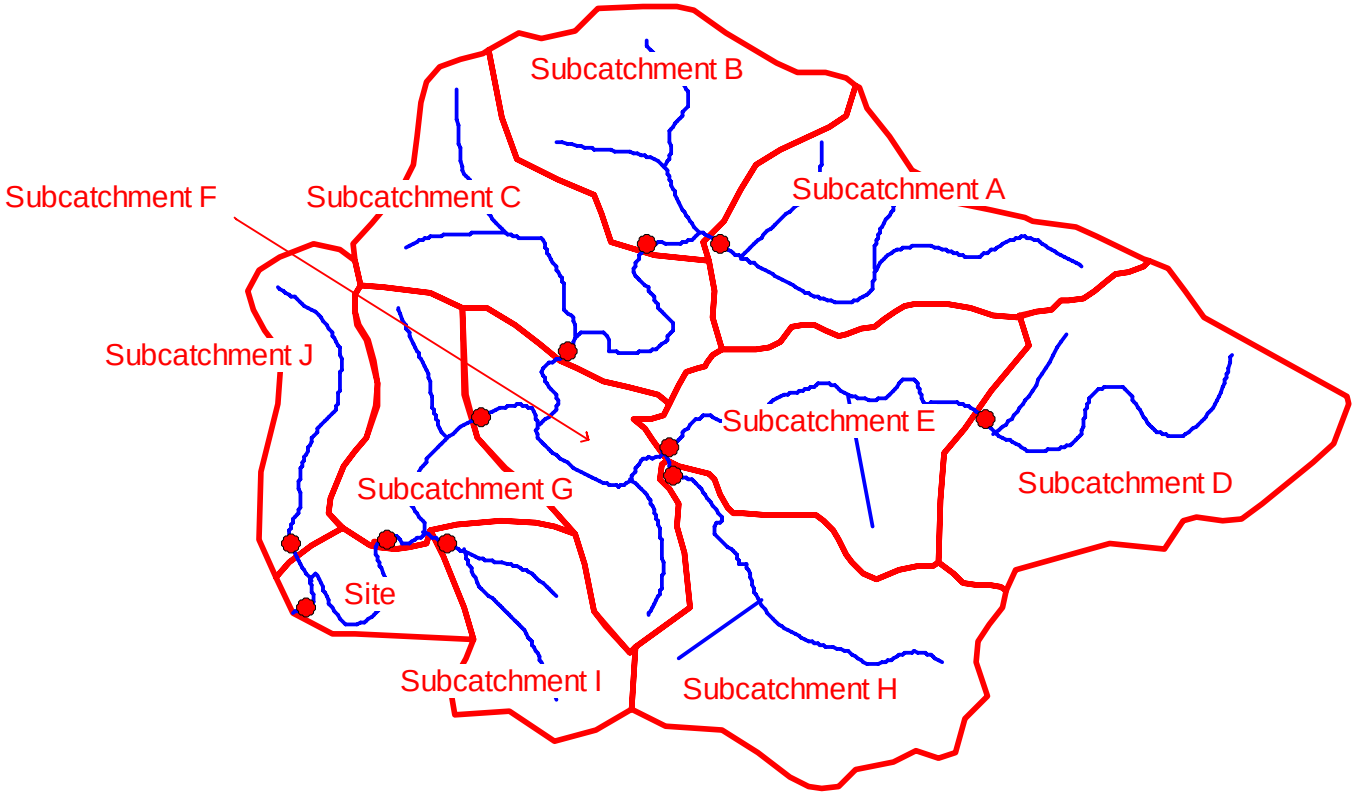


Figure 2 – RAFTS Model Layout, Scale 1:50 000 @ A4

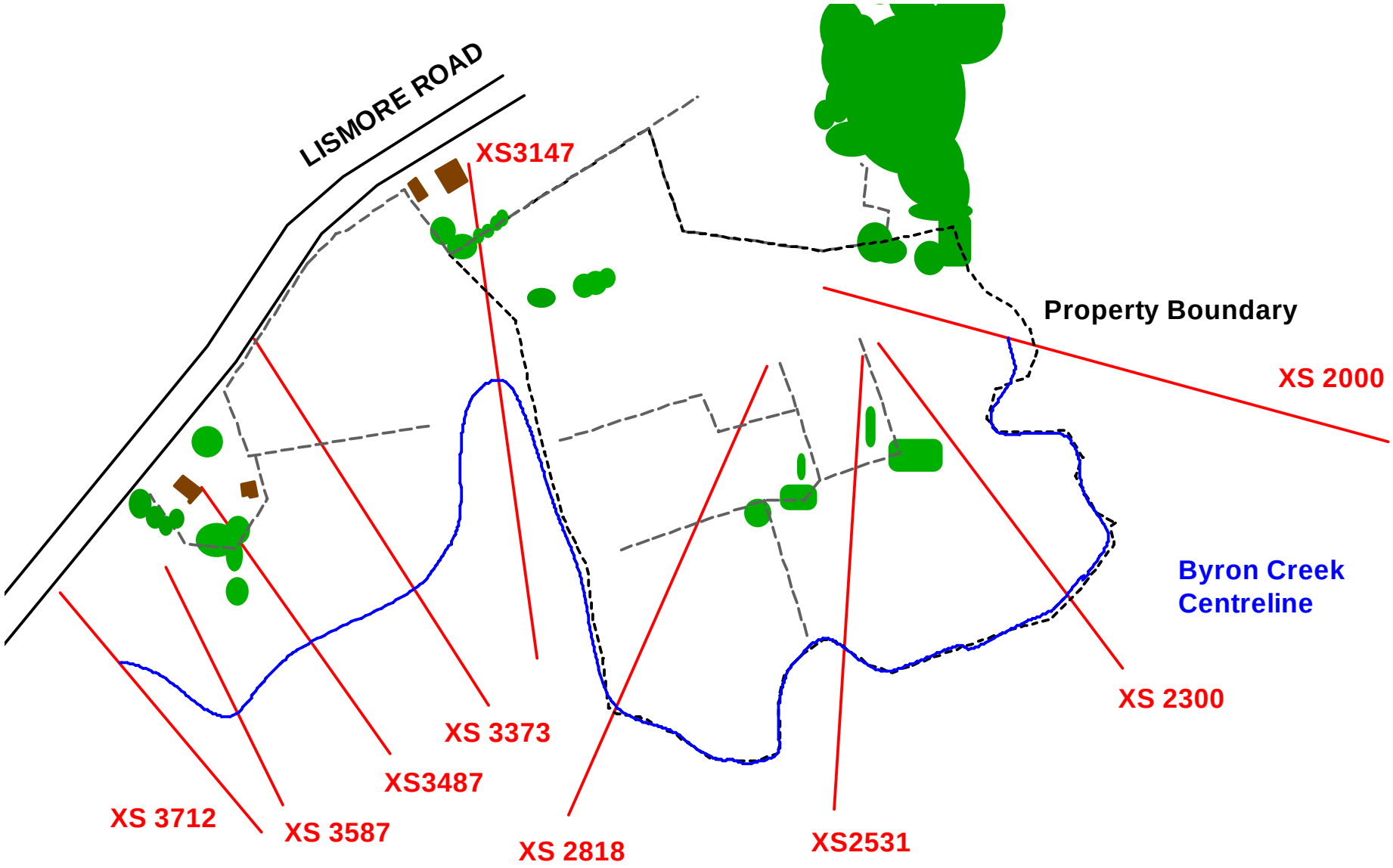


Figure 3 –Location of MIKE 11 Cross Sections, Scale 1:5000 @ A4

4.0 CALIBRATION EVENT – JANUARY 2006

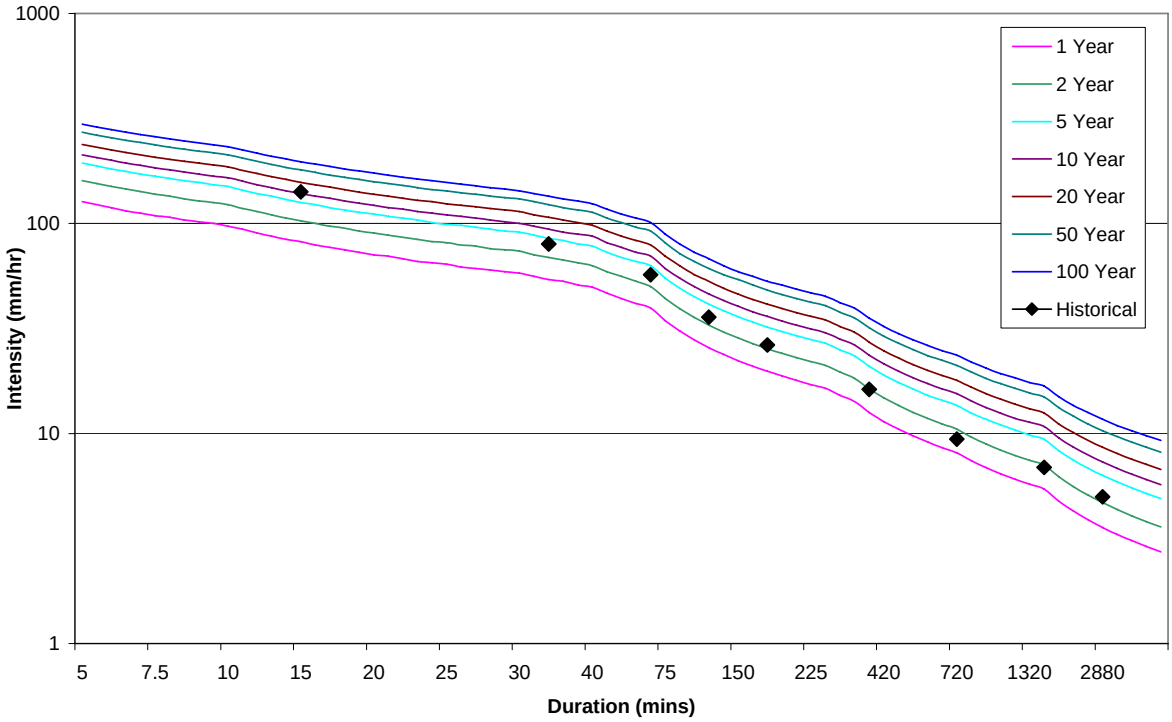
4.1 GENERAL

The hydrologic and hydraulic models were set up as accurately as possible, yet a large uncertainty remained in the storage coefficient (Bx) of the RAFTS model and the Manning's 'n' roughness and the tailwater conditions in the MIKE11 model. Calibration of these models to a historical rainfall event was desirable.

From the 18th to 20th January 2006, a large rainfall event occurred in the area. The Bureau of Meteorology provided rainfall records for this event from recording stations in Cape Byron, Lismore Airport and Ballina Airport. The Cape Byron data was the most complete and as it is located only 20 kms from the site, it was adopted for the calibration.

The total recorded rainfall was 244.6 mm at Cape Byron. The recorded rainfall was plotted against the Intensity-Duration-Frequency graph for Bangalow, as shown on Chart 4.0 below. The rainfall intensity varied between a 10 year and 2 year ARI event.

Chart 4.0 - Intensity-Duration -Frequency - Bangallow vrs Historical January 2006 Rainfall



The historical rainfall was entered into the RAFTS model of the catchment and then the model was run using a Bx factor of 1.0. Discharge hydrographs were exported into MIKE11 and the MIKE11 model was run.

Mr Keith Daly was able to identify where the water from Byron Creek had inundated his property during this January 2006 event, (approximately chainage 3147). This point was surveyed and found to be RL 41.98 m AHD.

The RAFTS Bx storage coefficient, the MIKE11 Manning's 'n' values and tailwater conditions were adjusted until the hydraulic model matched the historical water level at this point.

A water level of 42.0 m AHD was calculated in the MIKE11 model at chainage 3147, with a RAFTS model Bx factor of 0.5, MIKE11 model Mannings 'n' roughness of 0.1, 0.15 and 0.04 for creek base, creek banks and overbank areas respectively.

A height/discharge relationship was used as the downstream boundary condition. This relationship was automatically generated by MIKE11 using a downstream Manning's 'n' roughness of 0.08 and a downstream slope of 0.05%.

The calibration of the hydrologic and hydraulic model was considered satisfactory however calibration to more than one historical event would be preferable and may be possible in the future if more flood levels in Byron Creek are identified.

5.0 DESIGN 100 YEAR ARI DISCHARGE AND WATER LEVELS

5.1 RAFTS MODELLING – 100 YR ARI DISCHARGE

The calibrated RAFTS model was run for the 5 and 100 year ARI design storms for the 60 and 90 minute, and 2, 3, 4.5, 6, 9, 12, 18, 24, 36 and 48 hour rainfall events. The 12 hour storm was critical for both the 5 and 100 year ARI events.

As discussed in section 4.1 of the report, continuing losses of 2.5 and 0 mm/hr were used for the pervious and impervious subcatchments of the RAFTS model respectively. An initial loss of 0 and 1 mm was used for the pervious and impervious subcatchments respectively. Table 5.1 shows a summary of the RAFTS model parameters used in the calibration.

Table 5.1 – RAFTS Model Parameters

ARI (years)	Bx	Critical Storm Duration (hour)	Initial Pervious Loss (mm)	Continuing Pervious Loss (mm/hr)	Initial Impervious Loss (mm)	Continuing Impervious Loss (mm/hr)
5	0.5	12	0	2.5	1	0
100	0.5	12	0	2.5	1	0

The peak discharge for the 5 and 100 year ARI design events was 213.05 m^3/s and 384 .0m^3/s respectively. Details of the RAFTS modelling can be found in Appendix B of this report.

5.2 MIKE11 MODELLING – 100 YR ARI WATER LEVELS

The MIKE11 model of the waterway was run using the discharge hydrographs from the calibrated RAFTS model for the 5 and 100 year ARI design storms. It was found that the 9 hour and 2 hour storm was critical at different parts of the waterway. Extensive flooding occurs during the 100 year ARI event. Figure 4 shows the 100 year ARI inundation on the site and Table 5.2 shows the peak water levels for the 5 and 100 year ARI events on the existing site. It should be noted that Figure 4 only defines flood accurately on the site for illustration purposes, in reality the flooding is extensive on neighbouring properties to the south as well.

Table 5.2 – 5 and 100 year ARI Water Levels

MIKE11 Cross Section Location	5 yr ARI Water Level (m AHD)	100 yr ARI Water Level (m AHD)
2000	43.76	44.55
2300	43.36	44.17
2531	43.05	43.99
2818	42.84	43.86
3147	42.68	43.76
3373	42.59	43.71
3487	42.55	43.67
3587	42.52	43.64
3712	42.48	43.59

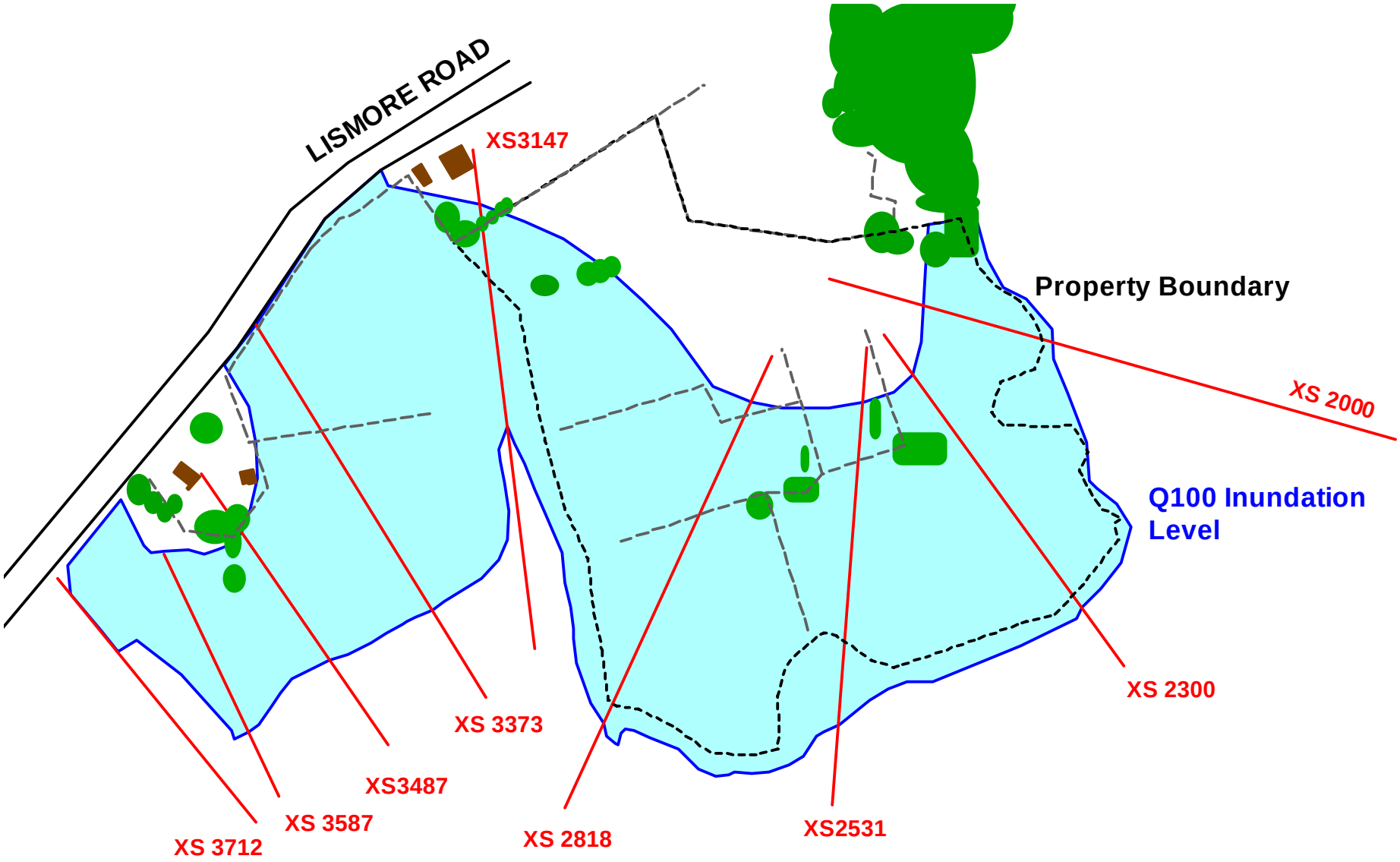


Figure 4 –100 Year ARI Inundation on the Existing Site, Scale 1:5000 @ A4

6.0 PROBABLE MAXIMUM PRECIPITATION (PMP) AND PROBABLE MAXIMUM FLOOD, (PMF)

6.1 GENERAL

The North Coast Regional Environmental Plan, (NSW, 2001) states that Council cannot rezone 'flood liable land' unless it is justified by a Floodplain Management Plan, prepared by Council in accordance with the Floodplain Management Manual. The Byron Shire Council has not prepared such a management plan for Byron Creek. However, advice from the NSW State Department of Planning indicates that the council can rezone 'flood liable land' on the basis of a flood study submitted by the applicant, if they have reviewed it in detail and are happy that it is consistent with the Floodplain Management Manual, (NSW, 2005).

NSW (2005) defines 'flood liable land' includes anything affected by the PMF or lower. Therefore the PMF needs to be identified on the site. This does not necessarily exclude residential development from between the AEP 1% level (Q100) and the PMF, but the flood study should provide a brief assessment of the risk to development in this area in terms of the potential to be affected by flooding. It is generally accepted that residential housing can occur with the PMF, but needs a freeboard (300 or 500mm above the 1% level).

6.2 PMP DEPTHS

The PMP rainfall depths were calculated using the methods described in the Commonwealth Bureau of Meteorology's The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method, (BOM, 2003).

Table 6.1 shows the calculated PMP rainfall depths. Details of these calculations can be found in Appendix A of this report.

Table 6.1 – PMP Rainfall Depths

Duration (hours)	PMP Rainfall Depths (mm)
0.3	160
0.5	240
0.8	300
1.0	350
1.5	440
2.0	500
2.5	560
3.0	600
4.0	680
5.0	750
6.0	800

6.3 RAFTS MODELLING – PMP

The PMP rainfall events were entered into the calibrated RAFTS model, with rainfall temporal patterns obtained from BOM, (2003). Spatial distribution of the rainfall was not used as the catchment is quite small and enclosed by only two spatial ellipses as specified in BOM (2003). The rainfall is considered to be slightly more conservative with this distribution.

The calibrated RAFTS model was run for the PMP design storms for the 30 and 60 minute, and 2, 3, 4 and 6 hour rainfall events. The 2 hour storm was found to be critical for the PMP storm events.

As discussed in section 4.1 of the report, continuing losses of 2.5 and 0 mm/hr were used for the pervious and impervious subcatchments of the RAFTS model respectively. An initial loss of 0 and 1 mm was used for the pervious and impervious subcatchments respectively. A B_x factor of 0.5 was used in the RAFTS modelling.

The peak discharge for the PMP 2 hour storm event was 1259.3 m^3/s. Details of the RAFTS modelling can be found in Appendix B of this report.

6.4 MIKE11 MODELLING – PMF WATER LEVELS

The MIKE11 model of the waterway was run using the discharge hydrographs for the PMF 2 hour design storm. Extreme flooding occurs during the PMF event. Figure 5 shows the PMF and the 100 year ARI inundation on the site to allow comparison. Table 6.2 shows the peak water levels for the PMF on the existing site. It should be noted that Figure 4 only defines flooding accurately on the site for illustration purposes, in reality the flooding is extensive on neighbouring properties to the south as well.

