10.0 Conclusion

Bonville is in the Coffs Harbour Local Government Area approximately 12km southwest of the city centre. The new Pacific Highway traverses the eastern part of Bonville and Pine Creek Way provides the main access through Bonville. A series of other roads connect with Pine Creek Way and provide access into the various parts of Bonville. Bonville includes a public primary school on Gleniffer Road, a service station and Australia Post outlet, a caravan park, over 55's living village and the Bonville International Golf Resort. Under the Coffs LEP 2000, Bonville is zoned mostly 1A Rural Agriculture with areas of 1B Rural Living, 7A Environmental Protection – Habitat and Catchment and 6A Open Space Public Recreation. There are areas of 6C Open Space Private Recreation and 2E Residential Tourist associated with the golf course property.

Bonville is located about the catchments of Bonville, Pine and Reedys Creeks. It is an undulating landscape with a series of ridges, hills and basins. The most notable ridges are the vegetated ridge to the north of Bonville and the ridge along Gleniffer Road. The site is a mixture of rural living and agriculture with small areas of cropping and grazing land. Cropping activities tend to be relatively small with crops including bananas, orchards and vegetables. Grazing is mostly by horses and cattle.

Much of the site is cleared and many areas of remnant vegetation are dominated by Camphor laurel. The largest expanse of remnant native vegetation is on the south face of the ridge extending from Tuckers Nob State Forest. Riparian vegetation is a combination of native vegetation and exotic weeds. Native vegetation at Bonville is mostly fragmented and has been affected by past and current land uses.

Bonville is a scenic Coffs Harbour location. The mountains to the west descend to create the valleys about Bonville and Pine Creeks. The undulating landscape and scenic setting means there is a variety of attractive views across the site. Scenic landmarks include the vegetated ridge to the north of Bonville, the vegetated ridge to the west of Bonville and the distinct Bonville Peak. The undulating rural landscape, the area of remnant vegetation and the riparian areas add to the scenic quality of Bonville. Bonville has a distinct visual character as a rural landscape within a natural setting.

In 2009, Coffs Harbour City Council adopted the Rural Residential Strategy. The strategy identified Bonville as the Priority Release Area due to its proximity to Boambee, Sawtell and Toormina and the Coffs Harbour city centre. The RRS recommended a one hectare lot size be adopted to provide a semi-rural ambience and to avoid the suburban character established by smaller lot sizes.

Further studies were required to be undertaken to facilitate the rezoning of the Bonville area for rural residential/large lot residential purposes. This Visual Analysis has been prepared for Coffs Harbour City Council as one of a series of environmental studies which will inform the rezoning process and the preparation of a Development Control Plan (DCP) and Contributions Plan (CP) for Bonville.

The purpose of the Visual Analysis was to:

- establish the key features contributing to Bonville's scenic quality;
- identify the potential visual impacts of future development relative to the current development of the site;
- identify locations particularly sensitive to visual impact; and
- identify view corridors from the Pacific Highway and Pine Creek Way.

This Visual Analysis considered the existing character of the site and its surrounds to identify what is the scenic value of the study area. Views beyond the site were found to be significant in establishing Bonville's visual character and its sense of place. The key features contributing to Bonville's visual character were found to include remnant vegetation, the site topography and creeks, the rural landscape, streetscapes, the village facilities and the golf course.

The vegetation of the Tuckers Nob State Forest serves to provide a backdrop to views to the west. Vegetation to the north, within the golf course and along riparian areas is also important in adding to the visual character. The variety and 'format' of vegetation across the site gives great visual diversity and also 'softens' the built elements of the study site. The undulating landscape provides great diversity in views across the landscape. The ridges and peaks beyond the site are scenic features. Bonville and Pine Creeks are local landmarks, particularly by their association with the Bonville Creek estuary and Bongil Bongil National Park. The rural landscape creates an overall impression of a visually complex landscape with a variety of activities and lifestyles occurring. It includes hobby farms with a few stock, larger farming properties, bush retreats and large new homes on elevated locations. It is an eclectic landscape but the overall impression is of a 'green' landscape with plenty of space and great visual amenity.

The visual character of Bonville's roads and village elements also contribute to its amenity. Many newer streets within Rural Living areas are devoid of trees, but generally roads elsewhere include road side vegetation. This vegetation gives a distinct 'country road' character to these locations. Distinctly rural elements such as fencing, paddock trees and green paddocks add to the rural character. The village is somewhat spread out with facilities along Pine Creek Way and Gleniffer Road. Each element, particular the Memorial Hall and school, have their own visual character, and collectively they contribute to the village feel of Bonville. The old timber bridge over the Pine Creek Way is an historical feature to the location. The Bonville International Golf Course is a local landmark and a feature to north Bonville.

The key site features occur across the study site in a variety of patterns and densities. The Visual Analysis divided the site into 15 Landscape Character Units to assess the occurrence of key features across the site and to evaluate the likely visual impacts of future rural residential development upon Bonville. The assessment for each Landscape Character Unit considered:

- the location;
- the characteristics of the Landscape Character Unit including zoning, vegetation, topography, pattern, density and character of built form;
- the dominant visual character and scenic quality of the Landscape Character Unit;
- views to and from the unit and the visual prominence of the unit;
- the context of the Landscape Character Unit; and
- the sensitivity of the Landscape Character Unit to change.

Figure 16 mapped the Landscape Character Units, each unit's Scenic Value and Visual Sensitivity to Change. Units found to have a high visual sensitivity to change were typically large areas of picturesque rural landscape that provided broad outlooks to the scenic landscape to the north and west. Units with a moderate scenic value tended to include a mix of built infrastructure.

Visual Sensitivity to Change was affected by the nature of existing views to the unit, the location of the view point and the extent and context of the unit. Areas found to have a high visual sensitivity to change were typically large areas of rural land visible from main roads. Units with a moderate visual sensitivity to change typically included an existing density of built infrastructure and could only be seen from limited locations. These units provided an appropriate context for further development. A limited number of units were found to have a low visual sensitivity to change

largely because the locations were mostly hidden from view or were close to existing Rural Living. For existing properties within each of those locations, it is likely that the residents would have a high sensitivity to any change within their immediate environment.

Future development cannot occur within the study area without resulting in a changed appearance to Bonville. Development will result in an increase in built dwellings and infrastructure and a reduction in the rural landscape. To maintain the scenic quality of the area, development needs to be executed in a way that suits and contributes to the visual character of Bonville. The final phase of this report describes Visual Enhancement Strategies for future development so that it may contribute to retaining the desirable visual character of Bonville. These strategies commence at the 'big picture' and progress to the individual design of future lots.