Table 6.2 – PMF Water Levels

MIKE11 Cross Section Location	PMF Water Level (m AHD)
2000	46.72
2300	46.59
2531	46.54
2818	46.48
3147	46.44
3373	46.40
3487	46.33
3587	46.28
3712	46.22

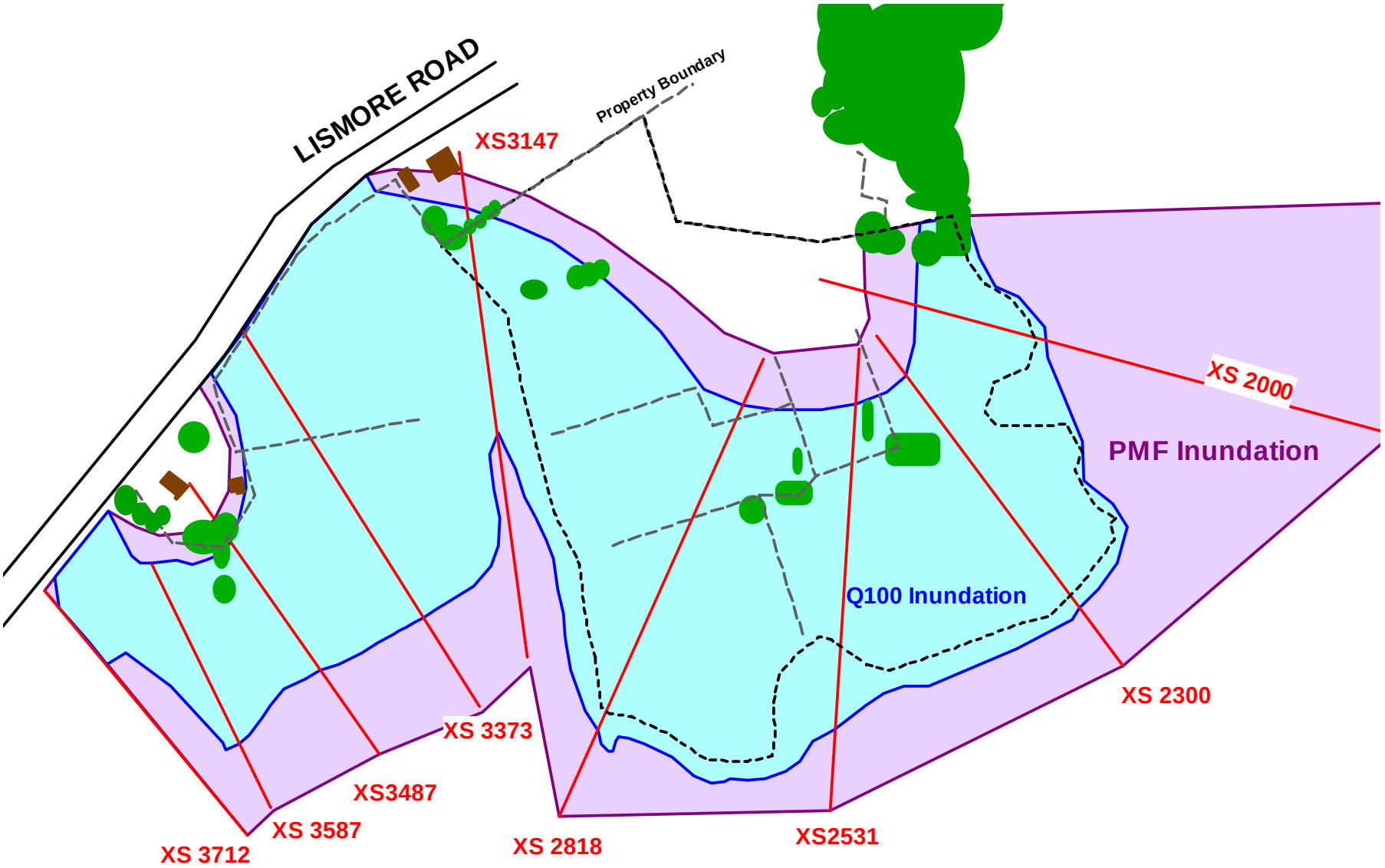


Figure 5 –PMF and 100 Year ARI Inundation on the Existing Site, Scale 1:5000 @ A4

7.0 MIKE11 MODELLING – DEVELOPED (MODIFIED) SITE

Close examination of the MIKE11 model cross sections XS 2818, XS 2531 and XS 2300 indicate that a small amount of earthworks would be beneficial to the development. On these cross sections, there is an area that has less than 0.3 m of water on it. By removing some mounded areas and moving the soil onto the flat low areas, some additional land can be reclaimed above the 100 year ARI level without increasing water levels. Appendix C shows the existing site scaled cross sections and the modifications to these cross sections proposed.

The MIKE11 model was run for the 100 year and PMF rainfall events to determine the impacts of the proposed earthworks on water levels and inundation. Figure 6 shows the changes in the 100 year ARI and PMF inundation on the site and Table 7.1 compares the peak water levels for the 100 year ARI and PMF events on the developed site. Figure 6 shows that the proposed modifications increase to area above the 100 year ARI water level on the site by 9286 m^2.

Table 7.1 – Comparison of 100 year ARI and PMF Water Levels – Existing and Developed Site

MIKE11 Cross Section Location	Water Level (m AHD)		Difference (m)	Water Level (m AHD)		Difference (m)
	100 yr ARI Existing	100 yr ARI Developed		PMF Existing	PMF Developed	
2000	44.55	44.51	-0.04	46.72	46.72	0.00
2300	44.17	44.13	-0.04	46.59	46.58	-0.01
2531	43.99	43.95	-0.04	46.54	46.53	-0.01
2818	43.86	43.84	-0.02	46.48	46.48	0.00
3147	43.75	43.76	+0.01	46.44	46.44	0.00
3373	43.71	43.72	+0.01	46.40	46.40	0.00
3487	43.67	43.68	+0.01	46.33	46.33	0.00
3587	43.64	43.65	+0.01	46.28	46.28	0.00
3712	43.59	43.60	+0.01	46.22	46.22	0.00

Table 7.1 shows that there is virtually no change in the PMF levels and changes in the 100 year ARI water levels of between -0.04 and +0.01 metres. These changes are considered to be minimal and the modifications are considered to be acceptable.

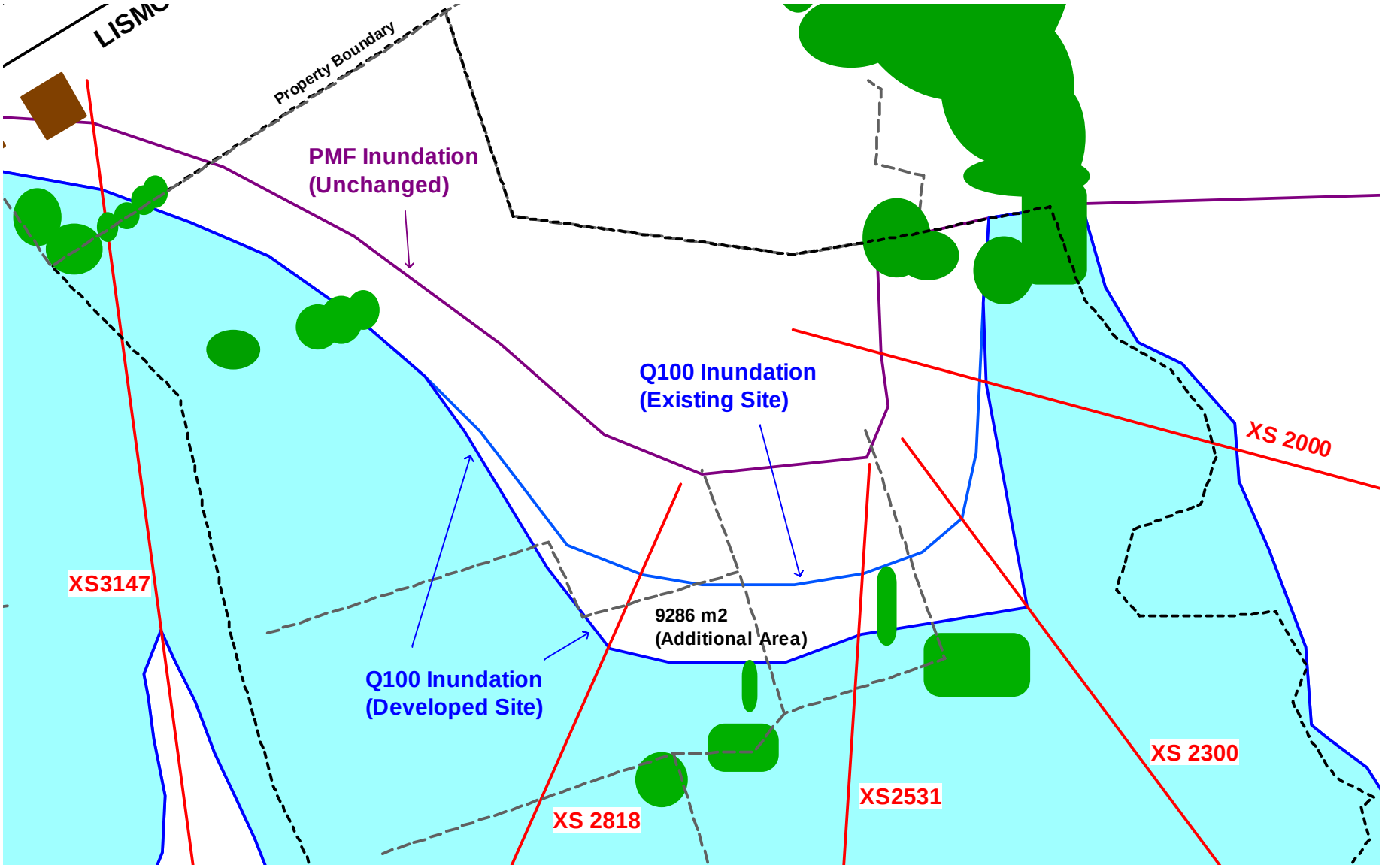


Figure 6 –Comparison of PMF and 100 Year ARI Inundation on Existing and Developed Site, Scale 1:2500 @ A4

8.0 CONCLUSIONS AND DISCUSSIONS

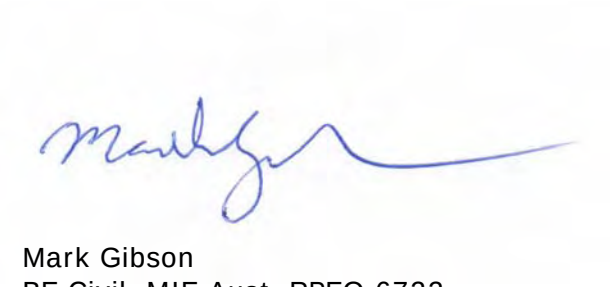
This report has defined the 100 year ARI and PMF water levels on the existing and proposed development site. This report has calculated that there is 3.49 ha of land, (approximately 40 allotments), proposed to be developed between the 100 year ARI and PMF water level.

All new allotments should be constructed above the 100 year ARI water levels specified in Table 7.1 (developed site) and new dwellings should be constructed with floor levels above the 100 year ARI levels plus 0.5 m freeboard.

This freeboard will give the dwellings flood immunities greater than a 100 year ARI but will not completely remove the risk of flooding.

During an event, greater than a 100 year ARI flood, none of the proposed development area becomes isolated or cut off from escape routes. Therefore the risk of loss of life is diminished.

It is acknowledged that there are areas which could improve the accuracy of this report, such as more surveyed cross sections across the site, additional historical flood levels and rainfall events to be included in the calibration and more investigation into upstream catchment dynamics. However, it is considered that the methodologies used and levels calculated in this report will be satisfactory to the Byron Shire Council and the NSW Department of Planning for the consideration of development of the site.



Mark Gibson
BE Civil, MIE Aust, RPEQ 6722

LIST OF APPENDICES

APPENDIX A

Rainfall Data

Rainfall Intensity for Bangalow, NSW

Duration	Average Recurrence Interval						
	1 Year (mm/hr)	2 Year (mm/hr)	5 Year (mm/hr)	10 Year (mm/hr)	20 Year (mm/hr)	50 Year (mm/hr)	100 Year (mm/hr)
5.0 m	127	160	194	212	238	272	297
5.5 m	123	155	188	206	231	263	288
6.0 m	119	150	182	200	224	256	280
6.5 m	115	146	177	194	218	249	272
7.0 m	112	142	172	189	212	243	265
7.5 m	109	138	168	184	207	237	259
8.0 m	107	135	164	180	202	231	253
8.5 m	104	131	160	176	198	226	247
9.0 m	102	128	157	172	194	221	242
9.5 m	100	126	153	168	190	217	237
10 m	97	123	150	165	186	212	232
11 m	94	118	144	159	179	205	224
12 m	90	114	139	153	173	198	216
13 m	87	110	135	148	167	191	209
14 m	84	106	130	143	162	185	203
15 m	82	103	126	139	157	180	197
16 m	79	100	123	135	153	175	192
17 m	77	97	119	132	149	170	187
18 m	75	95	116	128	145	166	182
19 m	73	92	113	125	141	162	178
20 m	71	90	111	122	138	158	174
21 m	70	88	108	119	135	155	170
22 m	68	86	106	117	132	152	166
23 m	66	84	104	114	129	148	163
24 m	65	82	101	112	127	145	160
25 m	64	81	99	110	124	143	157
26 m	62	79	98	108	122	140	154
27 m	61	78	96	106	120	138	151
28 m	60	76	94	104	118	135	148
29 m	59	75	92	102	116	133	146
30 m	58	74	91	100	114	131	143
32 m	56	71	88	97	110	127	139
34 m	54	69	85	94	107	123	135
36 m	53	67	83	91	104	119	131
38 m	51	65	80	89	101	116	128
40 m	49.7	63	78	87	98	113	124
45 m	46.6	59	73	81	92	106	117
50 m	43.9	56	69	77	87	101	111
55 m	41.6	53	66	73	83	96	106
60 m	39.6	50	63	70	79	92	101
75 m	34.5	44.0	55	61	70	81	89
90 m	30.8	39.3	49.2	55	63	72	80
105 m	27.9	35.7	44.8	50	57	66	73
120 m	25.6	32.8	41.3	46.2	53	61	68
135 m	23.8	30.4	38.4	43.0	49.1	57	63
150 m	22.2	28.5	36.0	40.3	46.1	54	59
165 m	20.9	26.8	33.9	38.0	43.5	51	56
180 m	19.8	25.3	32.1	36.1	41.3	48.2	53
195 m	18.8	24.1	30.6	34.3	39.4	45.9	51
210 m	17.9	23.0	29.2	32.8	37.6	43.9	48.7
225 m	17.1	22.0	28.0	31.5	36.1	42.2	46.8
240 m	16.4	21.1	26.9	30.2	34.7	40.6	45.0
270 m	15.2	19.6	25.0	28.1	32.3	37.8	42.0
5 h	14.2	18.3	23.4	26.4	30.3	35.5	39.5
6 h	12.6	16.3	20.9	23.6	27.2	31.9	35.5
7 h	11.4	14.8	19.0	21.5	24.8	29.1	32.4
8 h	10.5	13.6	17.5	19.8	22.9	26.9	29.9
9 h	9.74	12.6	16.3	18.4	21.3	25.1	27.9
10 h	9.11	11.8	15.2	17.3	20.0	23.5	26.3
11 h	8.57	11.1	14.4	16.3	18.9	22.3	24.8
12 h	8.10	10.5	13.6	15.5	17.9	21.1	23.6
14 h	7.42	9.61	12.5	14.3	16.6	19.6	21.9
16 h	6.88	8.92	11.7	13.3	15.5	18.3	20.5
18 h	6.43	8.35	11.0	12.5	14.6	17.3	19.3
20 h	6.05	7.86	10.4	11.8	13.8	16.4	18.4
22 h	5.73	7.45	9.83	11.3	13.1	15.6	17.5
24 h	5.44	7.09	9.37	10.8	12.5	14.9	16.8
30 h	4.77	6.23	8.29	9.53	11.1	13.3	15.0
36 h	4.28	5.59	7.47	8.62	10.1	12.1	13.6
42 h	3.89	5.09	6.84	7.90	9.28	11.1	12.6
48 h	3.57	4.69	6.32	7.32	8.61	10.3	11.7
54 h	3.31	4.35	5.88	6.82	8.04	9.67	10.9
60 h	3.09	4.06	5.51	6.40	7.55	9.10	10.3
66 h	2.90	3.81	5.19	6.04	7.13	8.60	9.75
72 h	2.73	3.59	4.90	5.71	6.75	8.16	9.26

The rainfall intensities shown above are calculated in accordance with Chapter 2, Australian Rainfall and Runoff - 1987 Edition.

Bangalow, NSW; 28.6831 South 153.53 East

28 February,2007

AUS-IFD
Ver 2.0, 2001

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*  Percentage complete between first and last records assumes 48 observation per
day.
   Some days there may be more then 48 reports if there have been significant
changes in
   the weather, so the percentage completeness is an estimate.

st,058216,58  ,BYRON BAY (CAPE BYRON AWS)              ,01/1994,        ,-28.6399,
153.6358,GPS            ,NSW,  95.0,  98.0,94599,2002,2007, 55,  0,100,  0,  0,  0,#
st,058198,58  ,BALLINA AIRPORT AWS                     ,11/1992,        ,-28.8353,
153.5585,GPS            ,NSW,   1.3,   2.2,94596,1999,2007, 51,  0,100,  0,  0,  0,#
st,058214,58  ,LISMORE AIRPORT AWS                     ,02/2002,        ,-28.8343,
153.2616,SURVEY         ,NSW,   8.7,   9.3,94572,2002,2007, 52,  0,100,  0,  0,  0,#
```

Cape Byron Data - January 2006

hm	Station	Hour24:Minutes	Day/Month/Year	in	DD/MM/YYYY HH24:MI	Adjusted Time Minutes	Adjusted Rainfall per hour
hm	58216	11:00	18-01-06	0:00	0	N	1:00	0
hm	58216	12:00	18-01-06	1:00	0	N	1:00	0
hm	58216	13:00	18-01-06	2:00	0	N	1:00	0
hm	58216	14:00	18-01-06	3:00	3.2	N	1:00	3.2
hm	58216	15:00	18-01-06	4:00	3.8	N	1:00	0.6
hm	58216	16:00	18-01-06	5:00	3.8	N	1:00	0
hm	58216	17:00	18-01-06	6:00	4	N	1:00	0.2
hm	58216	17:41	18-01-06	6:41	7.2	N	0:41	3.2
hm	58216	18:00	18-01-06	7:00	17	N	0:19	9.8
hm	58216	18:08	18-01-06	7:08	19.8	N	0:08	2.8
hm	58216	18:18	18-01-06	7:18	20.4	N	0:10	0.6
hm	58216	19:00	18-01-06	8:00	23.6	N	0:42	3.2
hm	58216	20:00	18-01-06	9:00	24.2	N	1:00	0.6
hm	58216	21:00	18-01-06	10:00	24.2	N	1:00	0
hm	58216	22:00	18-01-06	11:00	24.2	N	1:00	0
hm	58216	22:22	18-01-06	11:22	26.6	N	0:22	2.4
hm	58216	22:42	18-01-06	11:42	43.8	N	0:20	17.2
hm	58216	22:57	18-01-06	11:57	62	N	0:15	18.2
hm	58216	23:17	18-01-06	12:17	73.2	N	0:20	11.2
hm	58216	23:35	18-01-06	12:35	78.4	N	0:18	5.2
hm	58216	23:41	18-01-06	12:41	83.6	N	0:06	5.2
hm	58216	0:00	18-01-06	13:00	88	N	0:19	4.4
hm	58216	0:54	18-01-06	13:54	98.2	N	0:54	10.2
hm	58216	0:57	18-01-06	13:57	98.6	N	0:03	0.4
hm	58216	1:53	18-01-06	14:53	105.8	N	0:56	7.2
hm	58216	3:00	18-01-06	16:00	112.2	N	1:07	6.4
hm	58216	4:00	18-01-06	17:00	120.8	N	1:00	8.6
hm	58216	5:00	18-01-06	18:00	124	N	1:00	3.2
hm	58216	5:49	18-01-06	18:49	126.8	N	0:49	2.8
hm	58216	6:00	18-01-06	19:00	128	N	0:11	1.2
hm	58216	7:00	18-01-06	20:00	130.6	N	1:00	2.6
hm	58216	8:00	18-01-06	21:00	131.2	N	1:00	0.6
hm	58216	9:00	18-01-06	22:00	134.2	N	1:00	3
hm	58216	10:00	18-01-06	23:00	2.4	N	1:00	2.4
hm	58216	11:00	19-01-06	0:00	2.6	N	1:00	0.2
hm	58216	12:00	19-01-06	1:00	2.6	N	1:00	0
hm	58216	13:00	19-01-06	2:00	2.6	N	1:00	0
hm	58216	14:00	19-01-06	3:00	5.8	N	1:00	3.2
hm	58216	14:04	19-01-06	3:04	7.4	N	0:04	1.6
hm	58216	14:18	19-01-06	3:18	11	N	0:14	3.6
hm	58216	15:00	19-01-06	4:00	17.6	N	0:42	6.6
hm	58216	15:13	19-01-06	4:13	21.2	N	0:13	3.6
hm	58216	16:00	19-01-06	5:00	29	N	0:47	7.8
hm	58216	16:22	19-01-06	5:22	32.8	N	0:22	3.8
hm	58216	17:00	19-01-06	6:00	39	N	0:38	6.2
hm	58216	17:02	19-01-06	6:02	39.8	N	0:02	0.8
hm	58216	18:00	19-01-06	7:00	45.6	N	0:58	5.8
hm	58216	18:28	19-01-06	7:28	45.8	N	0:28	0.2
hm	58216	18:52	19-01-06	7:52	46.6	N	0:24	0.8
hm	58216	20:00	19-01-06	9:00	52.8	N	1:08	6.2
hm	58216	20:47	19-01-06	9:47	54.2	N	0:47	1.4
hm	58216	21:00	19-01-06	10:00	54.8	N	0:13	0.6
hm	58216	22:00	19-01-06	11:00	55.6	N	1:00	0.8
hm	58216	23:00	19-01-06	12:00	55.8	N	1:00	0.2
hm	58216	0:00	19-01-06	13:00	56.2	N	1:00	0.4
hm	58216	1:00	19-01-06	14:00	57	N	1:00	0.8
hm	58216	2:00	19-01-06	15:00	58.6	N	1:00	1.6
hm	58216	3:00	19-01-06	16:00	59.8	N	1:00	1.2
hm	58216	4:00	19-01-06	17:00	62.8	N	1:00	3
hm	58216	5:00	19-01-06	18:00	64.2	N	1:00	1.4
hm	58216	6:00	19-01-06	19:00	65.6	N	1:00	1.4
hm	58216	7:00	19-01-06	20:00	66	N	1:00	0.4
hm	58216	8:00	19-01-06	21:00	66.4	N	1:00	0.4
hm	58216	8:45	19-01-06	21:45	69.4	N	0:45	3
hm	58216	9:00	19-01-06	22:00	69.6	N	0:15	0.2
hm	58216	10:00	19-01-06	23:00	2.8	N	1:00	2.8
hm	58216	10:37	19-01-06	23:37	13.4	N	0:37	10.6
hm	58216	11:00	20-01-06	0:00	26.2	N	0:23	12.8
hm	58216	11:30	20-01-06	0:30	29.2	N	0:30	3
hm	58216	12:00	20-01-06	1:00	30.4	N	0:30	1.2
hm	58216	13:00	20-01-06	2:00	34.2	N	1:00	3.8
hm	58216	13:53	20-01-06	2:53	36	N	0:53	1.8
hm	58216	14:07	20-01-06	3:07	37.8	N	0:14	1.8
hm	58216	15:00	20-01-06	4:00	39.8	N	0:53	2
hm	58216	16:00	20-01-06	5:00	40.6	N	1:00	0.8
hm	58216	17:00	20-01-06	6:00	40.6	N	1:00	0
hm	58216	18:00	20-01-06	7:00	40.6	N	1:00	0

Cape Byron Data - January 2006

hm	58216	19:00	20-01-06	8:00	40.6	N	1:00	0
hm	58216	20:00	20-01-06	9:00	40.6	N	1:00	0
hm	58216	21:00	20-01-06	10:00	40.6	N	1:00	0
hm	58216	22:00	20-01-06	11:00	40.6	N	1:00	0
hm	58216	23:00	20-01-06	12:00	40.6	N	1:00	0
hm	58216	0:00	20-01-06	13:00	40.6	N	1:00	0
hm	58216	1:00	20-01-06	14:00	40.6	N	1:00	0
hm	58216	2:00	20-01-06	15:00	40.6	N	1:00	0
hm	58216	3:00	20-01-06	16:00	40.6	N	1:00	0
hm	58216	4:00	20-01-06	17:00	40.6	N	1:00	0
hm	58216	5:00	20-01-06	18:00	40.6	N	1:00	0
hm	58216	6:00	20-01-06	19:00	40.6	N	1:00	0
hm	58216	7:00	20-01-06	20:00	40.6	N	1:00	0
hm	58216	8:00	20-01-06	21:00	40.6	N	1:00	0
hm	58216	9:00	20-01-06	22:00	40.8	N	1:00	0.2
hm	58216	10:00	20-01-06	23:00	0	N	1:00	0
							244.6	

GSDM Calculation Sheet - PMP Byron Creek

Catchment	Byron Creek
Area	25.6 km2
State	NSW
Smooth	0.2
Rough	0.8
Mean Elevation	50-140
Adjustment for Elevation	0
EAF	1
MAF	0.825

PMP Values (mm)				
Duration (hours)	**Initial Depth - Smooth (Ds)**	**Initial Depth - Rough (DR)**	**PMP Estimate = (DsxS + DRxR) x MAF x EAF**	**Rounded PMP Estimate (Nearest 10 mm**
0.3	190	190	156.75	160
0.5	290	290	239.25	240
0.8	355	355	292.875	300
1.0	425	425	350.625	350
1.5	485	540	436.425	440
2.0	540	630	504.9	500
2.5	580	700	557.7	560
3.0	605	760	601.425	600
4.0	675	865	682.275	680
5.0	730	955	750.75	750
6.0	775	1015	797.775	800

APPENDIX B

RAFTS Model Details

Banaglow 100 yr
Run started at: 27th February 2007 13:51:35

##
#
RUNTIME RESULTS
##
#

Max. no. of links allowed = 2000

Max. no. of routng increments allowed = 25000

Max. no. of rating curve points = 25000

Max. no. of storm temporal points = 25000

Max. no. of channel subreaches = 25

Max link stack level = 25

Input Version number = 650

LINK J 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 140.7
ESTIMATED PEAK FLOW (CUMECS) = 78.44
ESTIMATED TIME TO PEAK (MINS) = 26.00

LINK D 2.000

ESTIMATED VOLUME (CU METRES*10**3) = 409.2
ESTIMATED PEAK FLOW (CUMECS) = 144.58
ESTIMATED TIME TO PEAK (MINS) = 36.00

LINK E 2.001

ESTIMATED VOLUME (CU METRES*10**3) = 720.6
ESTIMATED PEAK FLOW (CUMECS) = 271.08
ESTIMATED TIME TO PEAK (MINS) = 35.00

LINK A 3.000

ESTIMATED VOLUME (CU METRES*10**3) = 288.8
ESTIMATED PEAK FLOW (CUMECS) = 120.79
ESTIMATED TIME TO PEAK (MINS) = 32.00

LINK B 3.001

ESTIMATED VOLUME (CU METRES*10**3) = 575.5
ESTIMATED PEAK FLOW (CUMECS) = 237.56
ESTIMATED TIME TO PEAK (MINS) = 33.00

LINK C 3.002