The **VISUAL ENHANCEMENT STRATEGIES** are:

Protect and Enhance Scenic Features

1. Maintain vegetation to Tuckers Nob State Forest as a natural backdrop.
2. Avoid visual scarring to ridges by locating infrastructure away from these locations.
3. Enhance existing and new creek crossings as visual connections to the natural landscape.
4. Retain areas of native vegetation to provide separation between development areas.
5. Retain native road side trees to provide screening to new development.
6. Retain scattered paddock trees (e.g. Figs and Eucalypts) as features to new Large Lots.
7. Avoid vegetation removal that leaves development devoid of natural features.
8. Set dwellings into hills where they are less prominent. Stabilise banks with planting. Rehabilitate ridges with weed removal and revegetation strategies.
9. Avoid siting dwellings on ridges where they can detract from the scenic landscape.
10. Integrate creeks and drainage lines as public open space. Rehabilitate drainage lines with weed removal and revegetation.
11. Maintain scenic views out from roads. Locate street trees to maintain or frame scenic views.

Contribute to Site Legibility and Uniqueness

12. Establish new businesses in closed outlets.
13. Upgrade existing closed facilities to be part of the new Bonville village.
14. Provide pedestrian and cycle links along Pine Creek Way as a main route.
15. Install new street trees with a focus on using locally native species. Consider large feature trees at locations where there road reserve is particularly wide.
16. Locate street trees to maintain and frame views to the scenic west.
17. Remove highway infrastructure that is no longer required.

18. Minimise signage to reduce visual clutter. Adopt a Bonville palette of signage.
19. Establish landmarks or built elements to clearly define the arrival at Bonville.
20. Provide street trees to new and existing development to add amenity and provide shade.
21. Create a village centre to become the community hub where residents can meet and interact. Provide good pedestrian and cycle links to the centre.
22. Locate the village centre and public locations with views to Bonville's scenic features to add distinctiveness to the suburb.

Understanding the Site

23. Undertake site investigations for each site that becomes the subject of development so that a site appropriate response can be evolved.

Subdivision Layout

24. Establish lots with enough space to accommodate all built infrastructure and services.
25. Avoid development on steep locations where more cut/fill and built infrastructure is required.
26. Use natural features to provide separation between lots and dwellings.
27. Stagger building sites to provide separation between dwellings.
28. Consider how the development will be seen from public locations.
29. Consider views from the development.
30. Minimise the division of remnant vegetation and riparian zones into many ownerships.
31. Provide public pedestrian and cycle links along streets and potential open spaces.
32. Include street tree planting to new roads.
33. Design subdivisions to be appropriate to the site topography.

Lot Planning

34. Prepare a lot plan that considers all the elements required and how they can be best sited.
35. Provide a minimum setback of 20m from the front boundary and 10m from the side boundary.
36. Consider greater setbacks with landscape elements located to create a 'green' visual buffer between the public road and dwelling and adjacent properties.
37. Use building styles and materials appropriate to the rural and natural setting.
38. For larger subdivisions establishing a design theme and covenants.

39. Adopt a limited palette of materials to create a cohesive landscape without clutter.
40. Adopt environmentally sustainable design principles.
41. Consider the use of locally available materials and labour.
42. Design buildings to be 'light' on the landscape.
43. Avoid large areas of cut and fill and visually dramatic retaining walls.
44. Design to take in the scenic views, but to have privacy.
45. Avoid large expanse of hard materials and locate services away from public view.
46. Consider a curved, gravel driveway with tree planting over a hard, straight driveway.
47. Use permeable, natural materials over hard materials.
48. Retain existing vegetation within individual lots.
49. Plant new trees.
50. Add to the amenity of streets by planting trees along frontages.
51. Establish community groups to create 'greenbelts' across properties.
52. Retain areas of unmown natural grasslands to maintain groundcover.
53. Use native species.
54. Use landscaping to provide privacy and to 'soften' built elements.
55. Adopt a rural fence style. Avoid solid, high fencing.
56. Integrate stormwater management into the site design and improve stormwater quality through Water Sensitive Urban Design measures.
57. Enhance retained vegetation with revegetation strategies.
58. Instigate a weed removal strategy.
59. Encourage wildlife to your garden through native planting.
60. Encourage the natural regeneration of native species by fencing off areas and not mowing.

It is intended these strategies be included, and further developed, in future planning and the preparation of a Development Control Plan for Bonville Rural Residential areas.

References

2009 Coffs Harbour City Council, *Rural Residential Strategy,* Coffs Harbour, NSW.

2013 Ecological Australia, *Bonville Rural Residential Local Environmental Study,* prepared for Coffs Harbour City Council, Coffs Harbour, NSW.

2000 Coffs Harbour City Council, *Local Environmental Plan,* Coffs Harbour, NSW.

2013 Coffs Harbour City Council, *Draft Local Environmental Plan,* Coffs Harbour, NSW.

APPENDIX F – Archaeological Assessment

BONVILLE RURAL RESIDENTIAL ENVIRONMENTAL STUDIES AND PLANNING PROPOSAL

Aboriginal and European Heritage Constraints Assessment.

July 2012

Prepared for

Coffs Harbour City Council

Prepared by

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Tim Hill Heritage Management and Planning.

Prepared for

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EXECUTIVE SUMMARY

The purpose of this Heritage assessment is to investigate and document the range of issues/constraints that require further investigation to enable the zoning of lands at Bonville for rural residential purposes/large lot residential development. This project involves the preparation of a planning proposal that will inform an amendment to the Coffs Harbour City Local Environmental Plan (LEP) 2000 and draft Coffs Harbour LEP 2012, as well as the preparation of a Development Control Plan (DCP) and Developer Contributions Plan (CP) for the release area.

The archaeological survey employed a 'meandering pedestrian transect' methodology with a total distance of just over 14 kms (Table 1). Survey areas were identified and targeted and considered location and position within the study area so-as to capture as broad a sample of topography as possible and to target areas considered likely candidates for future rural residential development. Survey transects were recorded with a GPS – some images were taken to demonstrate the nature of the study area and transects (see photos below). Significant survey constraints included access to land and ground visibility.

The results of the survey confirm the predictive model that '*it is unlikely that Aboriginal use of the study area- being 'away from the littoral'- was either intensive or likely to be represented through archaeological evidence'*. Given the survey constraints it is 'possible' that archaeological materials exist within these areas- and as such future development would be guided by the NSW Due Diligence Process. However in the context of an assessment relating to future zoning of agricultural land and regrowth forest in the study area *archaeological values should not be considered a significant constraint*.

The survey identified several 'board notched stumps' relating to early forestry activity in the Valley In addition, no evidence or accounts of mills or forestry infrastructure (apart from existing roads) were identified during the survey. This would suggest that horticulture has been a more dominant industry. The Old Bonville Bridge is an item worthy of consideration for heritage listing. There are few wooden trestle bridges left so near to the coast and its size and state of maintenance makes it a good example for future conservation. The future use of this method of bridge construction continues a historic theme within the valley and should be encouraged within the area.

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1. Background

The purpose of this Heritage assessment is to investigate and document the range of issues/constraints that require further investigation to enable the zoning of lands at Bonville for rural residential purposes/large lot residential development. This project involves the preparation of a planning proposal that will inform an amendment to the Coffs Harbour City Local Environmental Plan (LEP) 2000 and draft Coffs Harbour LEP 2012, as well as the preparation of a Development Control Plan (DCP) and Developer Contributions Plan (CP) for the release area.

The Bonville locality was recommended as the preferred area for Rural Residential Development due to its easy accessibility to the nearby centres of Boambee and Sawtell/Toormina and close proximity to the City Centre. The release of this land will also enable it to take full advantage of the facilities and services that will be provided to support the new urban population forecast for this area.

This project will inform Coffs Harbour City LEP 2000 and draft Coffs Harbour LEP 2012 (prepared under the provisions of the Standard Instrument (LEPs) Order 2006) in the form of a Planning Proposal.

The area is relatively free of land constraints with a rich natural landscape that provides a diversity of environments including coastal estuarine settings, wetlands, eucalypt woodlands, littoral rainforests, and rural/agricultural landscapes. Bongil Bongil National Park adjoins the eastern boundary of the study area. The majority of the study area is currently zoned Rural 1A Agriculture and Environmental Protection 7A Habitat and Catchment under Coffs Harbour City Local Environmental Plan 2000.

Lands within the centre of the study area are already zoned Rural 1B Living under the provisions of LEP 2000 (i.e. Braford Drive/Bakker Drive/Faviell Drive rural residential development area). Bonville Golf Resort, located to the north-east of existing rural residential development, has recently been the subject of a separate Planning Proposal and some of its lands are now zoned for tourist residential uses.

The Scope of Works for the Heritage Assessment included;

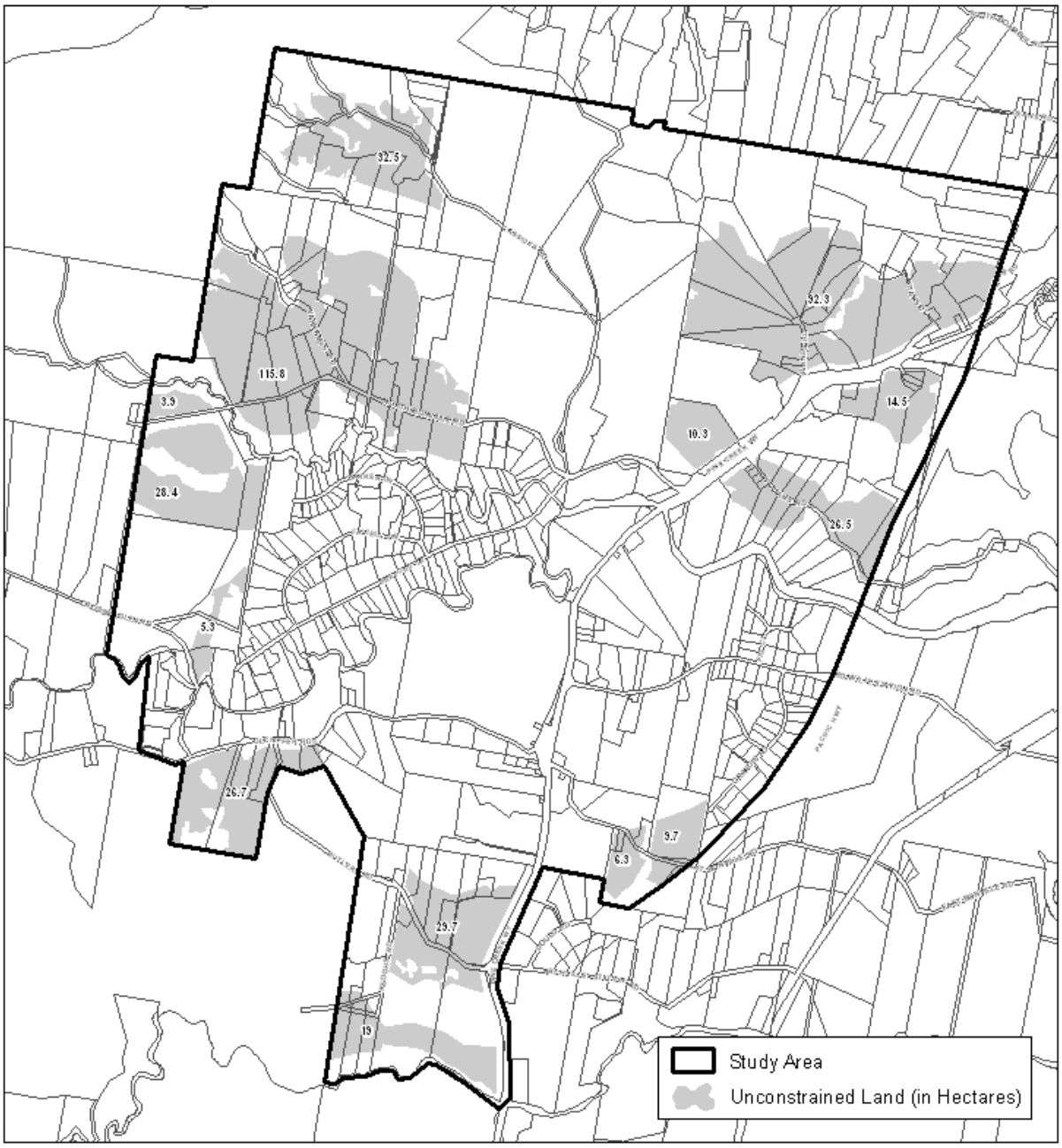
> The consultant must undertake an assessment as to the items or areas of Aboriginal culture and heritage, as well as European heritage.

Appropriate management strategies must be provided if Aboriginal or European sites of significance are found.

Consultation with the Office of Environment and Heritage and Coffs Harbour and District Local Aboriginal Land Council.

NOTE: During the archaeology assessment fort the North Boambee Valley (West) Planning Proposal, it was confirm by OEH that consultation with Local Aboriginal Land Councils is not a formal requirement for rezoning and strategic planning studies. Therefore, an assessment of 'areas' of Aboriginal cultural heritage significance will be restricted to a database search of declared 'Aboriginal Places'. Additional consultation with OEH will be undertaken to identify whether they have any Aboriginal Place 'nominations' identified within the study area. It is not necessary, and would lead to additional expense and delays, if consultation with Aboriginal community groups- such as Coffs Harbour Local Aboriginal Land Council and other any other family groups- are carried out for the purpose of the Planning Proposal.