```
 ESTIMATED VOLUME (CU METRES*10**3) =          871.7
 ESTIMATED PEAK FLOW         (CUMECS) =    267.33
 ESTIMATED TIME TO PEAK         (MINS) =     66.00

 LINK H                 4.000

 ESTIMATED VOLUME (CU METRES*10**3) =          366.8
 ESTIMATED PEAK FLOW         (CUMECS) =    145.65
 ESTIMATED TIME TO PEAK         (MINS) =     35.00

 LINK F                 2.002

 ESTIMATED VOLUME (CU METRES*10**3) =          2141.
 ESTIMATED PEAK FLOW         (CUMECS) =    369.72
 ESTIMATED TIME TO PEAK         (MINS) =    208.00

 LINK I                 5.000

 ESTIMATED VOLUME (CU METRES*10**3) =          155.9
 ESTIMATED PEAK FLOW         (CUMECS) =     79.49
 ESTIMATED TIME TO PEAK         (MINS) =     26.00

 LINK G                 2.003

 ESTIMATED VOLUME (CU METRES*10**3) =          1484.
 ESTIMATED PEAK FLOW         (CUMECS) =    276.22
 ESTIMATED TIME TO PEAK         (MINS) =    300.00

 LINK Site              1.001

 ESTIMATED VOLUME (CU METRES*10**3) =          1085.
 ESTIMATED PEAK FLOW         (CUMECS) =    236.44
 ESTIMATED TIME TO PEAK         (MINS) =    240.00



################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to 22: 0.0 18/ 1/2006
################################################################################
#


                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =        60.
                              RETURN PERIOD (YRS)      =       100.
                              BX                       =     0.5000
                              TOTAL OF FIRST SUB-AREAS  (ha) =    2494.87
                              TOTAL OF SECOND SUB-AREAS (ha) =      65.66
                              TOTAL OF ALL SUB-AREAS (ha)    =    2560.53


     SUMMARY OF CATCHMENT AND RAINFALL DATA
 Link      Catch. Area      Slope    % Impervious     Pern         B        Link
 Label      #1     #2     #1    #2      #1   #2     #1    #2    #1   #2     No.
             (ha)             (%)          (%)
J         109.04 23.760  13.50 10.00  0.000 0.000  .060 .025  .0786 .0214  1.000
```

D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	108.23	0.000	1.000	2.500	0.000	105.73	107.23	78.436	26.00	0.000
D	108.23	0.000	0.000	2.500	0.000	105.73	0.000	144.58	36.00	0.000
E	108.23	0.000	0.000	2.500	0.000	105.73	0.000	271.08	35.00	177.0
A	108.23	0.000	0.000	2.500	0.000	105.73	0.000	120.79	32.00	0.000
B	108.23	0.000	0.000	2.500	0.000	105.73	0.000	237.56	33.00	35.00
C	108.23	0.000	0.000	2.500	0.000	105.73	0.000	267.33	66.00	115.0
H	108.23	0.000	0.000	2.500	0.000	105.73	0.000	145.65	35.00	0.000
F	108.23	0.000	0.000	2.500	0.000	105.73	0.000	369.72	208.0	109.0
I	108.23	0.000	0.000	2.500	0.000	105.73	0.000	79.491	26.00	0.000
G	108.23	0.000	1.000	2.500	0.000	105.73	107.23	276.22	300.0	100.0
Site	108.23	0.000	1.000	2.500	0.000	105.73	107.23	236.44	240.0	0.000

LINK J 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 166.5
ESTIMATED PEAK FLOW (CUMECS) = 61.51
ESTIMATED TIME TO PEAK (MINS) = 36.00

LINK D 2.000

ESTIMATED VOLUME (CU METRES*10**3) = 484.4
ESTIMATED PEAK FLOW (CUMECS) = 136.24
ESTIMATED TIME TO PEAK (MINS) = 41.00

LINK E 2.001

```
 ESTIMATED VOLUME (CU METRES*10**3) =          853.0
 ESTIMATED PEAK FLOW         (CUMECS) =    254.42
 ESTIMATED TIME TO PEAK         (MINS) =     41.00

 LINK A                3.000

 ESTIMATED VOLUME (CU METRES*10**3) =          341.9
 ESTIMATED PEAK FLOW         (CUMECS) =    110.70
 ESTIMATED TIME TO PEAK         (MINS) =     40.00

 LINK B                3.001

 ESTIMATED VOLUME (CU METRES*10**3) =          681.0
 ESTIMATED PEAK FLOW         (CUMECS) =    218.67
 ESTIMATED TIME TO PEAK         (MINS) =     41.00

 LINK C                3.002

 ESTIMATED VOLUME (CU METRES*10**3) =          1032.
 ESTIMATED PEAK FLOW         (CUMECS) =    263.30
 ESTIMATED TIME TO PEAK         (MINS) =     75.00

 LINK H                4.000

 ESTIMATED VOLUME (CU METRES*10**3) =          434.4
 ESTIMATED PEAK FLOW         (CUMECS) =    135.38
 ESTIMATED TIME TO PEAK         (MINS) =     41.00

 LINK F                2.002

 ESTIMATED VOLUME (CU METRES*10**3) =          2556.
 ESTIMATED PEAK FLOW         (CUMECS) =    378.25
 ESTIMATED TIME TO PEAK         (MINS) =    217.00

 LINK I                5.000

 ESTIMATED VOLUME (CU METRES*10**3) =          184.4
 ESTIMATED PEAK FLOW         (CUMECS) =     65.34
 ESTIMATED TIME TO PEAK         (MINS) =     40.00

 LINK G                2.003

 ESTIMATED VOLUME (CU METRES*10**3) =          2922.
 ESTIMATED PEAK FLOW         (CUMECS) =    378.26
 ESTIMATED TIME TO PEAK         (MINS) =    326.00

 LINK Site             1.001

 ESTIMATED VOLUME (CU METRES*10**3) =          2806.
 ESTIMATED PEAK FLOW         (CUMECS) =    378.27
 ESTIMATED TIME TO PEAK         (MINS) =    426.00



################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to  0:30.0 19/ 1/2006
################################################################################
#
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Banaglow 100 yr

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 90.
RETURN PERIOD (YRS) = 100.
BX = 0.5000
TOTAL OF FIRST SUB-AREAS (ha) = 2494.87
TOTAL OF SECOND SUB-AREAS (ha) = 65.66
TOTAL OF ALL SUB-AREAS (ha) = 2560.53

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	85.833	0.000	1.000	2.500	0.000	125.00	127.75	61.510	36.00	0.000
D	85.833	0.000	0.000	2.500	0.000	125.00	0.000	136.24	41.00	0.000
E	85.833	0.000	0.000	2.500	0.000	125.00	0.000	254.42	41.00	177.0
A	85.833	0.000	0.000	2.500	0.000	125.00	0.000	110.70	40.00	0.000
B	85.833	0.000	0.000	2.500	0.000	125.00	0.000	218.67	41.00	35.00
C	85.833	0.000	0.000	2.500	0.000	125.00	0.000	263.30	75.00	115.0
H	85.833	0.000	0.000	2.500	0.000	125.00	0.000	135.38	41.00	0.000
F	85.833	0.000	0.000	2.500	0.000	125.00	0.000	378.25	217.0	109.0
I	85.833	0.000	0.000	2.500	0.000	125.00	0.000	65.342	40.00	0.000
G	85.833	0.000	1.000	2.500	0.000	125.00	127.75	378.26	326.0	100.0
Site	85.833	0.000	1.000	2.500	0.000	125.00	127.75	378.27	426.0	0.000

LINK J 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 187.0
ESTIMATED PEAK FLOW (CUMECS) = 57.79
ESTIMATED TIME TO PEAK (MINS) = 37.00

LINK D 2.000

ESTIMATED VOLUME (CU METRES*10**3) = 544.0
ESTIMATED PEAK FLOW (CUMECS) = 130.68
ESTIMATED TIME TO PEAK (MINS) = 46.00

LINK E 2.001

ESTIMATED VOLUME (CU METRES*10**3) = 957.7
ESTIMATED PEAK FLOW (CUMECS) = 241.27
ESTIMATED TIME TO PEAK (MINS) = 45.00

LINK A 3.000

ESTIMATED VOLUME (CU METRES*10**3) = 383.7
ESTIMATED PEAK FLOW (CUMECS) = 103.83
ESTIMATED TIME TO PEAK (MINS) = 45.00

LINK B 3.001

ESTIMATED VOLUME (CU METRES*10**3) = 764.4
ESTIMATED PEAK FLOW (CUMECS) = 205.51
ESTIMATED TIME TO PEAK (MINS) = 45.00

LINK C 3.002

ESTIMATED VOLUME (CU METRES*10**3) = 1158.
ESTIMATED PEAK FLOW (CUMECS) = 252.93
ESTIMATED TIME TO PEAK (MINS) = 77.00

LINK H 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 487.2
ESTIMATED PEAK FLOW (CUMECS) = 127.90
ESTIMATED TIME TO PEAK (MINS) = 45.00

LINK F 2.002

ESTIMATED VOLUME (CU METRES*10**3) = 2871.
ESTIMATED PEAK FLOW (CUMECS) = 383.96
ESTIMATED TIME TO PEAK (MINS) = 219.00

LINK I 5.000

ESTIMATED VOLUME (CU METRES*10**3) = 206.9
ESTIMATED PEAK FLOW (CUMECS) = 61.41
ESTIMATED TIME TO PEAK (MINS) = 41.00

LINK G 2.003

ESTIMATED VOLUME (CU METRES*10**3) = 3295.
ESTIMATED PEAK FLOW (CUMECS) = 383.99
ESTIMATED TIME TO PEAK (MINS) = 328.00

Banaglow 100 yr

LINK Site 1.001

ESTIMATED VOLUME (CU METRES*10**3) = 3577.
ESTIMATED PEAK FLOW (CUMECS) = 384.00
ESTIMATED TIME TO PEAK (MINS) = 428.00

##
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
to 3: 0.0 19/ 1/2006
##
#

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 120.
RETURN PERIOD (YRS) = 100.
BX = 0.5000
TOTAL OF FIRST SUB-AREAS (ha) = 2494.87
TOTAL OF SECOND SUB-AREAS (ha) = 65.66
TOTAL OF ALL SUB-AREAS (ha) = 2560.53

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	72.567	0.000	1.000	2.500	0.000	140.13	144.13	57.792	37.00	0.000
D	72.567	0.000	0.000	2.500	0.000	140.13	0.000	130.68	46.00	0.000

E	72.567	0.000	0.000	2.500	0.000	140.13	0.000	241.27	45.00	177.0
A	72.567	0.000	0.000	2.500	0.000	140.13	0.000	103.83	45.00	0.000
B	72.567	0.000	0.000	2.500	0.000	140.13	0.000	205.51	45.00	35.00
C	72.567	0.000	0.000	2.500	0.000	140.13	0.000	252.93	77.00	115.0
H	72.567	0.000	0.000	2.500	0.000	140.13	0.000	127.90	45.00	0.000
F	72.567	0.000	0.000	2.500	0.000	140.13	0.000	383.96	219.0	109.0
I	72.567	0.000	0.000	2.500	0.000	140.13	0.000	61.409	41.00	0.000
G	72.567	0.000	1.000	2.500	0.000	140.13	144.13	383.99	328.0	100.0
Site	72.567	0.000	1.000	2.500	0.000	140.13	144.13	384.00	428.0	0.000

LINK J 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 219.1
ESTIMATED PEAK FLOW (CUMECS) = 50.58
ESTIMATED TIME TO PEAK (MINS) = 60.00

LINK D 2.000

ESTIMATED VOLUME (CU METRES*10**3) = 636.6
ESTIMATED PEAK FLOW (CUMECS) = 117.44
ESTIMATED TIME TO PEAK (MINS) = 61.00

LINK E 2.001

ESTIMATED VOLUME (CU METRES*10**3) = 1121.
ESTIMATED PEAK FLOW (CUMECS) = 214.31
ESTIMATED TIME TO PEAK (MINS) = 61.00

LINK A 3.000

ESTIMATED VOLUME (CU METRES*10**3) = 448.9
ESTIMATED PEAK FLOW (CUMECS) = 90.32
ESTIMATED TIME TO PEAK (MINS) = 61.00

LINK B 3.001

ESTIMATED VOLUME (CU METRES*10**3) = 894.2
ESTIMATED PEAK FLOW (CUMECS) = 178.87
ESTIMATED TIME TO PEAK (MINS) = 61.00

LINK C 3.002

ESTIMATED VOLUME (CU METRES*10**3) = 1355.
ESTIMATED PEAK FLOW (CUMECS) = 223.29
ESTIMATED TIME TO PEAK (MINS) = 95.00

LINK H 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 570.2
ESTIMATED PEAK FLOW (CUMECS) = 111.79
ESTIMATED TIME TO PEAK (MINS) = 61.00