Map 1- The Bonville area.



Candidate Area - Bonville

2. The physical environment.

The study are is located within the Mid-North Coast of New South Wales to the south of Toormina/Sawtell and the City of Coffs Harbour. Bonville itself is a locality with a rich forestry, pastoral and horticultural history and as such the study area has been significantly altered. The majority of the study area has been 'disturbed' and where native vegetation exists it is largely in the form of 'regrowth' forests. Several waterways and riparian zones do exist throughout the study area and are of specific interest to the heritage assessment.

Bonville Creek is the main drainage system comprising most of the northern area of the study area. Numerous small tributaries and moist gullies drain into Bonville Creek- however in general the study area does not include any areas of 'estuary'- most of the creeks in the candidate areas have freshwater and rocky bottoms. No mangroves were observed during the field assessment. Pine creek is a second major drainage system within the south of the study area- however only the upper reaches of this system is within the study area. Again- no estuarine areas were observed during the field assessment.

The major geological features of the study area include;

- Quaternary Alluvial soils associated to the lower drainage areas to the east of the study area;
- Permian sedimentary and basic volcanics to the south of the study area;
- 'Brooklana Formation' Carboniferous sedimentary in the north west of the study area; and
- 'Moombil Beds' Carboniferous sedimentary possible in a small section to the centre and west of the study area.

3. Literature Review and Predictive Model

3.1. European History.

The first historical documents relating to the Coffs Harbour area were the naming of the 'Solitary Islands' by James Cook in May 1770, with additionally mapping by Matthew Flinders in 1979. However – despite the early records from 1791 of two runaway convicts William and Mary Bryan and their two children running away to the area, however it was not until 1847 that the next record of the settlement exists, with Captain John Korff taking shelter at the southern Headland of the now 'Coffs Harbour'. European settlement of the area was relatively late compared to areas along the Bellinger and Clarence Rivers;

> There was at least some cedar getting at Coffs Creek by Walter Harvie and George Tucker in 1865, with the camp set up by Harvie and Tucker being one of the earliest known semi-permanent settlements in the Coffs Harbour area. Timber getters often employed the services of Aboriginal bushmen who had the knowledge and skills to rapidly identify Cedar trees. (Thomas 2013:2)

Geographic factors leading to this relatively late settlement of the Coffs Harbour area include it's distance between Sydney and Brisbane which reduced the security of pioneering settlements and the absence of a major river to access the rich timber resources typical of North Coast floodplains.

Table 1. List of early settlers in the Boambee & Bonville areas (sourced from Coffs Harbour City Council Library *http://libraries.coffsharbour.nsw.gov.au/Local-Heritage/collection/Pages/local-pioneers.aspx*)

Newport, James	1881	Near North Boambee bridge grew first sugar cane - mill operated by four bullocks
Bayldon, William	1871	Selected at present Lyonsville, named Bonville - chemist by training - much first aid treatment to pioneers - introduced good horses to Bellinger area
Reedy	1884	Selected Bonville Creek
Archer	1884	Selected Pine Creek
Gardiner, Charles	1892	Selected Boambee - grew pineapples, bananas
Keiler	1886	Selected near narrow Boambee bridge - several acres grapes - wine
Brewis, Richard/Sam	1892	Selected
Singleton, Matt		Selected Crossmaglen - very active in local affairs and did much for Bonville Reserve in its early days - bred fine stock
Schneider, August	1886	Selected Englands Road - established sugar mill, later sawmill

Several industrial/landuse themes can be defined within the Bonville area- being;

> Forestry and forest related industries including early extraction of Cedar and later more broad forestry remaining Eucalypt species. This later process of clearing has historic linkages to the settlement of the area post World War 1 and the clearing of land for early agriculture and horticulture.
>
> Horticulture and agriculture. Farming has played an important role in the study area and has had the most significant impact on the physical landscape. Large areas of land have been cleared and regrowth managed for grazing and horticulture. Significant early crops include Bananas, Sugar Cane and Pineapples. Some agricultural diversification has taken place- and contemporary landuse includes Blueberries, Aquaculture and Nuts (Macadamias particularly). A number of market Gardens have operated within the area and are consistent with the historical process of dividing agricultural land into smaller lots as the wider district population increases.
>
> Mining and Extraction. Some small quarries existing in the area and sand extraction has taken place along the coastal strip. Extractive industries have played a relatively minor historic role in the study area.

3.2. Aboriginal History.

The study area is located within the Gumbaynggirr Nation/Language Area which is broadly know to include the lands north of Nambucca Heads, South of the Clarence River and west up to the Great Dividing Range (Thomas 2013:1). The name Bonville is derived for the Gumbaynggirr place name 'Bongol Bongol/Bongil Bongil which which means a place where one stays a long time'. The derived name is assigned to W.E. Bayldon- the first selector in the locality. (Sourced for the Geographical

Names Board- July 2012
http://www.gnb.nsw.gov.au/place_naming/placename_search/extract?id=KWckFxtL).

There is a historical record of a 'fight' between the Sawtell and Clarence 'tribes' at the end of the 19th century 'on the ridge separating Boambee and Bonville Creeks'- however the camp associated to this event was located downstream nearer to Sawtell (Collins 1997:10).

Estimates of population density were common amongst early explorers , Government Officials and ethnohistorians. The earliest official records and data occurred well after the first stage of 'contact' and as such post-date an initial population decline through dispersal, disease and conflict.

Given the problematic nature of population estimates- the latter and more 'general' observations of Mathews (1898) for the broader Northern NSW coastline are more relevant;

> In the well watered coastal districts of New South Wales, where fish and game are abundant, their hunting grounds would be comparatively small" Mathews 1898:66.

Radcliffe Brown (in Lane 1970:V.8) concludes for the coastal areas that population densities would be in the order of 'one person to every three square miles'. Estimates of tribal groups in the order of 200 individuals are relatively common amongst ethnohistoric and anthropological literature (ie. Lane 1970 for the Nambucca River district immediately south). An additional element to this discussion of population density is the differentiation of the coastal and escarpment areas where it is generally accepted had lower and much more mobile Aboriginal populations. For the larger River systems (Nambucca, Clarence and Maclaey) the concept of more intensive use of the coast as compared to the up-river and escarpment is generally accepted (i.e McBryde 1974, Godwin 1990). However a uniqueness of the Coffs Harbour area is the close proximity of the Great Dividing Range to the Coast. No other 'district' on the North Coast has such a narrow coastal zone- or such a short distance between the very different environments of coast and elevated/cold forests. The extent to which this affected landuse is not known- however the absence of historic information about Bonville (as an example) indicates that this narrow intermediate zone was not intensively used. There is however great potential for pathways and routes between the coast and escarpment/hinterland.

The 'contact' experience of Gumbayngirr people of the study area is somewhat different to other groups resident on the larger river systems of the North Coast. There are no historical accounts of 'massacres' within the study area, although that is not to say they didn't happen along the coastal zone -such as the documented massacre at Red Rock (Goulding 2001:63). Unlike the larger properties and permanent building of European settlers, most Aboriginal living areas form the contact period tended to be very small shacks made from remnant and scavenged materials located usually on Crown Land. Historic living areas tended also to be seasonal- be it for seasonal bush resources such as fish runs of for seasonal work within the horticulture industry. Camps located inland- such as the Bonville area- tended to be on Public land and nearby to small townships where there was access to water either naturally occurring or at a public tap. The four main camping areas identified by Goulding (2001:64,65) area Corindi Lake, Inland from Arrawara, Nana Glen (junction of Orara River and Bucca Bucca Creek), Happy Valley in Coffs Harbour, Coffs Creek/Fitzroy Oval,

Wongala Estate and Yellow Rock. Generally speaking the historical experiences of Aboriginal people has been one of exclusion up until the 1960's;

> We have seen that the European group has almost universally accepted stereotypes of the Aboriginal group. These provide the rationale for its continued exclusion fro the social life of the European community. It has been shown that only some of the stereotypes are correct, and that Aboriginal communities are in a particularly vulnerable position with regard to scandal because the private lives of their members are the specific concern of certain members of the European group. (Calley 1956:201).

The nature of historic Aboriginal camps and economy within the historic period is such that it is unlikely these types of 'sites' will be present in the historic record of the study area.

4. Archaeological research within the study area.

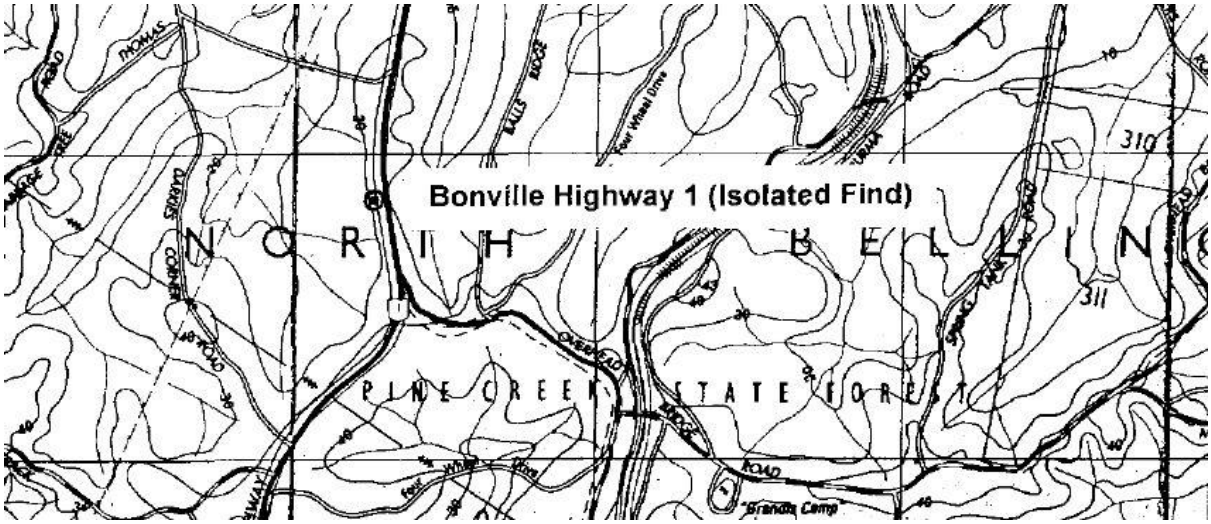
An AHIMS 'extensive' database search of the study area was completed in May 2013 using the provided shapefile. Six (6) records were returned- including one (1) 'Isolated Artefact' and 5 'Potential Archaeological Deposits'. No 'Aboriginal Places' have been recorded within the study area. No registered historic heritage items are within the study area.

Table 2. AHIMS database results.

No.	Name	Easting	Northing	Type
22-1-0103	Bonville Highway 1	502260	6639860	Isolated Find
22-1-0237	BPS02	503786	6638343	Potential Archaeological Deposit (PAD)
22-1-0241	BPS06,	505038	6640256	Potential Archaeological Deposit (PAD)
22-1-0242	BPS07	505319	6640945	Potential Archaeological Deposit (PAD)
22-1-0302	Bonville Borrow Pit 1	505042	6640167	Potential Archaeological Deposit (PAD)
22-1-0303	Bonville Borrow Pit 2	505315	6641062	Potential Archaeological Deposit (PAD)

A request for the site card for Bonville Highway 1 (BH1) showed that the mapped location of Bonville Highway 1 (BH1) is further south of the study area near 'Overhead Bridge Road'. It is possible that the coordinates were entered incorrectly on the card or within AHIMS.

Map 2. Location of Bonville Highway 1 from Site Card.



The most comprehensive 'regional' model for the area is provided by Godwin (1990) in a major review of the earlier archaeological research of Isabelle McBryde. Godwins model specifically investigates patterns of movement between the coastal, sub-coastal and tablelands (escarpment) areas. However the applicability of this model to the Bonville and Coffs Harbour area is problematic as the tablelands/escarpment intrudes so much in to the coastal zone. For the purposes of understanding the archaeological record the study area is considered to fall into the 'coastal' area.

> Amongst coastal groups proper there was no movement form the coast back into the sub-coastal river valleys and foothills. These people were semi-sedentary and lived close to the coast the whole year round. Movement associated with the subsistence round involved travelling only short distances away from the littoral. There were instances of long distance travel associated with ceremonial gatherings. However, such movement was generally parallel to the coast (i.e. north-south along the coast rather than east-west from coast to hinterland). (Godwin 1990:122,123)

Using this model it is unlikely that Aboriginal use of the study area- being 'away from the littoral'- was either intensive or likely to be represented through archaeological evidence.