LINK F 2.002

```
 ESTIMATED VOLUME (CU METRES*10**3) =          3360.
 ESTIMATED PEAK FLOW         (CUMECS) =    351.55
 ESTIMATED TIME TO PEAK         (MINS) =    237.00

 LINK I                5.000

 ESTIMATED VOLUME (CU METRES*10**3) =           242.0
 ESTIMATED PEAK FLOW         (CUMECS) =     53.59
 ESTIMATED TIME TO PEAK         (MINS) =     60.00

 LINK G                2.003

 ESTIMATED VOLUME (CU METRES*10**3) =          3858.
 ESTIMATED PEAK FLOW         (CUMECS) =    351.61
 ESTIMATED TIME TO PEAK         (MINS) =    346.00

 LINK Site             1.001

 ESTIMATED VOLUME (CU METRES*10**3) =          4198.
 ESTIMATED PEAK FLOW         (CUMECS) =    351.62
 ESTIMATED TIME TO PEAK         (MINS) =    446.00
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################################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to  8: 0.0 19/ 1/2006
################################################################################################
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                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =       180.
                              RETURN PERIOD (YRS)      =       100.
                              BX                       =     0.5000
                              TOTAL OF FIRST SUB-AREAS  (ha) =    2494.87
                              TOTAL OF SECOND SUB-AREAS (ha) =      65.66
                              TOTAL OF ALL SUB-AREAS (ha)    =    2560.53
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000

F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	57.123	0.000	1.000	2.500	0.000	163.87	170.37	50.583	60.00	0.000
D	57.123	0.000	0.000	2.500	0.000	163.87	0.000	117.44	61.00	0.000
E	57.123	0.000	0.000	2.500	0.000	163.87	0.000	214.31	61.00	177.0
A	57.123	0.000	0.000	2.500	0.000	163.87	0.000	90.320	61.00	0.000
B	57.123	0.000	0.000	2.500	0.000	163.87	0.000	178.87	61.00	35.00
C	57.123	0.000	0.000	2.500	0.000	163.87	0.000	223.29	95.00	115.0
H	57.123	0.000	0.000	2.500	0.000	163.87	0.000	111.79	61.00	0.000
F	57.123	0.000	0.000	2.500	0.000	163.87	0.000	351.55	237.0	109.0
I	57.123	0.000	0.000	2.500	0.000	163.87	0.000	53.590	60.00	0.000
G	57.123	0.000	1.000	2.500	0.000	163.87	170.37	351.61	346.0	100.0
Site	57.123	0.000	1.000	2.500	0.000	163.87	170.37	351.62	446.0	0.000

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 LINK J                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =          255.8
 ESTIMATED PEAK FLOW         (CUMECS) =     46.95
 ESTIMATED TIME TO PEAK         (MINS) =     60.00

 LINK D                2.000

 ESTIMATED VOLUME (CU METRES*10**3) =          741.2
 ESTIMATED PEAK FLOW         (CUMECS) =    113.68
 ESTIMATED TIME TO PEAK         (MINS) =     61.00

 LINK E                2.001

 ESTIMATED VOLUME (CU METRES*10**3) =          1305.
 ESTIMATED PEAK FLOW         (CUMECS) =    208.16
 ESTIMATED TIME TO PEAK         (MINS) =     61.00

 LINK A                3.000

 ESTIMATED VOLUME (CU METRES*10**3) =          522.8
 ESTIMATED PEAK FLOW         (CUMECS) =     88.42
 ESTIMATED TIME TO PEAK         (MINS) =     60.00

 LINK B                3.001
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 ESTIMATED VOLUME (CU METRES*10**3) =          1041.
 ESTIMATED PEAK FLOW         (CUMECS) =    175.11
 ESTIMATED TIME TO PEAK         (MINS) =     60.00

 LINK C                 3.002

 ESTIMATED VOLUME (CU METRES*10**3) =          1578.
 ESTIMATED PEAK FLOW         (CUMECS) =    216.81
 ESTIMATED TIME TO PEAK         (MINS) =     95.00

 LINK H                 4.000

 ESTIMATED VOLUME (CU METRES*10**3) =          664.1
 ESTIMATED PEAK FLOW         (CUMECS) =    109.32
 ESTIMATED TIME TO PEAK         (MINS) =     60.00

 LINK F                 2.002

 ESTIMATED VOLUME (CU METRES*10**3) =          3913.
 ESTIMATED PEAK FLOW         (CUMECS) =    362.31
 ESTIMATED TIME TO PEAK         (MINS) =    237.00

 LINK I                 5.000

 ESTIMATED VOLUME (CU METRES*10**3) =          281.8
 ESTIMATED PEAK FLOW         (CUMECS) =     50.90
 ESTIMATED TIME TO PEAK         (MINS) =     60.00

 LINK G                 2.003

 ESTIMATED VOLUME (CU METRES*10**3) =          4494.
 ESTIMATED PEAK FLOW         (CUMECS) =    362.71
 ESTIMATED TIME TO PEAK         (MINS) =    346.00

 LINK Site              1.001

 ESTIMATED VOLUME (CU METRES*10**3) =          4892.
 ESTIMATED PEAK FLOW         (CUMECS) =    362.75
 ESTIMATED TIME TO PEAK         (MINS) =    446.00
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################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to 15:30.0 19/ 1/2006
################################################################################
#
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ROUTING INCREMENT (MINS)	=	1.00
STORM DURATION (MINS)	=	270.
RETURN PERIOD (YRS)	=	100.
BX	=	0.5000
TOTAL OF FIRST SUB-AREAS (ha)	=	2494.87
TOTAL OF SECOND SUB-AREAS (ha)	=	65.66
TOTAL OF ALL SUB-AREAS (ha)	=	2560.53

Banaglow 100 yr

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	44.916	0.000	1.000	2.500	0.000	190.87	201.12	46.954	60.00	0.000
D	44.916	0.000	0.000	2.500	0.000	190.87	0.000	113.68	61.00	0.000
E	44.916	0.000	0.000	2.500	0.000	190.87	0.000	208.16	61.00	177.0
A	44.916	0.000	0.000	2.500	0.000	190.87	0.000	88.422	60.00	0.000
B	44.916	0.000	0.000	2.500	0.000	190.87	0.000	175.11	60.00	35.00
C	44.916	0.000	0.000	2.500	0.000	190.87	0.000	216.81	95.00	115.0
H	44.916	0.000	0.000	2.500	0.000	190.87	0.000	109.32	60.00	0.000
F	44.916	0.000	0.000	2.500	0.000	190.87	0.000	362.31	237.0	109.0
I	44.916	0.000	0.000	2.500	0.000	190.87	0.000	50.898	60.00	0.000
G	44.916	0.000	1.000	2.500	0.000	190.87	201.12	362.71	346.0	100.0
Site	44.916	0.000	1.000	2.500	0.000	190.87	201.12	362.75	446.0	0.000

LINK J 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 285.1
ESTIMATED PEAK FLOW (CUMECS) = 37.43
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK D 2.000

ESTIMATED VOLUME (CU METRES*10**3) = 824.4

ESTIMATED PEAK FLOW (CUMECS) = 101.70
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK E 2.001

ESTIMATED VOLUME (CU METRES*10**3) = 1451.
ESTIMATED PEAK FLOW (CUMECS) = 182.40
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK A 3.000

ESTIMATED VOLUME (CU METRES*10**3) = 581.4
ESTIMATED PEAK FLOW (CUMECS) = 75.07
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK B 3.001

ESTIMATED VOLUME (CU METRES*10**3) = 1158.
ESTIMATED PEAK FLOW (CUMECS) = 149.13
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK C 3.002

ESTIMATED VOLUME (CU METRES*10**3) = 1755.
ESTIMATED PEAK FLOW (CUMECS) = 174.51
ESTIMATED TIME TO PEAK (MINS) = 125.00

LINK H 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 738.7
ESTIMATED PEAK FLOW (CUMECS) = 94.26
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK F 2.002

ESTIMATED VOLUME (CU METRES*10**3) = 4352.
ESTIMATED PEAK FLOW (CUMECS) = 327.50
ESTIMATED TIME TO PEAK (MINS) = 241.00

LINK I 5.000

ESTIMATED VOLUME (CU METRES*10**3) = 313.4
ESTIMATED PEAK FLOW (CUMECS) = 41.38
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK G 2.003

ESTIMATED VOLUME (CU METRES*10**3) = 5000.
ESTIMATED PEAK FLOW (CUMECS) = 337.63
ESTIMATED TIME TO PEAK (MINS) = 350.00

LINK Site 1.001

ESTIMATED VOLUME (CU METRES*10**3) = 5442.
ESTIMATED PEAK FLOW (CUMECS) = 337.83
ESTIMATED TIME TO PEAK (MINS) = 450.00

Results for period from 17: 0.0 18/ 1/2006
to 23: 0.0 19/ 1/2006

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ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 360.
RETURN PERIOD (YRS) = 100.
BX = 0.5000
TOTAL OF FIRST SUB-AREAS (ha) = 2494.87
TOTAL OF SECOND SUB-AREAS (ha) = 65.66
TOTAL OF ALL SUB-AREAS (ha) = 2560.53

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area (ha) #1	#2	Slope (%) #1	#2	% Impervious (%) #1	#2	Pern #1	#2	B #1	#2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	#2	Cont. Loss #1 (mm/h)	#2	Excess Rain #1 (mm)	#2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	37.879	0.000	1.000	2.500	0.000	212.27	226.27	37.427	90.00	0.000
D	37.879	0.000	0.000	2.500	0.000	212.27	0.000	101.70	90.00	0.000
E	37.879	0.000	0.000	2.500	0.000	212.27	0.000	182.40	90.00	177.0
A	37.879	0.000	0.000	2.500	0.000	212.27	0.000	75.069	90.00	0.000
B	37.879	0.000	0.000	2.500	0.000	212.27	0.000	149.13	90.00	35.00
C	37.879	0.000	0.000	2.500	0.000	212.27	0.000	174.51	125.0	115.0
H	37.879	0.000	0.000	2.500	0.000	212.27	0.000	94.261	90.00	0.000
F	37.879	0.000	0.000	2.500	0.000	212.27	0.000	327.50	241.0	109.0

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I         37.879 0.000 0.000  2.500 0.000  212.27  0.000  41.376  90.00 0.000

G         37.879 0.000 1.000  2.500 0.000  212.27 226.27  337.63  350.0 100.0

Site      37.879 0.000 1.000  2.500 0.000  212.27 226.27  337.83  450.0 0.000


 LINK J                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =          331.5
 ESTIMATED PEAK FLOW         (CUMECS) =     37.40
 ESTIMATED TIME TO PEAK         (MINS) =     90.00

 LINK D                2.000

 ESTIMATED VOLUME (CU METRES*10**3) =          954.7
 ESTIMATED PEAK FLOW         (CUMECS) =    100.81
 ESTIMATED TIME TO PEAK         (MINS) =     90.00

 LINK E                2.001

 ESTIMATED VOLUME (CU METRES*10**3) =          1681.
 ESTIMATED PEAK FLOW         (CUMECS) =    181.05
 ESTIMATED TIME TO PEAK         (MINS) =     90.00

 LINK A                3.000

 ESTIMATED VOLUME (CU METRES*10**3) =          673.3
 ESTIMATED PEAK FLOW         (CUMECS) =     74.68
 ESTIMATED TIME TO PEAK         (MINS) =     90.00

 LINK B                3.001

 ESTIMATED VOLUME (CU METRES*10**3) =          1341.
 ESTIMATED PEAK FLOW         (CUMECS) =    148.29
 ESTIMATED TIME TO PEAK         (MINS) =     90.00

 LINK C                3.002

 ESTIMATED VOLUME (CU METRES*10**3) =          2032.
 ESTIMATED PEAK FLOW         (CUMECS) =    167.51
 ESTIMATED TIME TO PEAK         (MINS) =    125.00

 LINK H                4.000

 ESTIMATED VOLUME (CU METRES*10**3) =          855.3
 ESTIMATED PEAK FLOW         (CUMECS) =     93.60
 ESTIMATED TIME TO PEAK         (MINS) =     90.00

 LINK F                2.002

 ESTIMATED VOLUME (CU METRES*10**3) =          5039.
 ESTIMATED PEAK FLOW         (CUMECS) =    307.04
 ESTIMATED TIME TO PEAK         (MINS) =    241.00

 LINK I                5.000

 ESTIMATED VOLUME (CU METRES*10**3) =          363.0
 ESTIMATED PEAK FLOW         (CUMECS) =     41.33
 ESTIMATED TIME TO PEAK         (MINS) =     90.00

 LINK G                2.003
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 ESTIMATED VOLUME (CU METRES*10**3) =           5792.
 ESTIMATED PEAK FLOW         (CUMECS) =    352.32
 ESTIMATED TIME TO PEAK         (MINS) =    350.00

 LINK Site              1.001

 ESTIMATED VOLUME (CU METRES*10**3) =           6306.
 ESTIMATED PEAK FLOW         (CUMECS) =    357.21
 ESTIMATED TIME TO PEAK         (MINS) =    450.00
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################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to 14: 0.0 20/ 1/2006
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                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =       540.
                              RETURN PERIOD (YRS)      =       100.
                              BX                       =     0.5000
                              TOTAL OF FIRST SUB-AREAS  (ha) =    2494.87
                              TOTAL OF SECOND SUB-AREAS (ha) =      65.66
                              TOTAL OF ALL SUB-AREAS (ha)    =    2560.53
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SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area (ha) #1	Catch. Area (ha) #2	Slope (%) #1	Slope (%) #2	% Impervious (%) #1	% Impervious (%) #2	Pern #1	Pern #2	B #1	B #2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity	Init. Loss #1	Init. Loss #2	Cont. Loss #1	Cont. Loss #2	Excess Rain #1	Excess Rain #2	Peak Inflow	Time to	Link Lag

	(mm/h)	(mm)		(mm/h)	(mm)		(m^3/s)	Peak	mins
J	29.815	0.000	1.000	2.500	0.000	245.83 267.33	37.398	90.00	0.000
D	29.815	0.000	0.000	2.500	0.000	245.83 0.000	100.81	90.00	0.000
E	29.815	0.000	0.000	2.500	0.000	245.83 0.000	181.05	90.00	177.0
A	29.815	0.000	0.000	2.500	0.000	245.83 0.000	74.680	90.00	0.000
B	29.815	0.000	0.000	2.500	0.000	245.83 0.000	148.29	90.00	35.00
C	29.815	0.000	0.000	2.500	0.000	245.83 0.000	167.51	125.0	115.0
H	29.815	0.000	0.000	2.500	0.000	245.83 0.000	93.602	90.00	0.000
F	29.815	0.000	0.000	2.500	0.000	245.83 0.000	307.04	241.0	109.0
I	29.815	0.000	0.000	2.500	0.000	245.83 0.000	41.328	90.00	0.000
G	29.815	0.000	1.000	2.500	0.000	245.83 267.33	352.32	350.0	100.0
Site	29.815	0.000	1.000	2.500	0.000	245.83 267.33	357.21	450.0	0.000

LINK J 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 367.9
ESTIMATED PEAK FLOW (CUMECS) = 39.06
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK D 2.000

ESTIMATED VOLUME (CU METRES*10**3) = 1056.
ESTIMATED PEAK FLOW (CUMECS) = 101.39
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK E 2.001

ESTIMATED VOLUME (CU METRES*10**3) = 1860.
ESTIMATED PEAK FLOW (CUMECS) = 184.09
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK A 3.000

ESTIMATED VOLUME (CU METRES*10**3) = 745.0
ESTIMATED PEAK FLOW (CUMECS) = 77.18
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK B 3.001

ESTIMATED VOLUME (CU METRES*10**3) = 1484.
ESTIMATED PEAK FLOW (CUMECS) = 153.01
ESTIMATED TIME TO PEAK (MINS) = 90.00

LINK C 3.002

ESTIMATED VOLUME (CU METRES*10**3) = 2248.
ESTIMATED PEAK FLOW (CUMECS) = 175.93
ESTIMATED TIME TO PEAK (MINS) = 125.00

LINK H 4.000

Banaglow 100 yr

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 ESTIMATED VOLUME (CU METRES*10**3) =          946.4
 ESTIMATED PEAK FLOW         (CUMECS) =     96.10
 ESTIMATED TIME TO PEAK         (MINS) =     90.00

 LINK F                 2.002

 ESTIMATED VOLUME (CU METRES*10**3) =         5576.
 ESTIMATED PEAK FLOW         (CUMECS) =    286.06
 ESTIMATED TIME TO PEAK         (MINS) =    267.00

 LINK I                 5.000

 ESTIMATED VOLUME (CU METRES*10**3) =          401.6
 ESTIMATED PEAK FLOW         (CUMECS) =     43.15
 ESTIMATED TIME TO PEAK         (MINS) =     90.00

 LINK G                 2.003

 ESTIMATED VOLUME (CU METRES*10**3) =         6410.
 ESTIMATED PEAK FLOW         (CUMECS) =    311.55
 ESTIMATED TIME TO PEAK         (MINS) =    361.00

 LINK Site              1.001

 ESTIMATED VOLUME (CU METRES*10**3) =         6981.
 ESTIMATED PEAK FLOW         (CUMECS) =    320.41
 ESTIMATED TIME TO PEAK         (MINS) =    450.00
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#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to  5: 0.0 21/ 1/2006
################################################################################
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                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =       720.
                              RETURN PERIOD (YRS)      =       100.
                              BX                       =     0.5000
                              TOTAL OF FIRST SUB-AREAS  (ha) =    2494.87
                              TOTAL OF SECOND SUB-AREAS (ha) =      65.66
                              TOTAL OF ALL SUB-AREAS (ha)    =    2560.53
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SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001

C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	25.165	0.000	1.000	2.500	0.000	271.98	300.98	39.064	90.00	0.000
D	25.165	0.000	0.000	2.500	0.000	271.98	0.000	101.39	90.00	0.000
E	25.165	0.000	0.000	2.500	0.000	271.98	0.000	184.09	90.00	177.0
A	25.165	0.000	0.000	2.500	0.000	271.98	0.000	77.176	90.00	0.000
B	25.165	0.000	0.000	2.500	0.000	271.98	0.000	153.01	90.00	35.00
C	25.165	0.000	0.000	2.500	0.000	271.98	0.000	175.93	125.0	115.0
H	25.165	0.000	0.000	2.500	0.000	271.98	0.000	96.097	90.00	0.000
F	25.165	0.000	0.000	2.500	0.000	271.98	0.000	286.06	267.0	109.0
I	25.165	0.000	0.000	2.500	0.000	271.98	0.000	43.146	90.00	0.000
G	25.165	0.000	1.000	2.500	0.000	271.98	300.98	311.55	361.0	100.0
Site	25.165	0.000	1.000	2.500	0.000	271.98	300.98	320.41	450.0	0.000

LINK J 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 444.1
ESTIMATED PEAK FLOW (CUMECS) = 28.64
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK D 2.000

ESTIMATED VOLUME (CU METRES*10**3) = 1269.
ESTIMATED PEAK FLOW (CUMECS) = 82.43
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK E 2.001

ESTIMATED VOLUME (CU METRES*10**3) = 2234.
ESTIMATED PEAK FLOW (CUMECS) = 145.73
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK A 3.000

ESTIMATED VOLUME (CU METRES*10**3) = 895.1

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 ESTIMATED PEAK FLOW         (CUMECS) =     58.72
 ESTIMATED TIME TO PEAK         (MINS) =    120.00

 LINK B                 3.001

 ESTIMATED VOLUME (CU METRES*10**3) =          1783.
 ESTIMATED PEAK FLOW         (CUMECS) =    116.93
 ESTIMATED TIME TO PEAK         (MINS) =    120.00

 LINK C                 3.002

 ESTIMATED VOLUME (CU METRES*10**3) =          2701.
 ESTIMATED PEAK FLOW         (CUMECS) =    151.70
 ESTIMATED TIME TO PEAK         (MINS) =    123.00

 LINK H                 4.000

 ESTIMATED VOLUME (CU METRES*10**3) =          1137.
 ESTIMATED PEAK FLOW         (CUMECS) =     74.50
 ESTIMATED TIME TO PEAK         (MINS) =    120.00

 LINK F                 2.002

 ESTIMATED VOLUME (CU METRES*10**3) =          6700.
 ESTIMATED PEAK FLOW         (CUMECS) =    271.38
 ESTIMATED TIME TO PEAK         (MINS) =    270.00

 LINK I                 5.000

 ESTIMATED VOLUME (CU METRES*10**3) =          482.6
 ESTIMATED PEAK FLOW         (CUMECS) =     31.67
 ESTIMATED TIME TO PEAK         (MINS) =    120.00

 LINK G                 2.003

 ESTIMATED VOLUME (CU METRES*10**3) =          7706.
 ESTIMATED PEAK FLOW         (CUMECS) =    283.18
 ESTIMATED TIME TO PEAK         (MINS) =    379.00

 LINK Site              1.001

 ESTIMATED VOLUME (CU METRES*10**3) =          8393.
 ESTIMATED PEAK FLOW         (CUMECS) =    284.60
 ESTIMATED TIME TO PEAK         (MINS) =    479.00



################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to 11: 0.0 22/ 1/2006
################################################################################
#


                            ROUTING INCREMENT (MINS) =       1.00
                            STORM DURATION (MINS)    =      1080.
                            RETURN PERIOD (YRS)      =       100.
                            BX                       =    0.5000
                            TOTAL OF FIRST SUB-AREAS  (ha) =    2494.87
```

Banaglow 100 yr
TOTAL OF SECOND SUB-AREAS (ha) = 65.66
TOTAL OF ALL SUB-AREAS (ha) = 2560.53

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	20.600	0.000	1.000	2.500	0.000	326.82	369.80	28.644	120.0	0.000
D	20.600	0.000	0.000	2.500	0.000	326.82	0.000	82.428	120.0	0.000
E	20.600	0.000	0.000	2.500	0.000	326.82	0.000	145.73	120.0	177.0
A	20.600	0.000	0.000	2.500	0.000	326.82	0.000	58.715	120.0	0.000
B	20.600	0.000	0.000	2.500	0.000	326.82	0.000	116.93	120.0	35.00
C	20.600	0.000	0.000	2.500	0.000	326.82	0.000	151.70	123.0	115.0
H	20.600	0.000	0.000	2.500	0.000	326.82	0.000	74.501	120.0	0.000
F	20.600	0.000	0.000	2.500	0.000	326.82	0.000	271.38	270.0	109.0
I	20.600	0.000	0.000	2.500	0.000	326.82	0.000	31.674	120.0	0.000
G	20.600	0.000	1.000	2.500	0.000	326.82	369.80	283.18	379.0	100.0
Site	20.600	0.000	1.000	2.500	0.000	326.82	369.80	284.60	479.0	0.000

LINK J 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 503.6
ESTIMATED PEAK FLOW (CUMECS) = 30.03

ESTIMATED TIME TO PEAK (MINS) = 116.00

LINK D 2.000

ESTIMATED VOLUME (CU METRES*10**3) = 1433.
ESTIMATED PEAK FLOW (CUMECS) = 87.11
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK E 2.001

ESTIMATED VOLUME (CU METRES*10**3) = 2522.
ESTIMATED PEAK FLOW (CUMECS) = 153.53
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK A 3.000

ESTIMATED VOLUME (CU METRES*10**3) = 1010.
ESTIMATED PEAK FLOW (CUMECS) = 61.61
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK B 3.001

ESTIMATED VOLUME (CU METRES*10**3) = 2013.
ESTIMATED PEAK FLOW (CUMECS) = 122.72
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK C 3.002

ESTIMATED VOLUME (CU METRES*10**3) = 3049.
ESTIMATED PEAK FLOW (CUMECS) = 176.42
ESTIMATED TIME TO PEAK (MINS) = 121.00

LINK H 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 1284.
ESTIMATED PEAK FLOW (CUMECS) = 78.25
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK F 2.002

ESTIMATED VOLUME (CU METRES*10**3) = 7563.
ESTIMATED PEAK FLOW (CUMECS) = 326.80
ESTIMATED TIME TO PEAK (MINS) = 270.00

LINK I 5.000

ESTIMATED VOLUME (CU METRES*10**3) = 544.7
ESTIMATED PEAK FLOW (CUMECS) = 33.22
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK G 2.003

ESTIMATED VOLUME (CU METRES*10**3) = 8702.
ESTIMATED PEAK FLOW (CUMECS) = 331.08
ESTIMATED TIME TO PEAK (MINS) = 379.00

LINK Site 1.001

ESTIMATED VOLUME (CU METRES*10**3) = 9481.
ESTIMATED PEAK FLOW (CUMECS) = 334.87
ESTIMATED TIME TO PEAK (MINS) = 479.00

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################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to 17: 0.0 23/ 1/2006
################################################################################
#
```

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 1440.
RETURN PERIOD (YRS) = 100.
BX = 0.5000
TOTAL OF FIRST SUB-AREAS (ha) = 2494.87
TOTAL OF SECOND SUB-AREAS (ha) = 65.66
TOTAL OF ALL SUB-AREAS (ha) = 2560.53

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	17.839	0.000	1.000	2.500	0.000	368.93	427.15	30.032	116.0	0.000
D	17.839	0.000	0.000	2.500	0.000	368.93	0.000	87.107	120.0	0.000
E	17.839	0.000	0.000	2.500	0.000	368.93	0.000	153.53	120.0	177.0
A	17.839	0.000	0.000	2.500	0.000	368.93	0.000	61.614	120.0	0.000
B	17.839	0.000	0.000	2.500	0.000	368.93	0.000	122.72	120.0	35.00
C	17.839	0.000	0.000	2.500	0.000	368.93	0.000	176.42	121.0	115.0

H	17.839	0.000	0.000	2.500	0.000	368.93	0.000	78.247	120.0	0.000
F	17.839	0.000	0.000	2.500	0.000	368.93	0.000	326.80	270.0	109.0
I	17.839	0.000	0.000	2.500	0.000	368.93	0.000	33.218	120.0	0.000
G	17.839	0.000	1.000	2.500	0.000	368.93	427.15	331.08	379.0	100.0
Site	17.839	0.000	1.000	2.500	0.000	368.93	427.15	334.87	479.0	0.000

LINK J 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 597.5
ESTIMATED PEAK FLOW (CUMECS) = 21.64
ESTIMATED TIME TO PEAK (MINS) = 65.00

LINK D 2.000

ESTIMATED VOLUME (CU METRES*10**3) = 1688.
ESTIMATED PEAK FLOW (CUMECS) = 62.82
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK E 2.001

ESTIMATED VOLUME (CU METRES*10**3) = 2972.
ESTIMATED PEAK FLOW (CUMECS) = 110.59
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK A 3.000

ESTIMATED VOLUME (CU METRES*10**3) = 1191.
ESTIMATED PEAK FLOW (CUMECS) = 44.31
ESTIMATED TIME TO PEAK (MINS) = 101.00

LINK B 3.001

ESTIMATED VOLUME (CU METRES*10**3) = 2372.
ESTIMATED PEAK FLOW (CUMECS) = 88.26
ESTIMATED TIME TO PEAK (MINS) = 107.00

LINK C 3.002

ESTIMATED VOLUME (CU METRES*10**3) = 3594.
ESTIMATED PEAK FLOW (CUMECS) = 133.71
ESTIMATED TIME TO PEAK (MINS) = 120.00

LINK H 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 1513.
ESTIMATED PEAK FLOW (CUMECS) = 56.29
ESTIMATED TIME TO PEAK (MINS) = 113.00

LINK F 2.002

ESTIMATED VOLUME (CU METRES*10**3) = 8912.
ESTIMATED PEAK FLOW (CUMECS) = 261.82
ESTIMATED TIME TO PEAK (MINS) = 235.00

LINK I 5.000

Banaglow 100 yr

```
 ESTIMATED VOLUME (CU METRES*10**3) =           641.9
 ESTIMATED PEAK FLOW         (CUMECS) =     23.88
 ESTIMATED TIME TO PEAK         (MINS) =     75.00

 LINK G                 2.003

 ESTIMATED VOLUME (CU METRES*10**3) =          0.1026E+05
 ESTIMATED PEAK FLOW         (CUMECS) =    275.77
 ESTIMATED TIME TO PEAK         (MINS) =    344.00

 LINK Site              1.001

 ESTIMATED VOLUME (CU METRES*10**3) =          0.1118E+05
 ESTIMATED PEAK FLOW         (CUMECS) =    277.85
 ESTIMATED TIME TO PEAK         (MINS) =    444.00
```

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################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to  5: 0.0 26/ 1/2006
################################################################################
#
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                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =      2160.
                              RETURN PERIOD (YRS)      =       100.
                              BX                       =     0.5000
                              TOTAL OF FIRST SUB-AREAS  (ha) =    2494.87
                              TOTAL OF SECOND SUB-AREAS (ha) =      65.66
                              TOTAL OF ALL SUB-AREAS (ha)    =    2560.53
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area (ha) #1	#2	Slope (%) #1	#2	% Impervious (%) #1	#2	Pern #1	#2	B #1	#2	Link No.
J	109.04	23.760	13.50	10.00	0.000	0.000	.060	.025	.0786	.0214	1.000
D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	14.480	0.000	1.000	2.500	0.000	434.82	520.29	21.639	65.00	0.000
D	14.480	0.000	0.000	2.500	0.000	434.82	0.000	62.822	120.0	0.000
E	14.480	0.000	0.000	2.500	0.000	434.82	0.000	110.59	120.0	177.0
A	14.480	0.000	0.000	2.500	0.000	434.82	0.000	44.307	101.0	0.000
B	14.480	0.000	0.000	2.500	0.000	434.82	0.000	88.258	107.0	35.00
C	14.480	0.000	0.000	2.500	0.000	434.82	0.000	133.71	120.0	115.0
H	14.480	0.000	0.000	2.500	0.000	434.82	0.000	56.289	113.0	0.000
F	14.480	0.000	0.000	2.500	0.000	434.82	0.000	261.82	235.0	109.0
I	14.480	0.000	0.000	2.500	0.000	434.82	0.000	23.884	75.00	0.000
G	14.480	0.000	1.000	2.500	0.000	434.82	520.29	275.77	344.0	100.0
Site	14.480	0.000	1.000	2.500	0.000	434.82	520.29	277.85	444.0	0.000