The archaeological site 'types' possibly located within the study area include;

> **Surface artefact scatters** are the material remains of Aboriginal people's activities. Scatter sites usually contains stone artefacts, but other material such as charcoal, animal bone, shell and ochre may also be present. The size of scatters may vary from one square metre to larger areas, and may contain from a few to thousands of artefacts. Stone artefacts can be found almost anywhere Aboriginal people camped or lived, particularly around occupation sites, in sand dunes, rock shelters, caves, on ridges and near watercourses. Ground-axe edges may also be found near axe-grinding grooves or quarries.
>
> **Aboriginal culturally modified (scarred and carved) trees** are trees that show the scars caused by the removal of bark or wood for the making of, for example, canoes, vessels, boomerangs, shelters and medicines. The shape and size of the scar may indicate the purpose for which the bark or wood was removed from the tree. In some regions of NSW,

trees were carved with intricate patterns and designs for ceremonial purposes, or to mark country boundaries or burials.

Other site types- including middens, rock-art, quarries, burials and stone arrangements are not likely to be located within the study area due to a range of factors including; post- contact ground disturbance and land clearing; the absence of specific resources required to produce such sites (such as shells or suitable stone); and the low likelihood that the study area was used for these activities (for example there are no accounts of ceremonies being held in the study area).

It is possible that the study area- particularly the northern section- was used as a traditional pathway to the higher escarpment area. However this use would manifest in the archaeological record as isolated artefacts rather than extensive artefact scatters or scarred trees.

5. Methodology.

The archaeological survey employed a 'meandering pedestrian transect' methodology with a total distance of just over 14 kms (Table 1). Survey areas were identified and targeted and considered location and position within the study area so-as to capture as broad a sample of topography as possible and to target areas considered likely candidates for future rural residential development (Map 3). Survey transects were recorded with a GPS – some images were taken to demonstrate the nature of the study area and transects (see photos below). Significant survey constraints included;

Access to land. The survey was coordinated with the ecological survey and many landowners either did not allow access, did not confirm that access was available or were un-contactable during the time of the survey.

Ground visibility. In almost all cases survey visibility was severely restricted through grass or vegetation cover. The study area has had several good seasons of rainfall and grass cover in particular was significant. This nature of the project was such that these areas of pasture will be most affected by rural residential development and as such were targeted over areas of bushland.

Photo 1. Transect 6 showing small vehicle track between cleared pasture and regrowth forest.

Photo 2- Transect 10 showing dense regrowth and small mountain bike/walking track to the south of Crossmaglen Road

Photo 3. Transect 3 looking east across paddocks towards Pine Creek Way.

Photo 4. Transect 7 showing exposure associated to small four-wheel drive track.

Photo 5. Transect 10- example of recent private forestry regrowth.

Map 3. Location of survey sample areas.

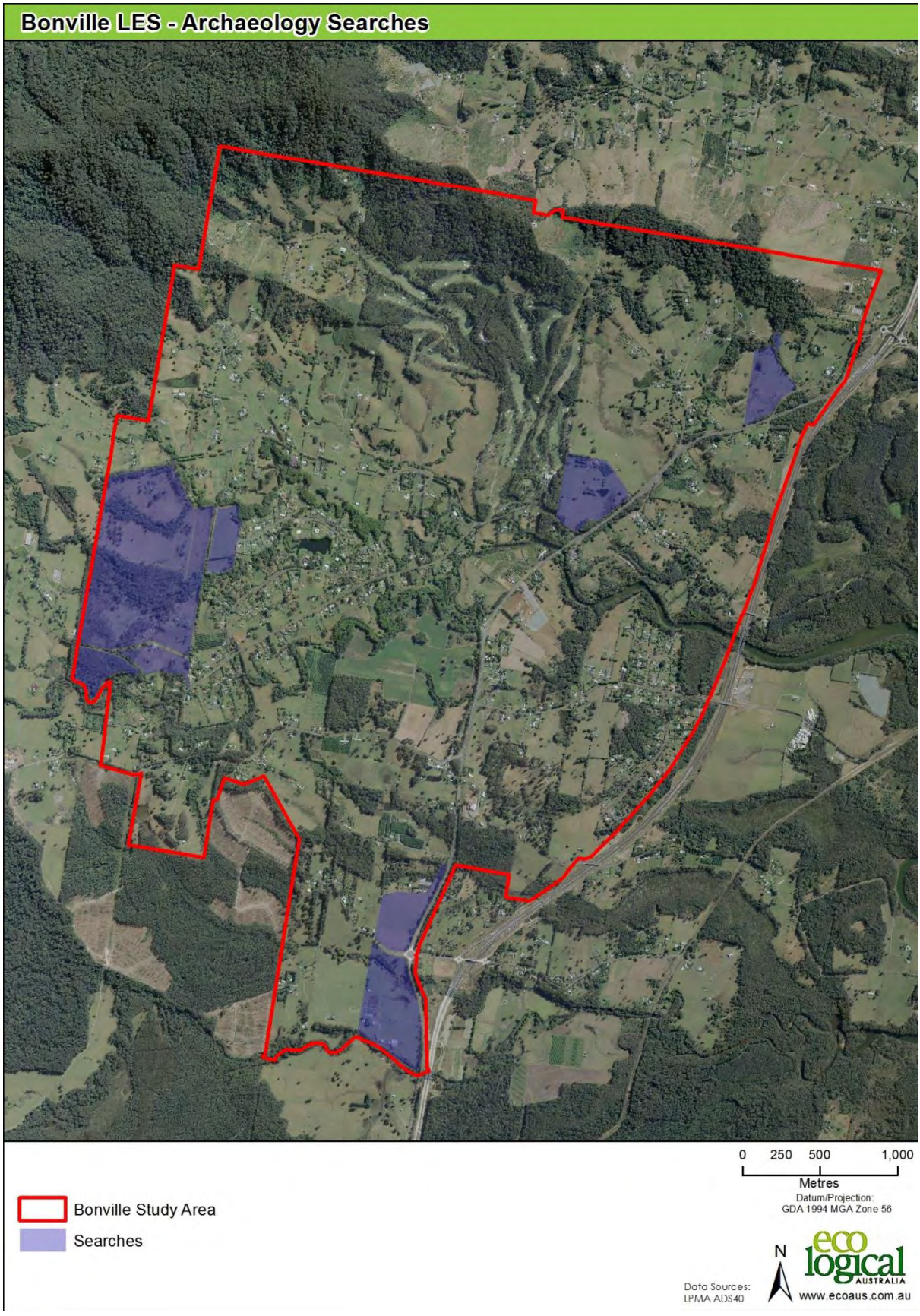


Table 3 Summary of survey transects.