```
 LINK J                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =          662.8
 ESTIMATED PEAK FLOW         (CUMECS) =     20.98
 ESTIMATED TIME TO PEAK         (MINS) =     66.00

 LINK D                2.000

 ESTIMATED VOLUME (CU METRES*10**3) =          1858.
 ESTIMATED PEAK FLOW         (CUMECS) =     60.88
 ESTIMATED TIME TO PEAK         (MINS) =    120.00

 LINK E                2.001

 ESTIMATED VOLUME (CU METRES*10**3) =          3271.
 ESTIMATED PEAK FLOW         (CUMECS) =    107.17
 ESTIMATED TIME TO PEAK         (MINS) =    120.00

 LINK A                3.000

 ESTIMATED VOLUME (CU METRES*10**3) =          1311.
 ESTIMATED PEAK FLOW         (CUMECS) =     42.94
 ESTIMATED TIME TO PEAK         (MINS) =    101.00

 LINK B                3.001

 ESTIMATED VOLUME (CU METRES*10**3) =          2611.
 ESTIMATED PEAK FLOW         (CUMECS) =     85.53
 ESTIMATED TIME TO PEAK         (MINS) =    105.00

 LINK C                3.002

 ESTIMATED VOLUME (CU METRES*10**3) =          3955.
```

Banaglow 100 yr

```
 ESTIMATED PEAK FLOW         (CUMECS) =    129.58
 ESTIMATED TIME TO PEAK         (MINS) =    120.00

 LINK H                 4.000

 ESTIMATED VOLUME (CU METRES*10**3) =          1665.
 ESTIMATED PEAK FLOW         (CUMECS) =     54.55
 ESTIMATED TIME TO PEAK         (MINS) =    114.00

 LINK F                 2.002

 ESTIMATED VOLUME (CU METRES*10**3) =          9810.
 ESTIMATED PEAK FLOW         (CUMECS) =    277.20
 ESTIMATED TIME TO PEAK         (MINS) =    235.00

 LINK I                 5.000

 ESTIMATED VOLUME (CU METRES*10**3) =          706.6
 ESTIMATED PEAK FLOW         (CUMECS) =     23.15
 ESTIMATED TIME TO PEAK         (MINS) =     75.00

 LINK G                 2.003

 ESTIMATED VOLUME (CU METRES*10**3) =         0.1130E+05
 ESTIMATED PEAK FLOW         (CUMECS) =    290.63
 ESTIMATED TIME TO PEAK         (MINS) =    344.00

 LINK Site              1.001

 ESTIMATED VOLUME (CU METRES*10**3) =         0.1232E+05
 ESTIMATED PEAK FLOW         (CUMECS) =    291.06
 ESTIMATED TIME TO PEAK         (MINS) =    444.00



################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to 17: 0.0 28/ 1/2006
################################################################################
#


                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =      2880.
                              RETURN PERIOD (YRS)      =       100.
                              BX                       =     0.5000
                              TOTAL OF FIRST SUB-AREAS  (ha) =    2494.87
                              TOTAL OF SECOND SUB-AREAS (ha) =      65.66
                              TOTAL OF ALL SUB-AREAS (ha)    =    2560.53


     SUMMARY OF CATCHMENT AND RAINFALL DATA
 Link      Catch. Area      Slope    % Impervious     Pern        B       Link
 Label      #1     #2     #1    #2      #1   #2     #1    #2    #1   #2     No.
            (ha)             (%)          (%)
J         109.04 23.760  13.50 10.00  0.000 0.000  .060 .025  .0786 .0214  1.000

D         388.50  0.000  5.600 0.000  0.000 0.000  .060 0.00  .2362 0.000  2.000
```

E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	12.401	0.000	1.000	2.500	0.000	478.60	594.27	20.976	66.00	0.000
D	12.401	0.000	0.000	2.500	0.000	478.60	0.000	60.881	120.0	0.000
E	12.401	0.000	0.000	2.500	0.000	478.60	0.000	107.17	120.0	177.0
A	12.401	0.000	0.000	2.500	0.000	478.60	0.000	42.938	101.0	0.000
B	12.401	0.000	0.000	2.500	0.000	478.60	0.000	85.532	105.0	35.00
C	12.401	0.000	0.000	2.500	0.000	478.60	0.000	129.58	120.0	115.0
H	12.401	0.000	0.000	2.500	0.000	478.60	0.000	54.551	114.0	0.000
F	12.401	0.000	0.000	2.500	0.000	478.60	0.000	277.20	235.0	109.0
I	12.401	0.000	0.000	2.500	0.000	478.60	0.000	23.146	75.00	0.000
G	12.401	0.000	1.000	2.500	0.000	478.60	594.27	290.63	344.0	100.0
Site	12.401	0.000	1.000	2.500	0.000	478.60	594.27	291.06	444.0	0.000

Run completed at: 27th February 2007 13:51:56

mik open 0

Run started at: 29th March 2007 14:37:04

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#########################################################################################
#
                          RUNTIME          RESULTS
#########################################################################################
#

Max. no. of links allowed =  2000

Max. no. of routng increments allowed = 25000

Max. no. of rating curve points = 25000

Max. no. of storm temporal points = 25000

Max. no. of channel subreaches =    25

Max link stack level =    25

Input Version number =          650

 LINK J                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =           657.7
 ESTIMATED PEAK FLOW         (CUMECS) =    131.75
 ESTIMATED TIME TO PEAK         (MINS) =     23.00

 LINK D                 2.000

 ESTIMATED VOLUME (CU METRES*10**3) =          1921.
 ESTIMATED PEAK FLOW         (CUMECS) =    371.19
 ESTIMATED TIME TO PEAK         (MINS) =     42.00

 LINK E                 2.001

 ESTIMATED VOLUME (CU METRES*10**3) =          3382.
 ESTIMATED PEAK FLOW         (CUMECS) =    656.71
 ESTIMATED TIME TO PEAK         (MINS) =     42.00

 LINK A                 3.000

 ESTIMATED VOLUME (CU METRES*10**3) =          1355.
 ESTIMATED PEAK FLOW         (CUMECS) =    265.08
 ESTIMATED TIME TO PEAK         (MINS) =     38.00

 LINK B                 3.001

 ESTIMATED VOLUME (CU METRES*10**3) =          2699.
 ESTIMATED PEAK FLOW         (CUMECS) =    527.76
 ESTIMATED TIME TO PEAK         (MINS) =     39.00

 LINK C                 3.002
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```
 ESTIMATED VOLUME (CU METRES*10**3) =          4089.
 ESTIMATED PEAK FLOW         (CUMECS) =    747.79
 ESTIMATED TIME TO PEAK         (MINS) =     67.00

 LINK H                 4.000

 ESTIMATED VOLUME (CU METRES*10**3) =          1721.
 ESTIMATED PEAK FLOW         (CUMECS) =    336.23
 ESTIMATED TIME TO PEAK         (MINS) =     42.00

 LINK F                 2.002

 ESTIMATED VOLUME (CU METRES*10**3) =         0.1014E+05
 ESTIMATED PEAK FLOW         (CUMECS) =   1259.26
 ESTIMATED TIME TO PEAK         (MINS) =    206.00

 LINK I                 5.000

 ESTIMATED VOLUME (CU METRES*10**3) =          730.5
 ESTIMATED PEAK FLOW         (CUMECS) =    145.44
 ESTIMATED TIME TO PEAK         (MINS) =     26.00

 LINK G                 2.003

 ESTIMATED VOLUME (CU METRES*10**3) =         0.1164E+05
 ESTIMATED PEAK FLOW         (CUMECS) =   1259.30
 ESTIMATED TIME TO PEAK         (MINS) =    315.00

 LINK Site              1.001

 ESTIMATED VOLUME (CU METRES*10**3) =         0.1267E+05
 ESTIMATED PEAK FLOW         (CUMECS) =   1259.31
 ESTIMATED TIME TO PEAK         (MINS) =    415.00



################################################################################
#
Bangalow - 100 yr ARI

Results for period from 17: 0.0 18/ 1/2006
                     to 19: 0.0 20/ 1/2006
################################################################################
#


                            ROUTING INCREMENT (MINS) =       1.00
                            STORM DURATION (MINS)    =       120.
                            RETURN PERIOD (YRS)      =         0.
                            BX                       =     0.5000
                            TOTAL OF FIRST SUB-AREAS  (ha) =    2494.87
                            TOTAL OF SECOND SUB-AREAS (ha) =      65.66
                            TOTAL OF ALL SUB-AREAS (ha)    =    2560.53


     SUMMARY OF CATCHMENT AND RAINFALL DATA
 Link      Catch. Area      Slope    % Impervious     Pern         B        Link
 Label      #1     #2     #1    #2      #1   #2     #1    #2    #1   #2     No.
             (ha)             (%)          (%)
J         109.04 23.760  13.50 10.00  0.000 0.000  .060 .025  .0786 .0214  1.000
```

D	388.50	0.000	5.600	0.000	0.000	0.000	.060	0.00	.2362	0.000	2.000
E	295.40	0.000	8.100	0.000	0.000	0.000	.060	0.00	.1704	0.000	2.001
A	274.00	0.000	8.200	0.000	0.000	0.000	.060	0.00	.1628	0.000	3.000
B	271.80	0.000	7.500	0.000	0.000	0.000	.060	0.00	.1695	0.000	3.001
C	281.10	0.000	9.700	0.000	0.000	0.000	.060	0.00	.1518	0.000	3.002
H	348.10	0.000	7.600	0.000	0.000	0.000	.060	0.00	.1915	0.000	4.000
F	191.90	0.000	10.60	0.000	0.000	0.000	.060	0.00	.1190	0.000	2.002
I	147.70	0.000	12.40	0.000	0.000	0.000	.060	0.00	.0961	0.000	5.000
G	116.60	38.500	10.50	12.00	0.000	0.000	.060	.025	.0923	.0251	2.003
Site	70.730	3.400	5.200	2.500	0.000	0.000	.060	.025	.1011	.0155	1.001

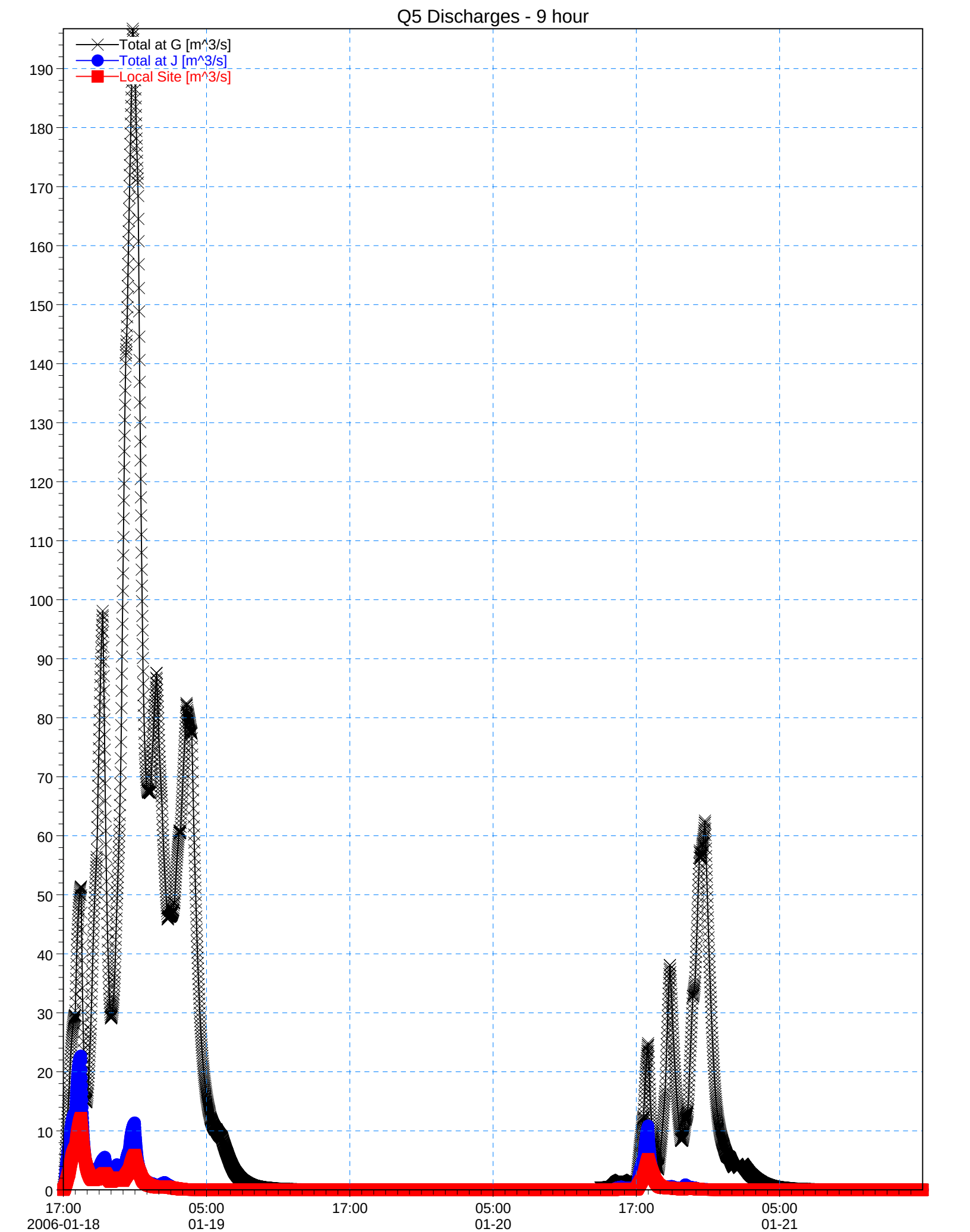
Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
J	-1.000	0.000	1.000	2.500	0.000	495.00	499.00	131.75	23.00	0.000
D	-1.000	0.000	0.000	2.500	0.000	495.00	0.000	371.19	42.00	0.000
E	-1.000	0.000	0.000	2.500	0.000	495.00	0.000	656.71	42.00	177.0
A	-1.000	0.000	0.000	2.500	0.000	495.00	0.000	265.08	38.00	0.000
B	-1.000	0.000	0.000	2.500	0.000	495.00	0.000	527.76	39.00	35.00
C	-1.000	0.000	0.000	2.500	0.000	495.00	0.000	747.79	67.00	115.0
H	-1.000	0.000	0.000	2.500	0.000	495.00	0.000	336.23	42.00	0.000
F	-1.000	0.000	0.000	2.500	0.000	495.00	0.000	1259.3	206.0	109.0
I	-1.000	0.000	0.000	2.500	0.000	495.00	0.000	145.44	26.00	0.000
G	-1.000	0.000	1.000	2.500	0.000	495.00	499.00	1259.3	315.0	100.0
Site	-1.000	0.000	1.000	2.500	0.000	495.00	499.00	1259.3	415.0	0.000

Run completed at: 29th March 2007 14:37:06

mik open 0

APPENDIX C

MIKE11 Model Details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Local Site [m^3/s]
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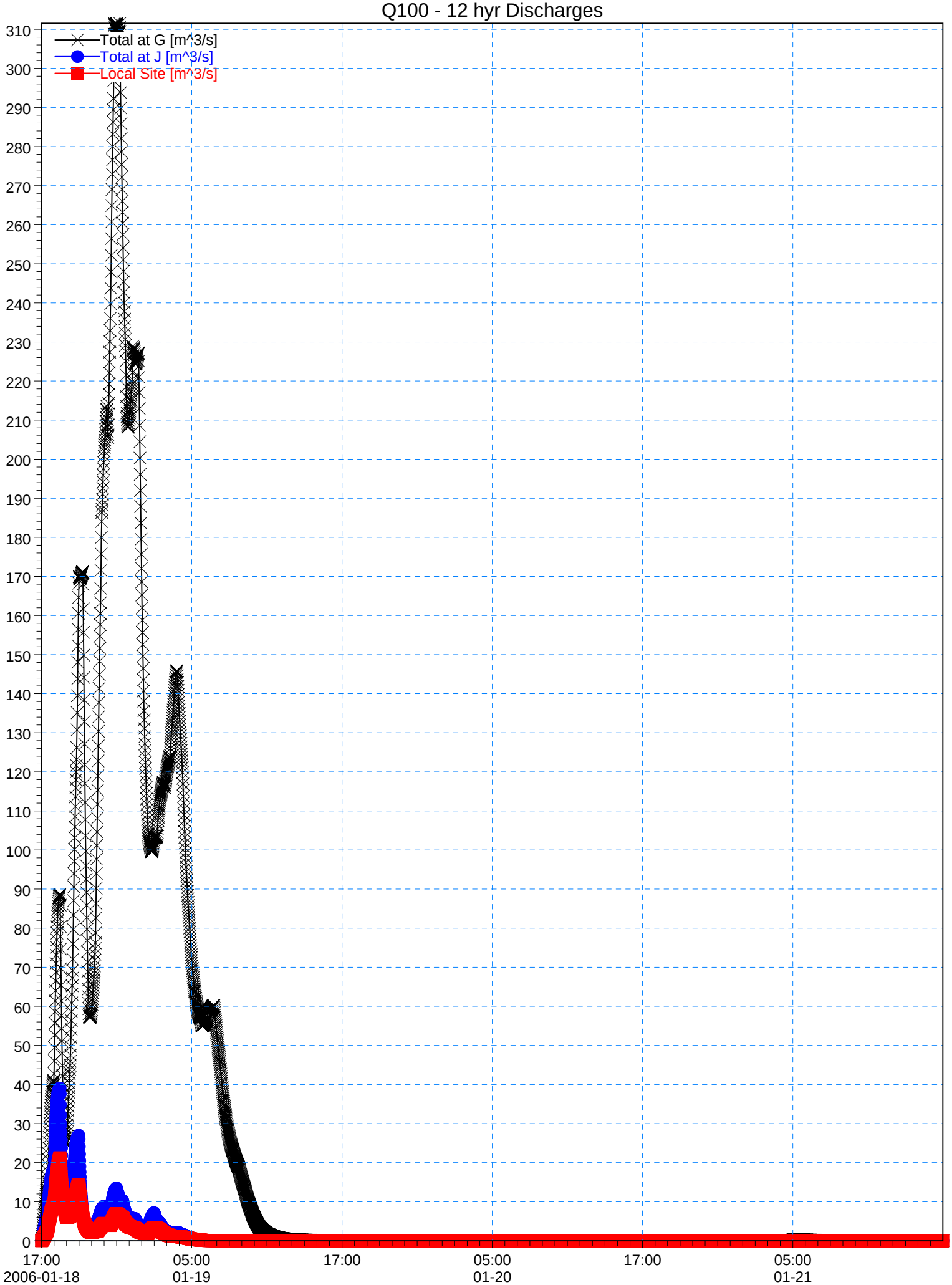
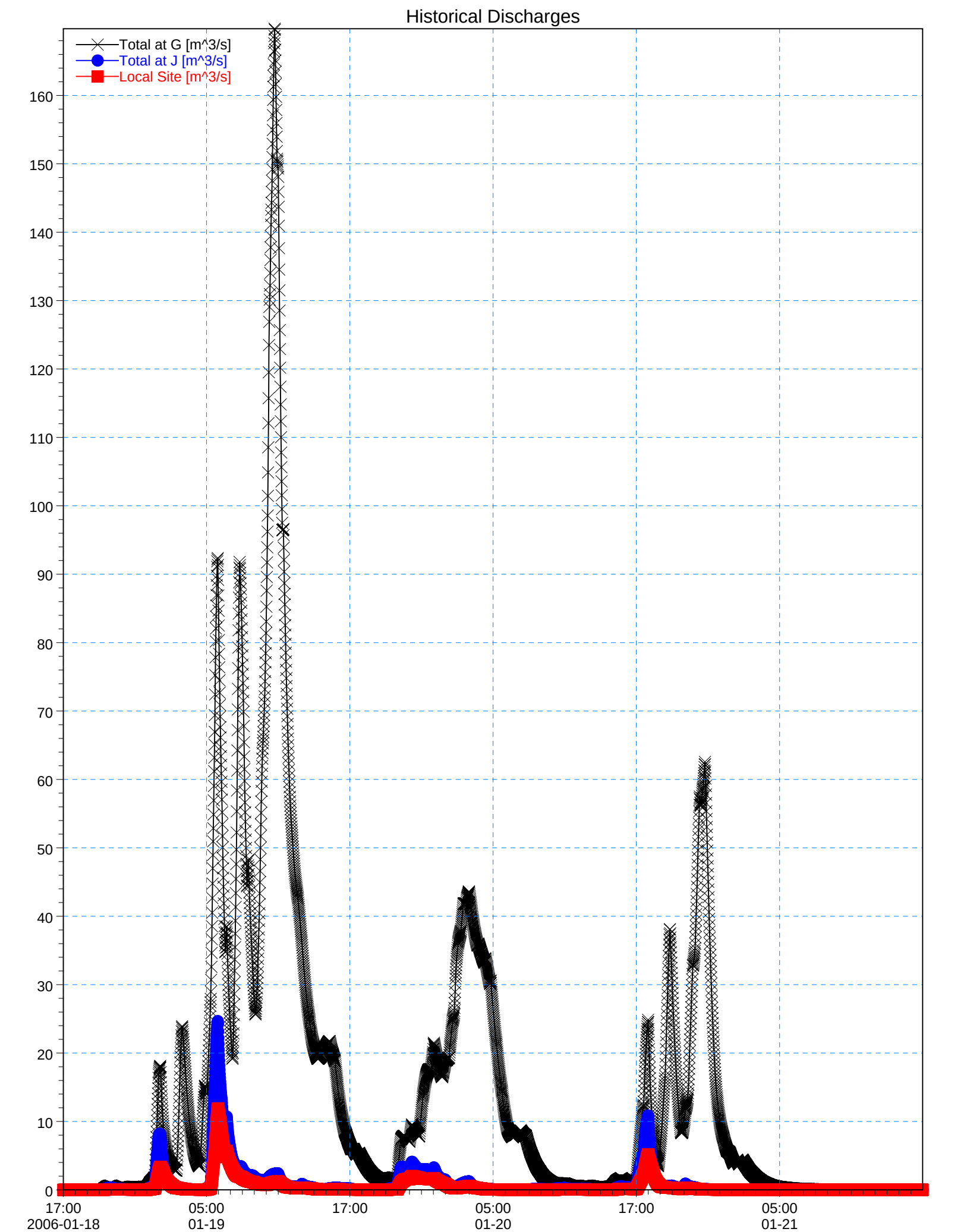
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
17:00
2006-01-18
05:00
01-19
17:00
05:00
01-20
17:00
05:00
01-21

Q100 - 12 hyr Discharges

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Total at J [m^3/s]
Local Site [m^3/s]
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90
80
70
60
50
40
30
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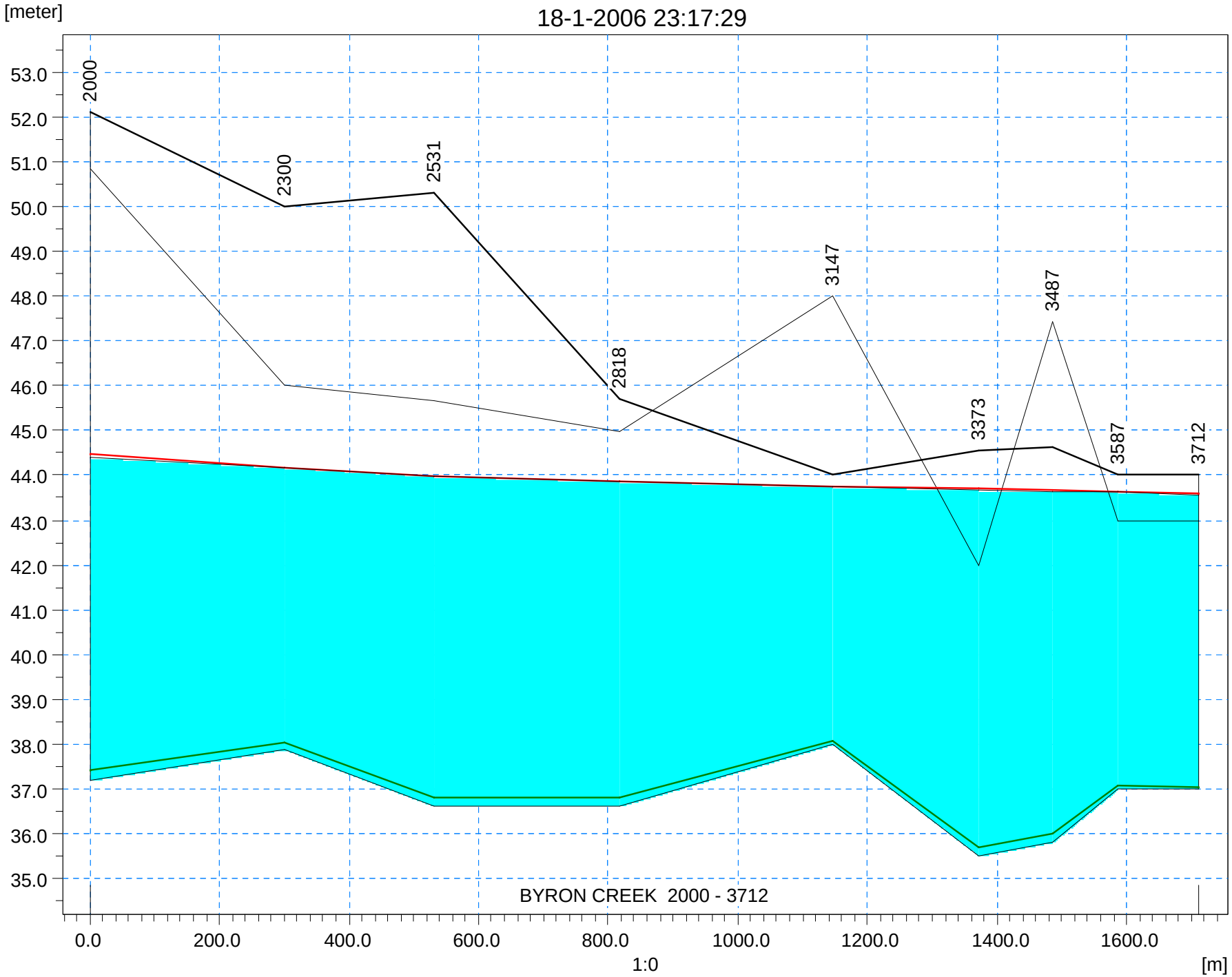
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37.0
36.0
35.0
2000
2300
2531
2818
3147
3373
3487
3587
3712
BYRON CREEK 2000 - 3712
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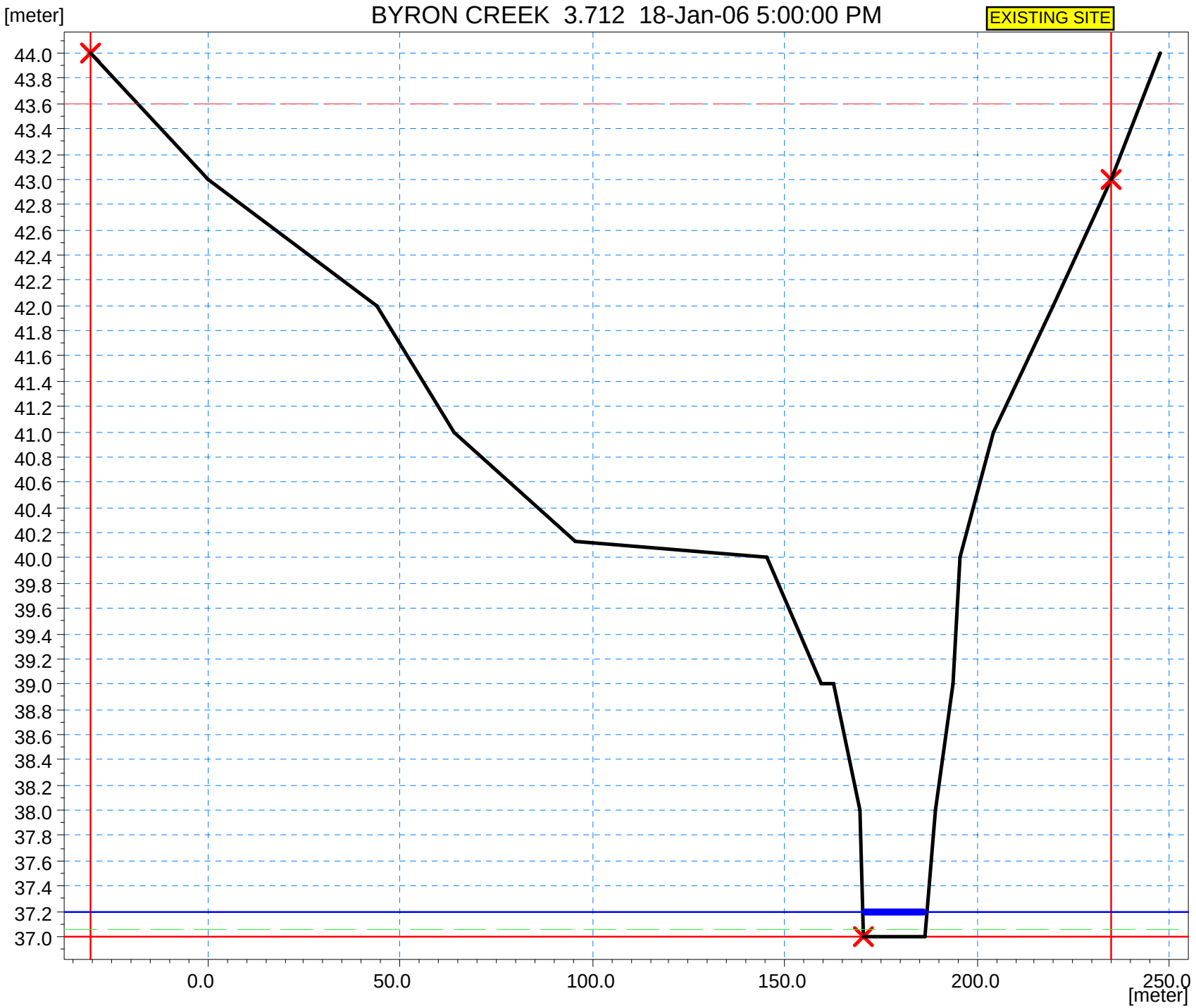
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42.4
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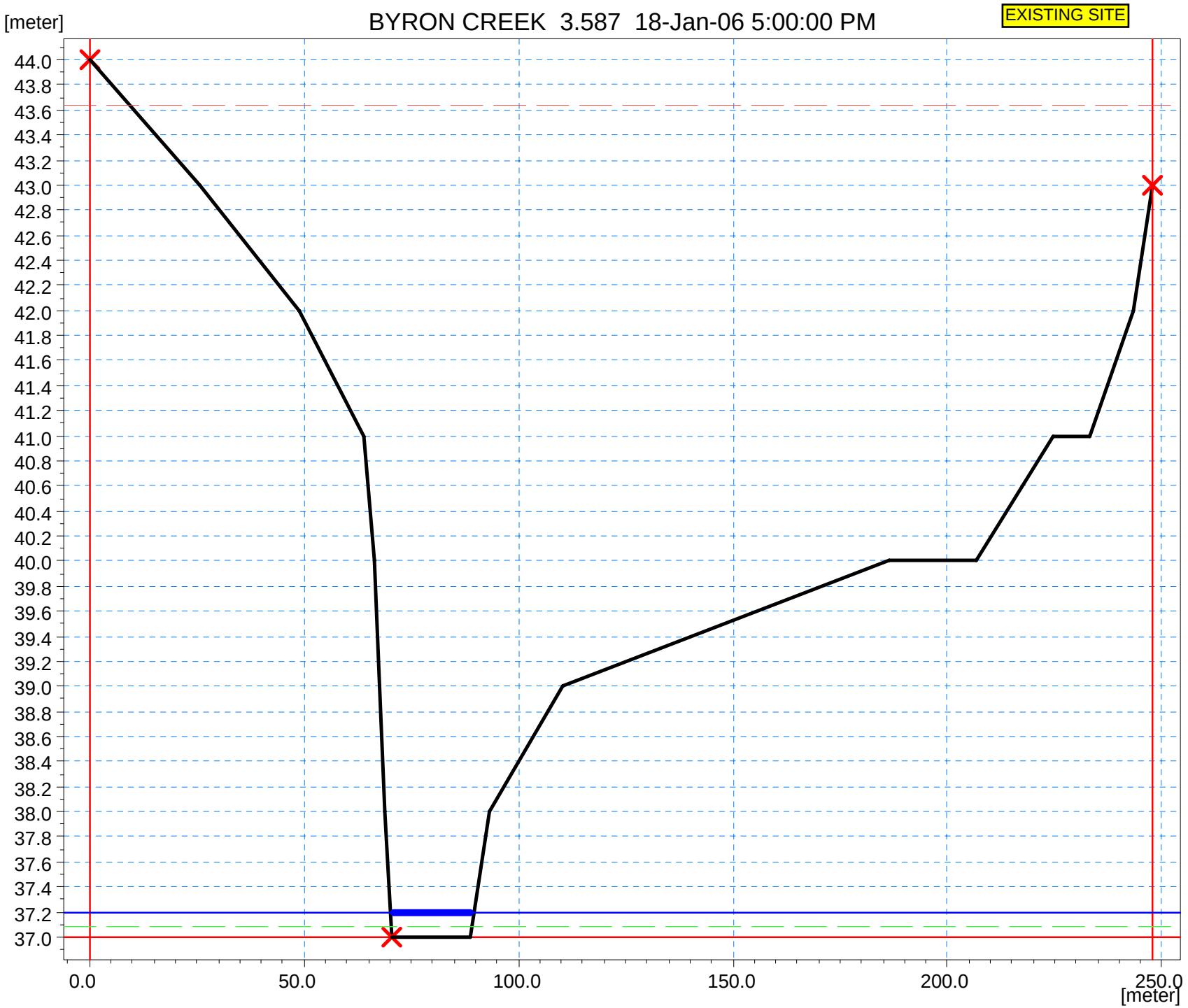
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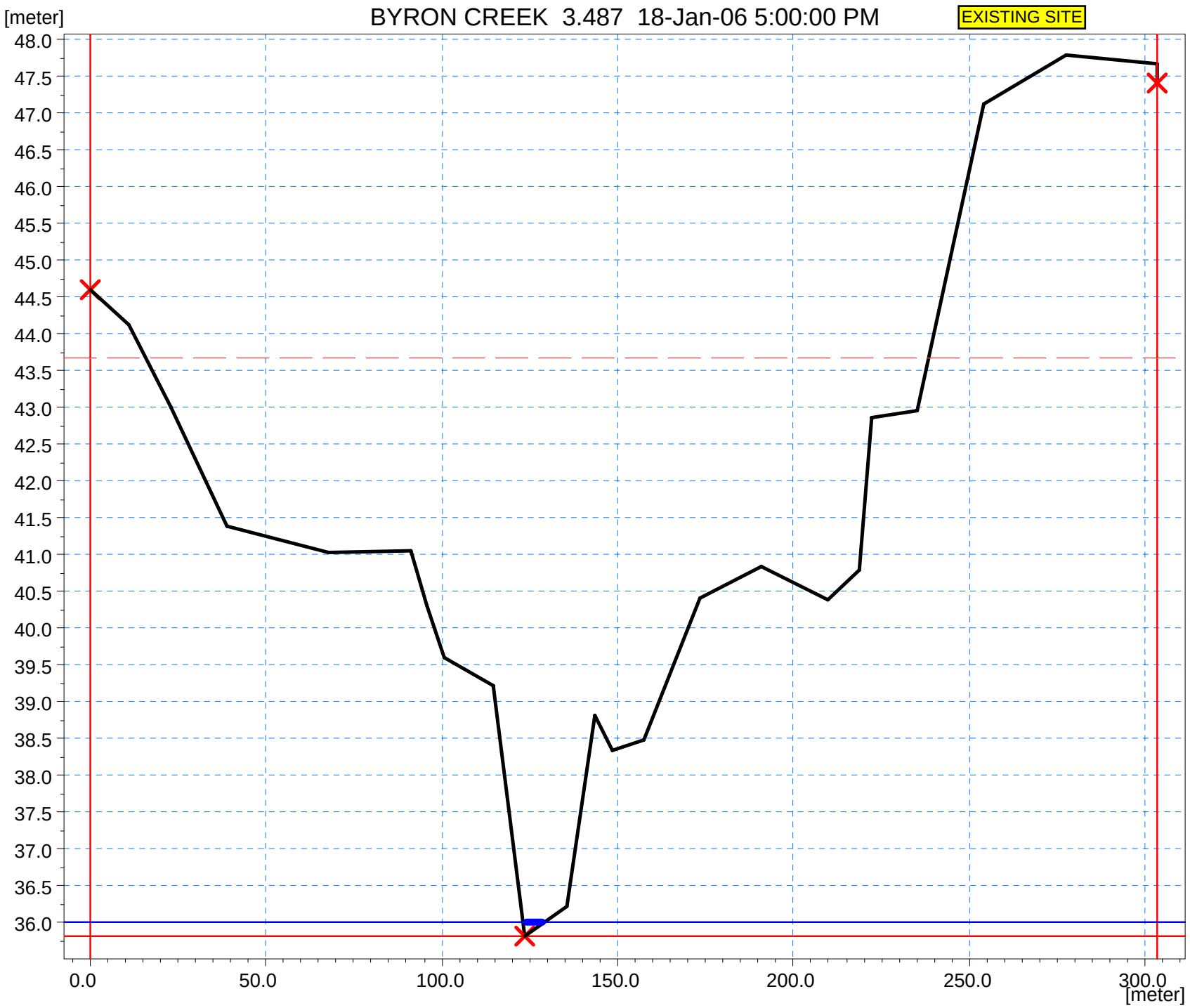
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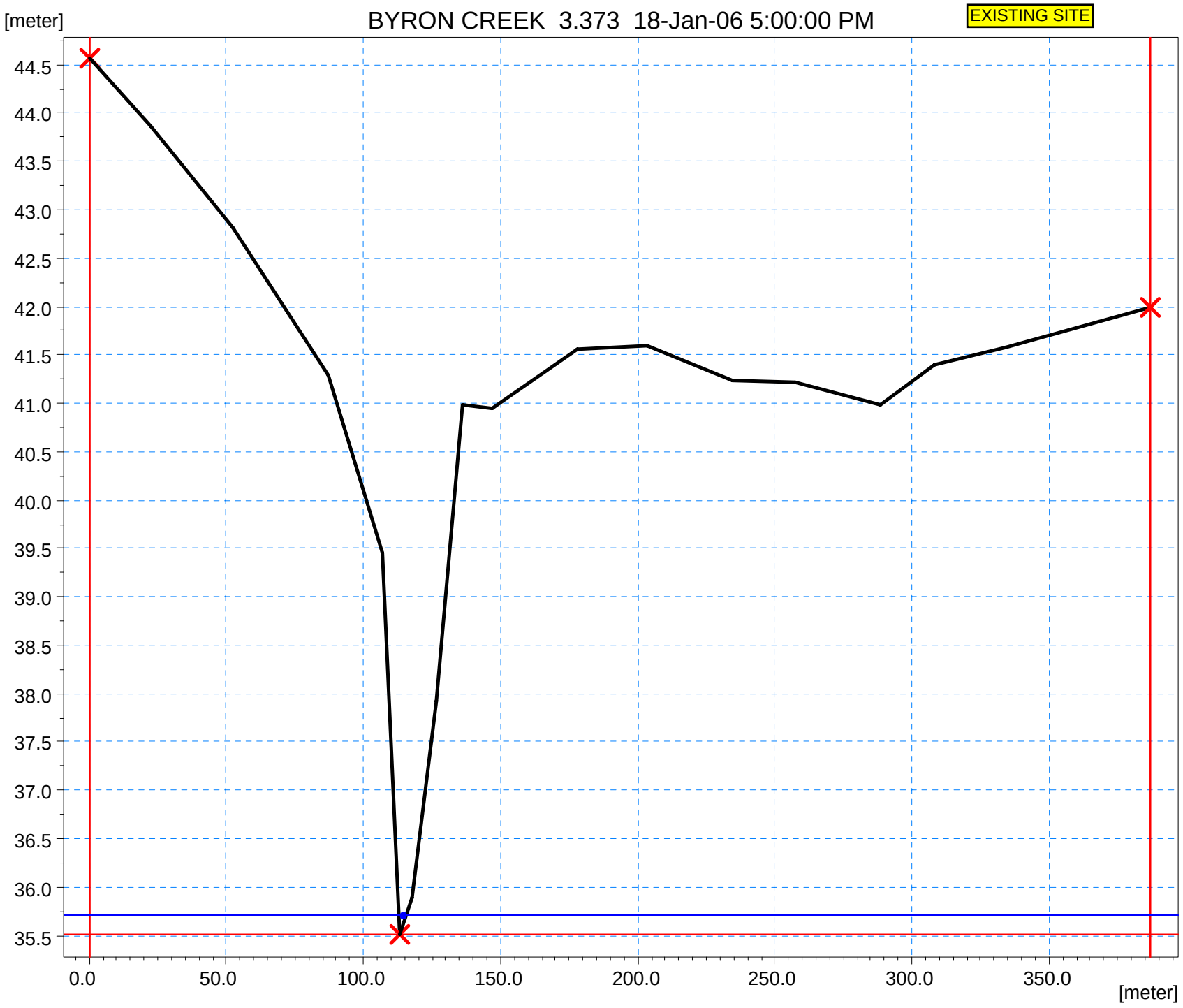
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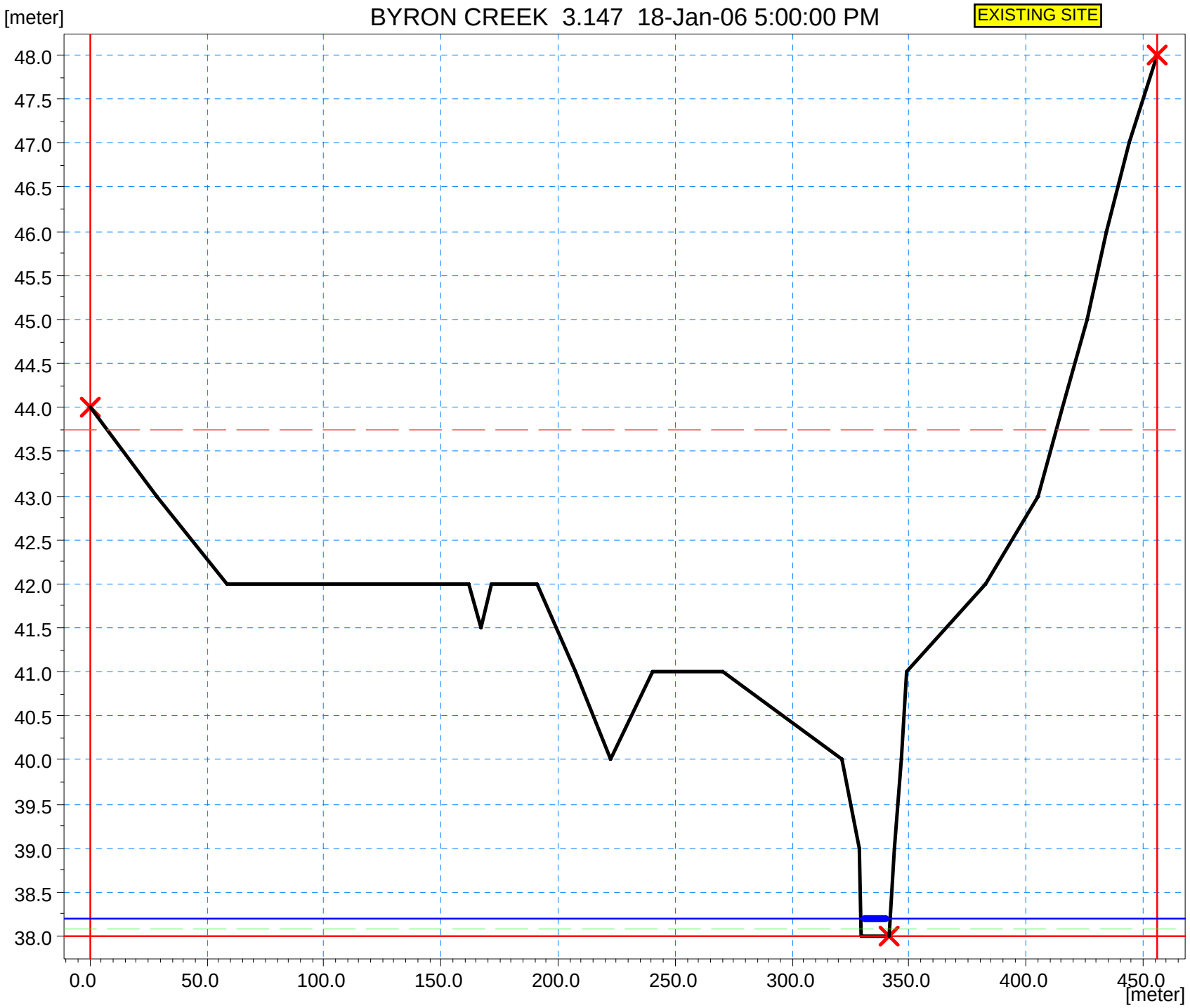
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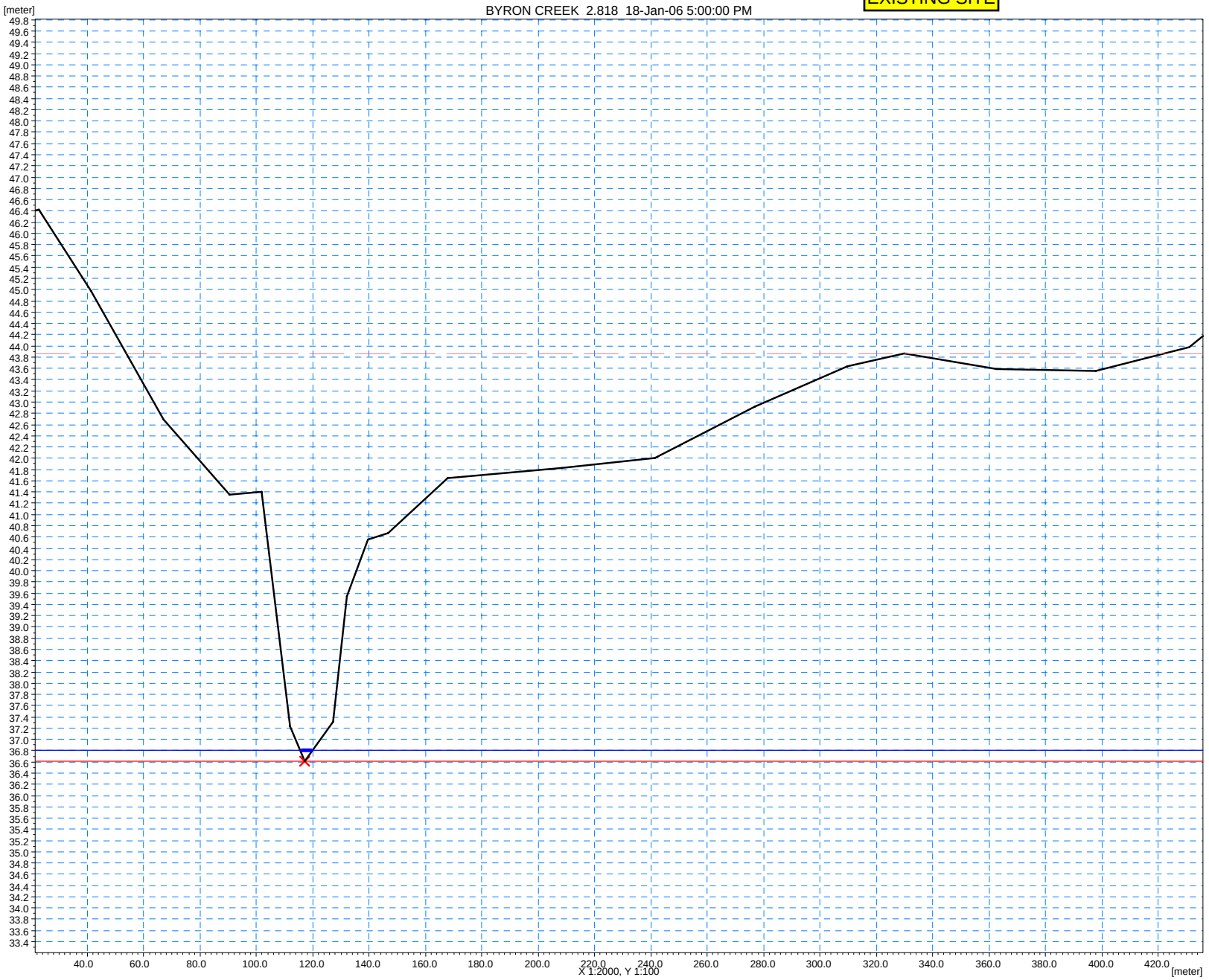