No.	Description	Distance (m)	Visibility (%)	Sites
1	Bonville Creek- Northern bank/riparian zone. some ground visibility from a access track and from clearing by neighbours	188	30	
2	Titans Close-Low ridges and boggy gully. Would have been Swamp Mahogony now pasture. Some outcropping rock on the top NW corner unsuitable for knapping.	1766	0	
3	North Bonville Road- Low ridges with gullies but no creeks. Survey is higher up slope and above water table. Between B.I.G and the old highway.	2715	0	
4	Crossmaglen Road- riparian vegetation with mixed Eucylptus- mainly Tallowood. Dense understorey (predominately Lomandra)	584	0	
5	Flat cleared area west of the reserve at Bakker Drive. Introduced grasses but had been recently mowed.	458	10	
6	Elevated ridge at North Bonville Road. A slight vehicle track along ridge/fenceline with some visibility. Transect included southern slope of ridge which was regrowth forest. 30% visibility on ridgeline-	935	10	
7	Small creekline at North Bonville Road- some small 4wd crossings across the creek . Some visibility but up to 60% on tracks.	576	10	
8	Creekline and lower slopes off Crossmaglen Road. Currently used for small scale forestry resulting in some surface visibility as medium sized patches of ground with approx. 50% visibility. Some sedimentary (possible greywacke) pebbles and cobbles visible on ground surface.	2236	15	
9	Regrowth forest on southern slope of Crossmaglen Road- some small tracks from logging activity.	1180	10	
10	Regrowth forest on southern slope above small creek to the south of Crossmaglen Road. Some ground visibility from a walking/bike track approximately 30% in places.	596	5	
11	Open pasture with low northernly slope/aspect to the north of Pine Creek.	1970	0	
12	Steep south facing paddock to the north off Buttler Road.	526	0	
13	Low slope and creek line of Crossmaglen Road to the west of Bakker Drive – introduced pasture and some remnant native vegetation.	538	0	
	TOTAL	14268		

6. Results.

6.1. Historic Heritage.

The survey identified several 'board notched stumps' relating to early forestry activity in the Valley (Photo 1). The density of these features was much less than that identified in the Boambee Valley (Hill 2011) indicating that forestry might not have been as important an industry. In addition, no evidence or accounts of mills or forestry infrastructure (apart from existing roads) were identified during the survey. This would suggest that horticulture has been a more dominant industry.

The Old Bonville Bridge is an item worthy of consideration for heritage listing. There are few wooden trestle bridges left so near to the coast and its size and state of maintenance makes it a good example for future conservation. It is safe assumed that now the Pacific Highway has been rerouted that this bridge is getting less traffic than it has in the past and the structure appears to be coping with current traffic levels. An interesting note is that a landowner on Crossmaglen Road has recently built a trestle bridge as a feature of his property and has indicated that this method of construction is as cost effective as concrete bridge construction and likely will last longer. The use of this method of bridge construction continues a historic theme within the valley as well as in some ways supporting the local timber industry. Several other smaller trestle bridges were located across the study area, however these would not equivalent candidates for nomination as heritage features.

Photo 5- 'Board notched stump' on (the top west road)

Photo 6- Old Bonville Trestle Bridge

Photo 7. Trestle bridge as main property access- Crossmaglen Road.

6.2. Aboriginal heritage.

No Aboriginal sites were recoded within the study area. Significant factors contributing to this result include relatively low effective survey visibility due to grass cover, the extent of forestry activity removing pre-contact vegetation (of particular relevance to identification of scarred trees) and the likelihood that Aboriginal use of the study area was such that archaeological sites exist at very low densities.

7. Discussion.

The results of the survey confirm the predictive model that '*it is unlikely that Aboriginal use of the study area- being 'away from the littoral'- was either intensive or likely to be represented through archaeological evidence'*. The focus of the study- being on rural land- further reduced the likelihood of locating Historic or Aboriginal sites, and it is unlikely that rural residential development within areas of existing agricultural land and areas of forest regrowth would have a significant risk to archaeological features.

In the context of the planning assessment the 'Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales' (DECCW 2010) requires that activities within the following landscape areas require consideration under the Due Diligence process (Appendix 1);

within 200m of waters, or

located within a sand dune system, or

located on a ridge top, ridge line or headland, or

located within 200m below or above a cliff face, or

within 20m of or in a cave, rock shelter, or a cave mouth

and is on land that is not disturbed land (see Definitions).

The Due Diligence Code does not adequately define 'waters'. The survey included a range of stream/creeks in the study area and did not identify any sites. Likewise, ridgelines were included in the survey however no sites were recorded on these 'landscape areas'- indicating that 'disturbance' is a significant factor in the distribution of sites.

Given the survey constraints it is 'possible' that archaeological materials exist within these areas- and as such future development would be guided by the NSW Due Diligence Process. However in the context of an assessment relating to future zoning of agricultural land in the study area *archaeological values should not be considered a significant constraint*.

Consideration should be given- either by Coffs Harbour City Council or within development proposals- to seek expert ecological advise and mapping of areas of 'disturbance' given the significance of these areas within the Due Diligence process. This may involve an analysis of historical aerial imagery or may be available through other vegetation mapping projects.

8. Conclusion

The archaeological assessment of the within the study area included a total of 14km of meandering pedestrian transect. The survey was significantly constrained by access to land and vegetation cover associated to agricultural and forestry activity.

The results of the survey confirm the predictive model that '*it is unlikely that Aboriginal use of the study area- being 'away from the littoral'- was either intensive or likely to be represented through archaeological evidence'*. The focus of the study- being on rural land- further reduced the likelihood of locating Historic or Aboriginal sites, and it is unlikely that rural residential development within areas of existing agricultural land and areas of forest regrowth would have a significant risk to archaeological features.

The survey identified several 'board notched stumps' relating to early forestry activity in the Valley In addition, no evidence or accounts of mills or forestry infrastructure (apart from existing roads) were identified during the survey. This would suggest that horticulture has been a more dominant industry. The Old Bonville Bridge is an item worthy of consideration for heritage listing. There are few wooden trestle bridges left so near to the coast and its size and state of maintenance makes it a good example for future conservation. The future use of this method of bridge construction continues a historic theme within the valley and should be encouraged within the area.