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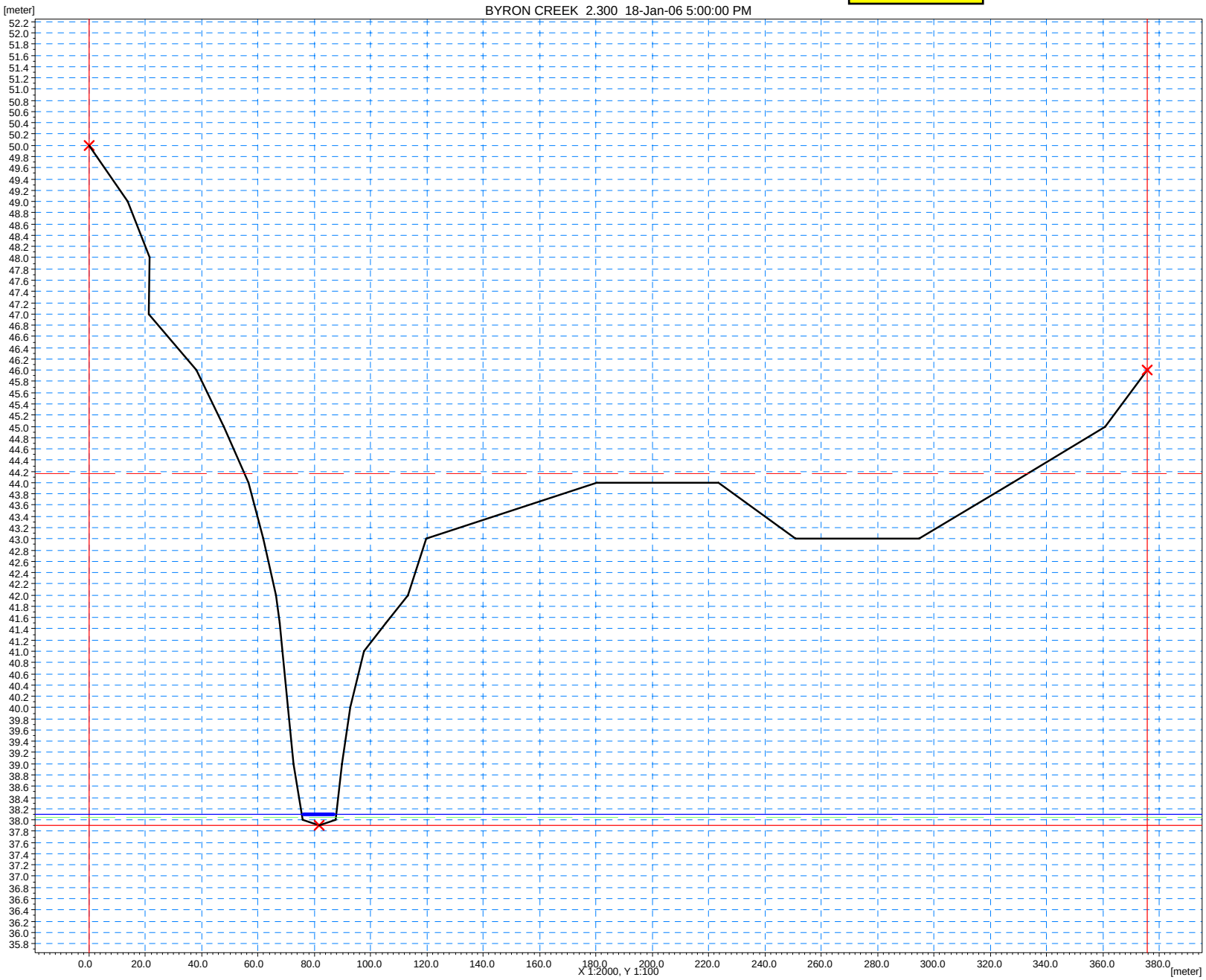

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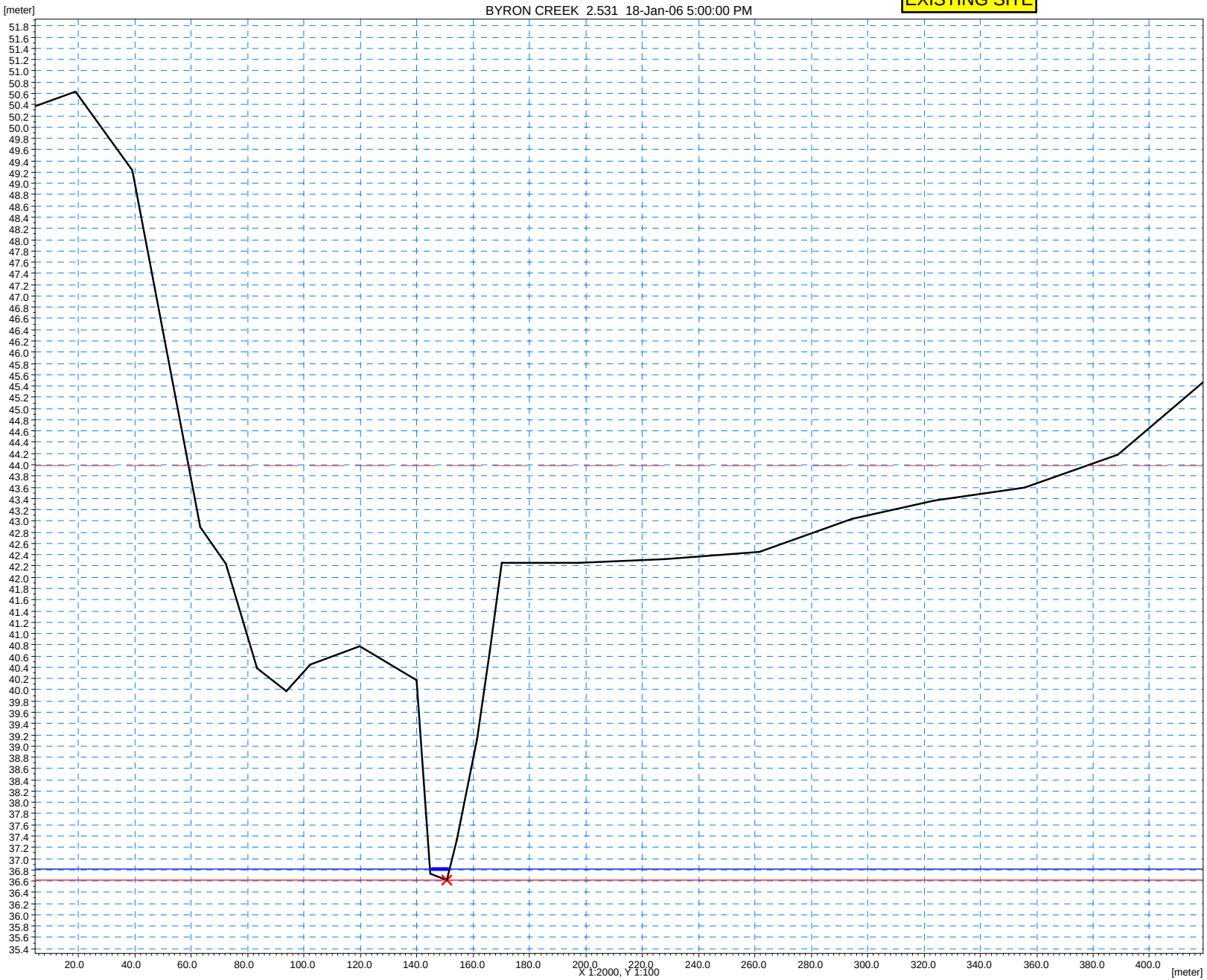

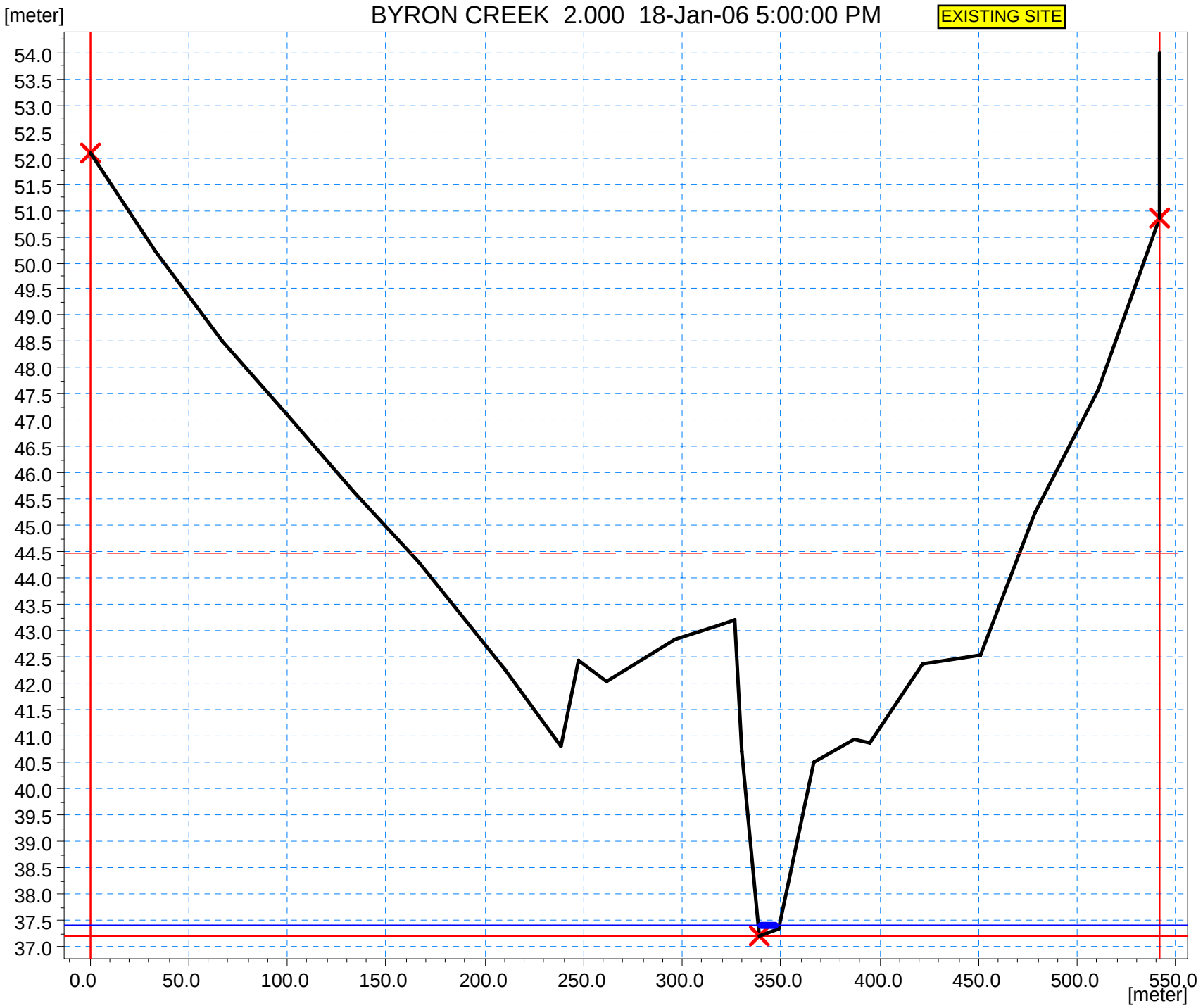
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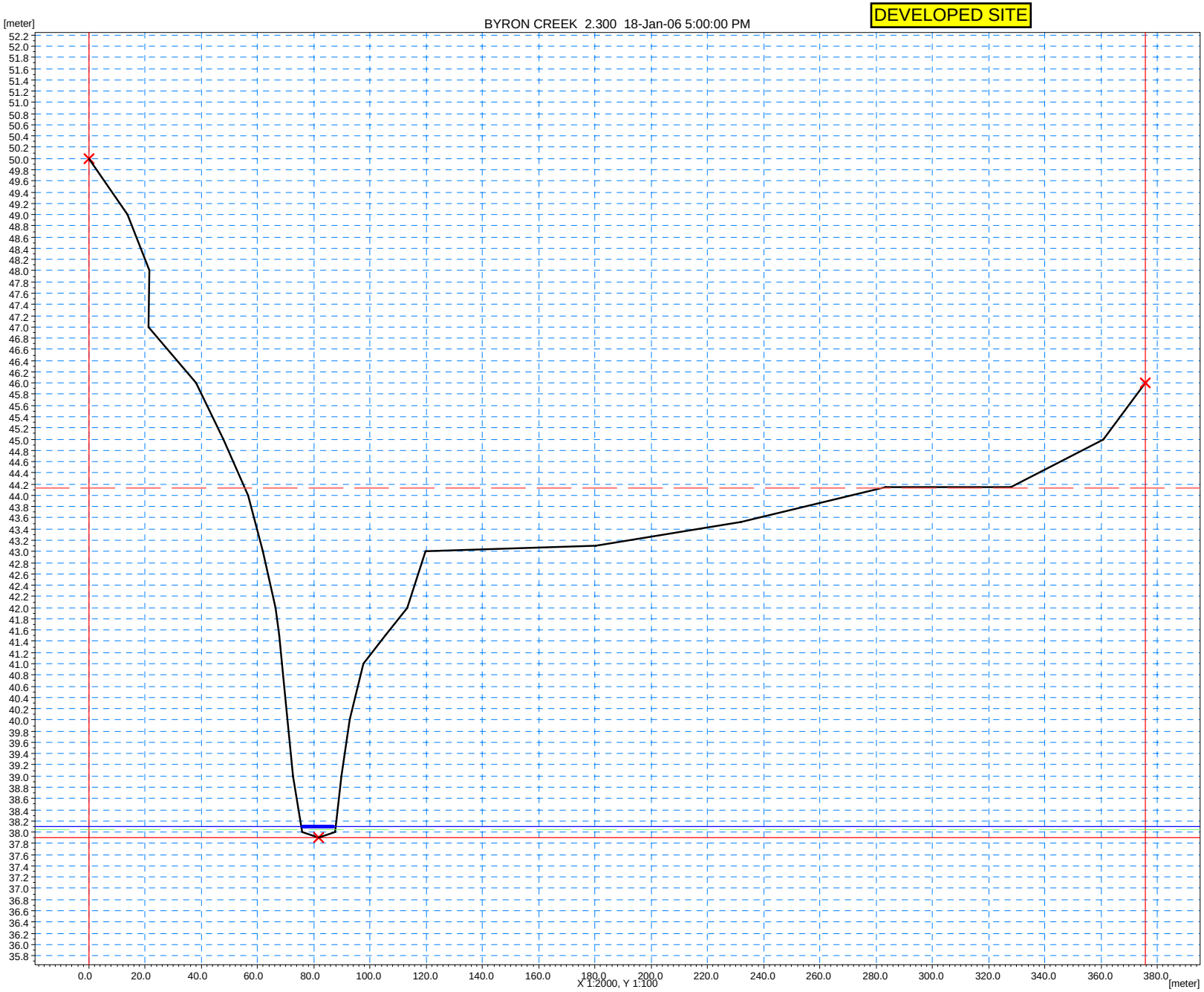
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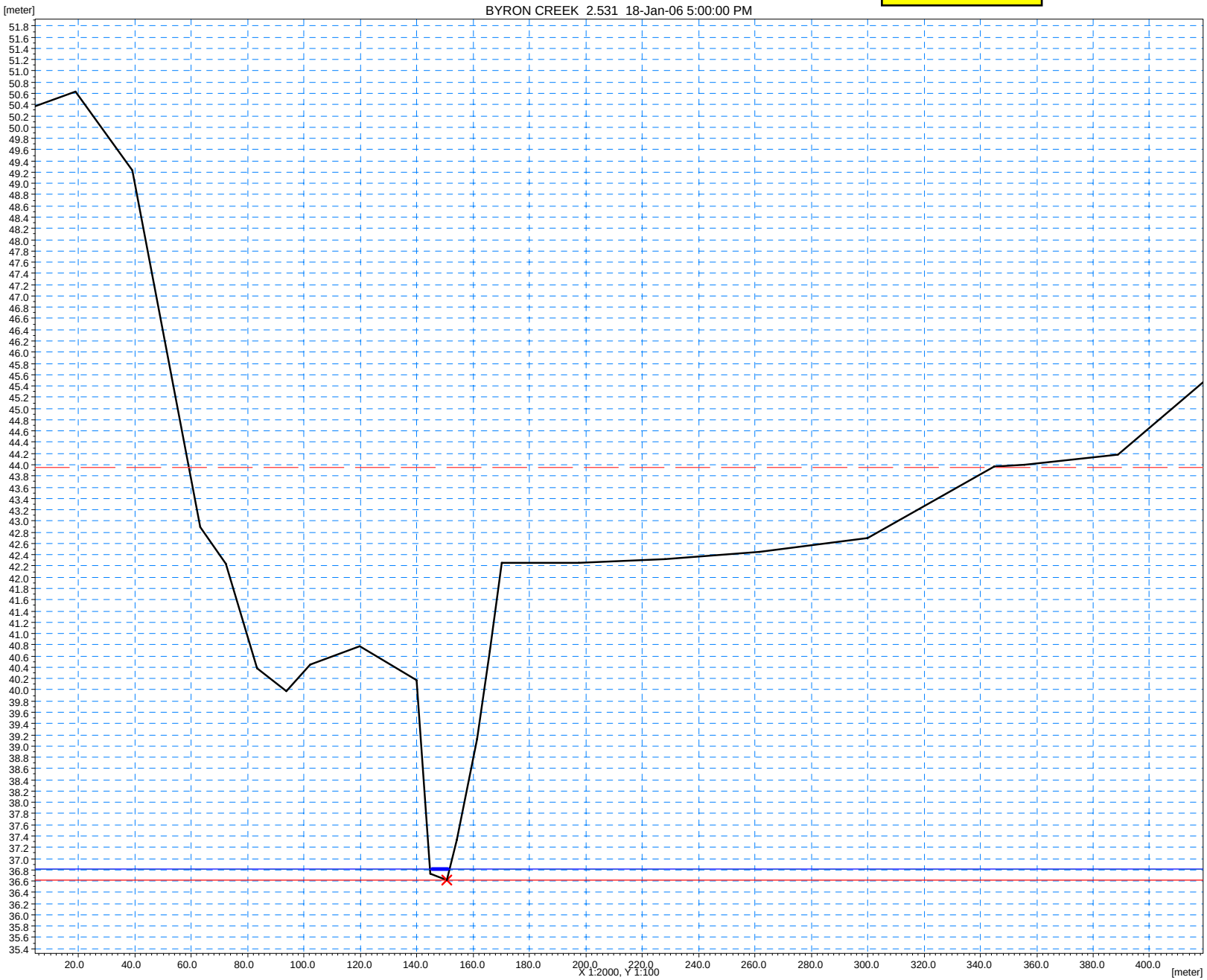

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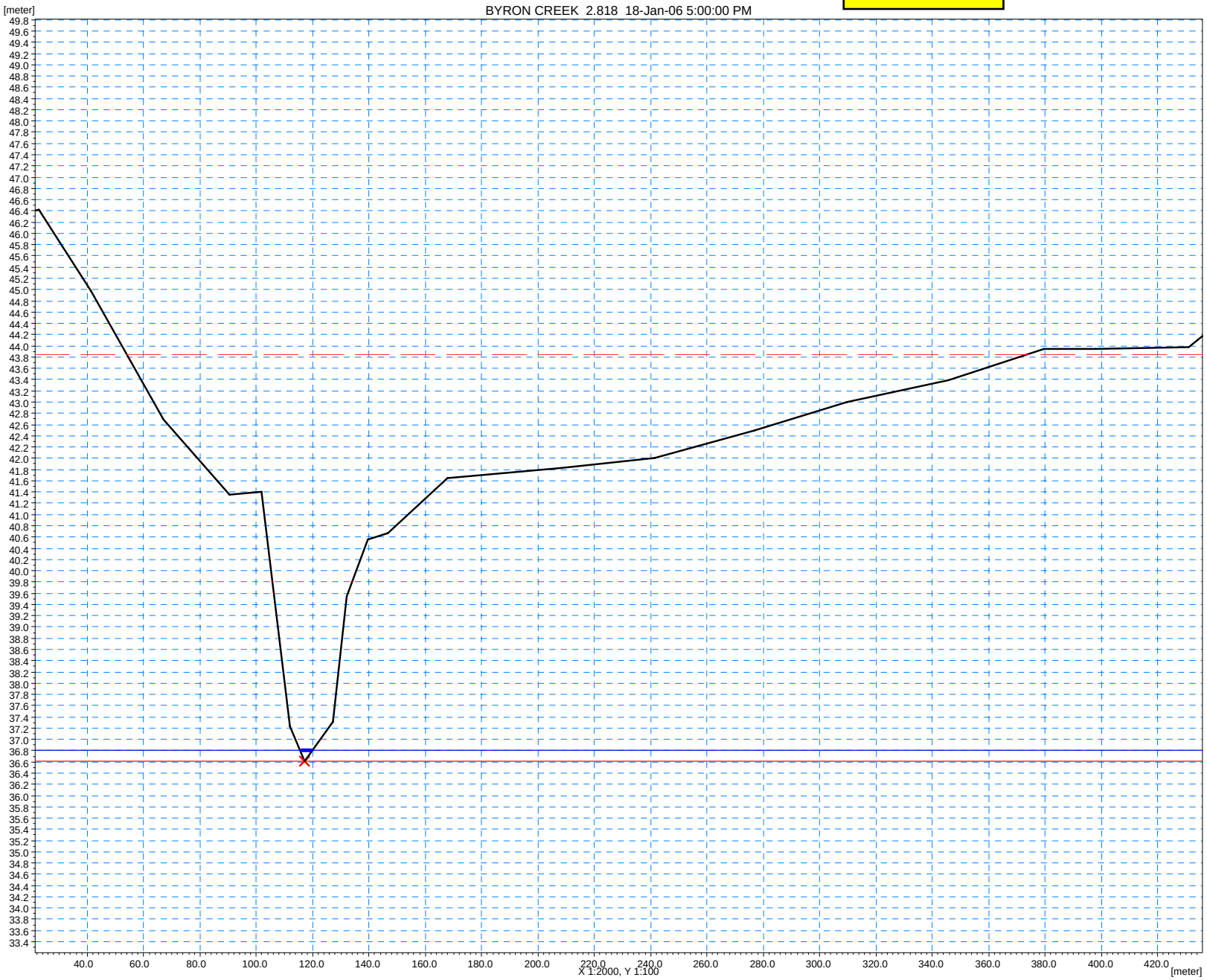

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Appendix B

Extract from Byron Shire Local Environmental Study

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The proposed concept plan within the rezoning application includes a range of smaller 1 and 2 bedroom dwellings, thus potentially providing access to affordable housing in the Shire. The medium density housing proposed within the application would meet some of the desired need for non-conventional housing types within Area 4. It is important to note that the standard of development would need to be in keeping with the surrounding neighbourhood.

It is recommended that a site specific DCP be prepared which will include design issues, bulk and scale, and site of buildings etc to assist in reducing visual impact. The issue of slope, flooding and access will also need to be carefully considered at DA stage.

The part of the site fronting Ballina Road is recommended for residential zoning and the residue of the site is recommended for environmental zoning as the land is constrained. Although the submission suggests the residential zone should cover more of the site, this is not considered appropriate. A portion of the site is identified within the settlement strategy for future release, and sufficient justification for its part development is given within the submission, as assessed above.

Recommendation

It is recommended to zone Lot 2 DP 1086364 Ballina Road, Bangalow to part R3 Medium Density Residential and part E3 Environmental Management as shown on Figure 5 in Appendix K.

Section 7.6.6(d) **Area 6, Lismore Road, Bangalow**

The site is located on the eastern side of Lismore Road. It has a total area of 28.49 ha and is irregular in shape. The site has frontage to Charlotte Street, Thomas Street and Little Thomas Street. The site is currently zoned 1 (a) General Rural and 1 (d) Investigation Zone under Byron LEP 1988 and the 1(a) section is also hatched (clause 38 of the LEP).

The applicant proposes low density residential development with approximately 35 to 45 residential lots. The proposed zone requested by the applicant is part residential with the remainder of the allotment general rural. The proponent has suggested that a portion of the area should be used for recreation and open space, and the Settlement Strategy states that the development of Area 6 should be "the catalyst for the provision of open space such as community gardens and playing fields, walkways and environmental repair along Byron Creek". However, the analysis recommends rezoning to residential and rural and does not include open space at this stage.

The major constraints that occur on the site include slope, flooding and drainage. Portions of the land greater than 15% in slope have been identified by the proponent and are not suitable for future urban development. A geotechnical study will need to be prepared as part of any DA. A floodplain management plan has not been prepared for Bangalow. However, the flood study provided by the applicant is considered sufficient for this stage of the process and it is suggested that this could be the basis for the identification of the boundary of the residential zone. Where flood prone land is encountered it must not be developed for urban use. It should be noted that the boundary proposed by the applicant's flood study, which took into account both flooding and climate change, is preferred to the boundary identified in the adopted Strategies and the 1(d) area.

Other environmental concerns associated with the site can be addressed at the DA stage. Any development application prepared for the site will need to consider the relevant aspects

of a new DCP including flooding, drainage, water sensitive urban design, heritage, geotech, etc.

Impact of additional residents on existing social services must be reviewed in tandem with other proposed rezonings in Bangalow. Existing social services are currently stretched. For example, the Bangalow Primary School is operating at near its design capacity and is being considered for further expansion if possible (Byron Shire Council, 2003). The impact of the proposed rezoning on the existing residents, especially in terms of amenity and increased traffic movements in the local streets, needs to be carefully considered and managed as part of any new development. The submission considered the social issues in a scoping exercise consistent with Councils draft social impact assessment (SIA) policy. A further SIA in accordance with the draft SIA DCP will also be required with the development application.

The economic implications are considered positive. The proposed development would not only provide job opportunities during the construction phase but will bring additional revenue into the local businesses and area once established.

Development of Area 6 (part of Lot 1 DP 127485) as residential development is considered to be to be a logical extension of the existing residential development in Bangalow Village. The site (Area 6) is identified within the Bangalow Settlement Strategy and the Far North Coast Regional Strategy as a future release area. There is a slight change proposed to the boundary of the area identified in the Strategies to ensure the proposed residential area is flood free.

The site adjoins a newly developed residential area of Bangalow, so if it is developed, it should have a minimal impact upon the village character associated with this area. However, the site is potentially visible from Lismore Road, and increased density could adversely impact upon the amenity of the area if appropriate DCP controls are not implemented. It is recommended that a site specific DCP be prepared which will include slope, design issues, bulk and scale, and site of buildings etc to assist in reducing visual impact. The application indicates access from Thomas Street and this will have some potential impacts on the amenity of existing residents. Whilst the Strategy stated access from Lismore Road was the preferable access, the flood issues associated with the site restrict this opportunity.

The residue of the site is recommended for rural zoning as the land is classified as being of high agricultural value.

Part of the site is identified within the settlement strategy for future release, and sufficient justification for its development is given within the rezoning submission, as assessed above.

Recommendation

It is recommended to zone Lot 1 DP 127485 Lismore Road, Bangalow to R2 Low Density Residential, RU1 Primary Production or RU2 Rural Landscape and E2 Environmental Conservation as shown on Figure 4 in Appendix K.

(e) Area 7, Parrot Tree Place, Bangalow

The site has frontage to Parrot Tree Place, which is accessed off Rifle Range Road. The majority of the site is cleared and has previously been utilised for grazing. There are no buildings or structures on the site. It has an area of approximately 5.87 ha and is irregular in shape but is designed to accommodate an extension of the adjoining subdivision. The site is currently zoned 1 (b1) Agricultural Protection under Byron LEP 1988.

Appendix C

Land Owner Statutory Declaration Contamination

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Keith and Joan Daly
"Sunnyside"
59 Lismore Road
Bangalow
NSW 2479

I, the undersigned, recall this information regarding our family property, which is Lot 1 DP 127485 in Bangalow and in particular that section of the property located north of Paddy's Creek and northwest of Byron Creek:

- The land has been and is being used exclusively for cattle grazing from 1926 to the current date.
- My father, James Ernest Daly operated the farm from 1926 to 1951.
- My Mother operated the farm from 1951 to 1964.
- My Brother, John Charles Daly operated the farm from 1964 to 1970.
- I, Keith Patrick Daly, have been operating the farm since 1970.
- There was never a cattle tick dip site used on the property or within 200 metres of the property since 1926.
- The land has not been used to grow crops since 1926.
- I have no recollection of any chemicals being used on the property since 1926.

As far as my knowledge extends, this is the only information I have regarding the historical usage of the property.

Signed on 2 February 2007

K. P. Daly

Keith Patrick Daly

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Appendix D

Social Assessment

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D.1 Introduction

Byron Shire Council has developed the *Draft Social Impact Assessment Development Control Plan* and the *Draft Social Impact Assessment Policy* as mechanisms for identifying and assessing the impact on communities of proposed projects, policies and development.

Social impact assessment looks at potential social impacts of change, using measurable social variables and community consultation as tools. The process includes plans to manage the identified impacts, whether positive or negative.

Initially a Social Impact assessment scope was prepared to identify the parameters of the study. The scope is presented in Table 3.5.

Table D.1 Social Impact Assessment Scope

What are the standard issues for consideration? *(These issues are not listed in order of importance)*	*What baseline data is available?*	*What information needs to be collected by the applicant?*	*What is the most appropriate collection tool?*	*What is the most appropriate analysis tool?*
Transport	Road, rail, cycleway/ walkway access to town and places of employment. Byron Shire Council Social Plan	Public transport services map. Local perception and experience with access and transport availability	Call to bus companies Local experience in accessing transport facilities	Map showing accessibility of site to public transport, pedestrian and private transport networks linking to commercial, recreation, tourism and industrial areas.
Safety and security	Crime statistics from police records	Crime statistics from local police station Community input	Liaison with police Neighbourhood community consultation	No specific analysis tool needed
Diversity	Community profile data	Demographic profile statistics (ABS)	Download local census data	Comparison to state and regional statistics Check alignment with Byron Shire Council social plan
Amenity	Information regarding existing community facilities (parents with young children, people with disabilities, young people, and elderly)	Amount and location of local open space Range and availability of community facilities	Liaison with council social planners Open space audit	No specific tool needs

What are the standard issues for consideration? *(These issues are not listed in order of importance)*	*What baseline data is available?*	*What information needs to be collected by the applicant?*	*What is the most appropriate collection tool?*	*What is the most appropriate analysis tool?*
Employment and training	Employment statistics – census data Existence of local training facilities	Information on various employment and training options within accessible distance	Download census data Liaison with local trainers	Compare the employment levels of the working population of Bangalow to that of surrounding areas, and assess the growth potential of the employment and training sector within the village and beyond.
Culture and village character	Bangalow Settlement Strategy Previous heritage studies	Community feedback on village character	Community consultation	No specific tools required

Community Consultation was required for the below tabulated items.

Table D.2 Community Consultation

Issues to be covered	*Community Representatives that need to be included*	*Number of sessions to be held*	*Advertising of sessions required*
Transport	Local bus company Residents in the vicinity	One	None
Safety and security	Residents in the vicinity	One	None
Culture and village character	Residents in the vicinity	One	None

The methodology used in undertaking the social impact assessment study is to assess the current situation in relation to all the issues identified for consideration, and then to indicate if and how the proposed development would impact upon the 'status quo'. These issues and the possible impacts as a result of the proposed development are discussed below.

The area being proposed for development extends from an already established urban area, and it will be planned and designed in such a way that it will result in an 'extension' of this community. Through this reasoning, it is expected that the proposed development will result in minor social impacts and therefore minimal change in comparison to the status quo.

D.2 Transport

Current issues identified include:

- regional bus network serves Bangalow; and
- Robinson, Charlotte and Thomas streets service the site.

Possible impacts as a result of proposed development include:

- increase in level of traffic, especially on the intersection of Robinson Street and Lismore Road; and
- demand for bus services could increase.

The rezoning of the site will provide for a relatively minor extension of the village area. The primary local access road, Robinson Street, is in place.

Residential development of the site will not generate significant additional traffic volumes. Depending on ultimate design, additional traffic volumes are likely to be in the order of 400 vehicle movement per day. In the context of the existing network capacity, this increase is minimal and is unlikely to result in any detrimental local social impacts. The internal road network can be provided as a loop road, effectively 'splitting' the total traffic volumes between Charlotte and Thomas Streets. The loop road can be designed to provide for future bus movements.

D.3 Safety and Security

Current issues identified include:

- according to a member of the Police Accountability Team and recent crime statistics, Bangalow is regarded as the safest place to live in coastal NSW between Newcastle and Tweed Heads; and
- a positive social impact on the community's feeling of security has been identified as a result of this.

Possible impacts as a result of proposed development include:

- low impact on safety and security of Bangalow's community would be expected, if the development follows previous development impact patterns; and
- on an urban design level, planning for safety and security can be reinforced through measures such as the use of street lighting, neighbourhood surveillance opportunities, and creating usable and accessible open public spaces.

Impacts on local safety and security can be minimised through incorporation of Crime Prevention Through Environmental Design (CPTED) principles at subdivision design stage. This is a requirement of Council, and so can be expected to occur. As such, the proposed rezoning will not significantly increase local safety and security issues.

D.4 Diversity

Current Issues identified include:

- Bangalow has a diverse demographic profile for a small village, and boasts a village feel and character that incorporates various groups.

Possible impacts as a result of proposed development include:

- The proposed development could offer even further diversity to the village of Bangalow. With new residents, come new skills, talents and an inevitable contribution to the village's diversity.

Residential development of the site is likely to have a beneficial impact in terms of adding to existing local diversity.

D.5 Amenity

Current issues identified include:

- according to the Bangalow Chamber of Commerce president, Michael Malloy, this year's kindergarten has five classes – a jump from three last year. He says the Primary school is at full capacity at present, and there may need to be an expansion plan urgently put in place; and
- community facilities are stretched in other areas as well. Single parents and single person households are not sufficiently catered for in the way of available affordable accommodation.

Possible impacts as a result of proposed development include:

- the proposed development will put further pressure on the already stretched resources with regard to community facilities. Conversely, additional Section 94 contributions coming from the development can add to the potentially available funds for the provision of new / additional facilities; and
- the new development could contribute to alleviating certain amenity / facility shortfalls, especially with regard to single person dwelling stock.

In the context of the existing Bangalow population, the rezoning of the subject site is minor. It will not significantly add to the local population.

Council's Section 94 Contributions plan provides for additional amenity / community facility outcomes commensurate with the scale and level of development. The development of the subject site will require the payment of various monetary contributions that will go toward the provision of additional / new services and facilities.

D.6 Employment and Training

Current issues identified include:

- residents of Bangalow currently rely upon the retail employment opportunities within the village of Bangalow, are self employed, work from small industrial operations in the Industrial Estate in Bangalow, or travel to Lismore, Tweed Coast, Byron or Ballina for other employment opportunities;
- secondary education institutions are not available in Bangalow, students must travel to Lismore, Byron, Ballina or Kingscliff; and
- tertiary training opportunities exist in Lismore, Kingscliff, Ballina and Wollongbar at TAFE and university institutions.

Possible impacts as a result of proposed development include:

- the proposed development will put further pressure on the already stretched resources with regard to employment and training facilities. Conversely, the additional population can add to the existing 'local market' for goods and services, creating new employment opportunities or strengthening the viability of existing employment ventures.

In the context of the existing Bangalow population, the rezoning of the subject site is minor. It will not significantly add to the local population. Impacts, positive or negative, on local employment and training opportunities are therefore not likely to be significant.

D.7 Culture and Village Character

During a study on Northern Rivers Regional Strategy, the Bangalow residents consulted felt strongly that the desirable qualities of a village (including size and quality of life) should be defined by four factors:

- walkability that is, the ability for most of the resident population to easily walk to all services and facilities;

- self-reliance that is, the village should 'stand-alone' and not rely heavily upon the services of other villages, towns, regional centres or cities;
- active democracy that is, a strongly networked community that actively participates in decision making relating to activities, events and future planning for the village – a 'strong sense of community; and
- distinctive image that is, the village should tell a story about its past and reflect the ideals of its community.

These four core principles were identified by the community as being critical to a successful village and include many important principles such as sense of community and sense of place.

Current issues identified include:

- the character of the Bangalow village would certainly be changed should new development overwhelm the landscape. Slow, phased development is, however, beneficial in contributing to extending the village as a place which is more self reliant, with a distinctive image; and
- the walkability of a village does become more difficult as its size grows outwards. The proposed site is still within walking distance of the village core, and therefore meets with the expectations of the community with regard retaining a village 'feel'.

Possible impacts as a result of proposed development include:

- the proposed rezoning would not affect the culture and character of the village if it is developed using the guidance of various strategies and principles outlined by the existing community in Bangalow; and
- the proposed rezoning is identified as being a candidate release area for urban settlement by the Bangalow Settlement Strategy (which was developed in consultation with the community). It is therefore assumed that the area has already been assessed in terms of fitting in with the 'desirable qualities' of Bangalow village residents.

The subject site is within walking distance of the village core and constitutes an 'extension' of an existing residential area. The development site and potential yield are not large in the context of the village. Development of the site is therefore unlikely to have a significant impact on the existing village character.

D.8 Previous Community Consultation

Detailed community consultation workshops were undertaken in Bangalow over the past 6 years, for two projects, namely the Bangalow Settlement Strategy and the Northern Rivers Regional Strategy.

The Northern Rivers Strategy workshops explored the potential role and contribution of villages in establishing and ensuring social, economic and ecological sustainability. This work was primarily focussed on settlement and population growth and economic development in the Northern Rivers region. The workshops also sought to establish community values relating to villages and examine a number of village characteristics (including size, density, community identity, connectedness and integration, function and design, diversity and multi-functionality).

The community was invited to participate through three processes – face to face interaction on the street; workshop of local community group leaders; and a website with a community questionnaire. In addition, various local community representatives were contacted, and their input recorded.

A summary of the survey responses is outlined below.

Economic Issues

Approximately 60% of the community group representatives surveyed were employed, most of whom were working in Lismore. Agriculture and tourism were identified as the main industries in Bangalow. Dairy and

timber were the main industries from which Bangalow was thought to have evolved. The village evolved as a result of people locating to the place because of industry or employment. Most people carry out their day-to-day shopping in the village centre of Bangalow. Services which are most wanted in the community include public transport, police, weekly farmers' markets and a public swimming pool.

Environmental Issues

There was an overall consensus that the historical element of the environment has been protected adequately. However, the environment in terms of landscape and important wildlife habitats, in their opinion, had not.

Most community group representatives have noticed an increase in housing and subdivisions as well as improvements to the main street in the last five years. Most people live in timber dwellings of which most are single detached houses that were built 10 – 20 years ago.

Social Issues

Most community group representatives surveyed describe Bangalow as: historical, busy/alive, expensive and relaxing. Bangalow's special attributes include: being small, historical, rural/country, quiet and culturally diverse. Most people travel to Byron Bay to the beach or walk within the village for recreation and generally agree that there are enough recreational areas in Bangalow. The community believes that the village atmosphere is created due to the fact that it is friendly and democratic, cohesive, and has a small population and physical size (walkable). The advantages of living in a village environment include: being able to walk everywhere, safety, knowing residents, and community spirit/caring for one another. Disadvantages included the lack of public transport and shopping facilities.

Other general comments include:

- businesses are doing well, but there is little opportunity for work especially for the young;
- business success is dependent on the type of business e.g. real estate doing well, but the 'lolly shop' (retail sector) is not;
- improved rail service between Byron Bay, Bangalow and Lismore is desired;
- public transport is poor;
- lots of changes and new concepts were emerging from Bangalow – pesticides (drift), Landcare and Waterwatch, cycle ways, ways to deal with vehicle emissions, wildlife corridors, internet, and types of housing.

Survey Responses from Business Sector Representatives

The majority of the business sector surveyed were either professionals or in the retail sector. Most of these people were born outside of Bangalow, from other towns in NSW, outside of NSW or overseas. A cross section of ages was surveyed, however most people were aged between 51 – 60 years. All of the business sector representatives surveyed are residents and have lived in Bangalow for an average period of approximately nine years. Generally, they think that Bangalow is successful socially, however, they are undecided as to whether Bangalow is successful, or not, in terms of economics and the environment.

Economic Issues

The people surveyed from the business sector are either business owners or they are employed and work in the village centre. The main industries, in their opinion, include: local trade/services; tourism; agriculture/farming and real estate. Generally, they believe that the original industries from which Bangalow evolved were: dairy; timber; and farming/agriculture. Most shopping is carried out in other villages or towns including Tweed Heads, Ballina, Byron Bay, Lismore and Mullumbimby. Services which are particularly wanted in the village include: more food shops; banking facilities with regular hours; regular trains and transport in general.

Environmental Issues

Sixty-five percent of the business sector people surveyed believes that historic landscapes and structures, and important wildlife habitats have been protected adequately in and around Bangalow. Most people agree that there are too many housing estates, and have noticed this change in the last one to five years. They mostly live in single detached dwellings made of timber or red brick, which were built approximately 20 or more years ago. The architectural styles of their houses mostly reflect the heritage and culture of the village. Ninety percent of residents recycle waste.

Social Issues

The business sector describes Bangalow as being: historical; busy/alive; expensive and relaxing. Bangalow's special attributes include: its people/ friendly nature; history; location and small size. Most people feel as though they are valued as part of the village community and partake in numerous community events. A large proportion of people believes there are not enough recreational areas and would like botanical gardens and a public swimming pool. They believe the village atmosphere is created by the friendly residents and the small population size.

The advantages of living in a village include: feeling safe; being close to work and having a sense of belonging. The most common disadvantages included: lack of shopping; loss of anonymity and access to transport. However, there was a portion (approximately 40%) that believed there are no disadvantages at all to living in a village environment.