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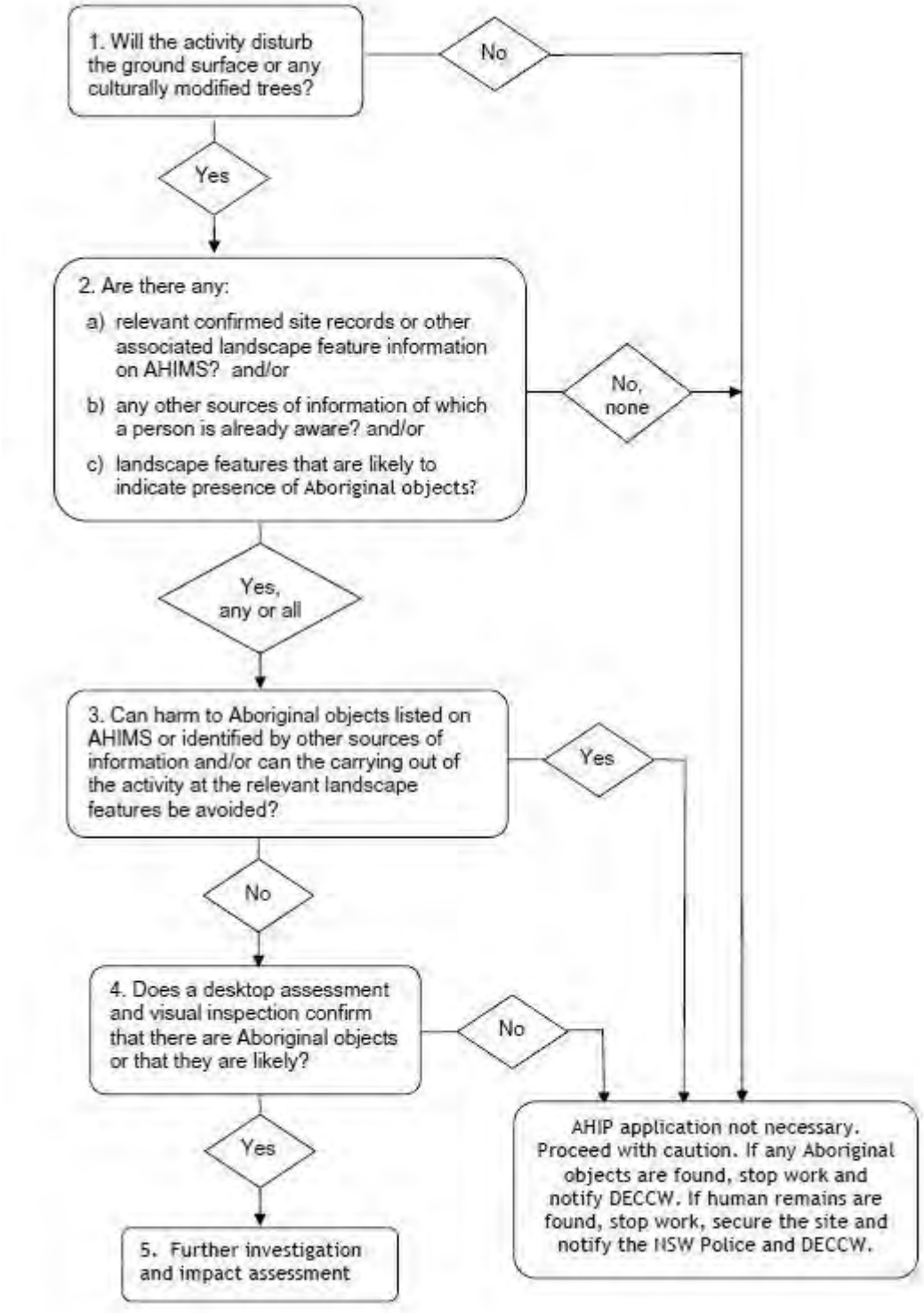
Appendix 1 The Generic Due Diligence Process



APPENDIX G – Flood Study

Bonville Rural Residential

Flood Mapping

Draft

December 2013

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D1 Preliminary Draft

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Name of Project:	Bonville Rural Residential
Name of Document:	Flood Mapping
Job Number:	13039

EXECUTIVE SUMMARY

This flood mapping has been prepared as part of a Local Environment Study of the Bonville Rural Residential Investigation Area. The study area encompasses some 1,858 Ha of mostly rural and rural residential land, west of the Pacific Highway at Bonville, some 10 km south of Coffs Harbour on the NSW mid north coast.

This study is limited to the mapping of land affected by main stream flooding. Such mapping forms a key input into the Local Environment Study. No determination of existing floodplain damages or further analysis of floodplain management options were undertaken.

In order to determine the extent of land affected by flooding, hydrologic and hydraulic computer flood modelling was undertaken. Key aspects were:

- A WBNM hydrologic computer model of the entire Bonville and Pine Creek catchments were prepared, extending to the ocean.

- The WBNM model included a rainfall elevation gradient consistent with recent Coffs Harbour flood studies.

- A Tuflow hydraulic computer model was constructed. The study area was modelled by a 4m two-dimensional grid. A one-dimensional model was extended from the study area to the ocean.

- The flood events modelled were:
  - 100-year ARI (1% AEP) flood under existing conditions. Temporal patterns from ARR87 (ref 4) were modelled for events of 30 min to 12 hour duration. Events of 2 hours (minor creeks) and 9 hours (Bonville and Pine Creeks) were generally found to be critical.
  - 100-year ARI with predicted effects of climate change by the year 2050 (0.5m rise in sea level and 10% increase in flows)
  - 500-year ARI under existing conditions.
  - The probable maximum flood (PMF).

- A sensitivity test was undertaken which found that flood level predictions within the study area are not sensitive to the ocean level assumption.

- The models were not calibrated due to an absence of data. However, the results were compared to what limited previous flood studies and historic flood level data is available. The comparison against previous studies was mixed, but was better against the limited historic flood data. The modelling for this study is considered superior to any previous investigations.

The results of the modelling are shown of Maps 1 to 7. These show the flood extends and contours for the 100-year ARI flood under existing conditions. The additional extents for the larger events are also shown.

1 INTRODUCTION

This investigation has been prepared as part of a Local Environment Study of the Bonville Rural Residential Investigation Area. The study area is shown in Figure 1 and covers some 1,858 Ha of existing rural, forest, recreational and rural residential land west of the Pacific Highway.

This study used computer flood modelling to determine and map flood levels and extents. Four flood events were considered:

- The 100-year average recurrence interval (ARI) flood under existing conditions;
- The 100-year ARI flood under climate change (2050 horizon);
- The 500-year ARI flood under existing conditions;
- The Probable Maximum Flood (PMF) under existing conditions.

The mapping prepared shows the main stream flood extents, flood depths and flood contours.

2 DATA SET

Three previous studies of relevance were reviewed:

- Bonville Creek Flood Study, (ref 1);
- Bonville International Golf Resort – Flood Study, (ref 2);
- Burgess Creek Flood Study, (ref 3).

The Bonville Creek flood study utilised RORB for the hydrology and EXTRAN for the channel hydraulics. The EXTRAN Hydraulic model extended from the ocean up to the then Pacific Highway (now Pine Creek Way). As such the hydraulic model only extended a short way into this study area. Regardless, this is the most expansive of the past studies and gives a basis to construct a downstream boundary for this study.

Ref 2 is confined to only a small part of the study area, being three minor creeks in and around the Bonville International Golf Resort. The study was undertaken using the steady state one dimensional HEC-RAS hydraulic model.

Ref 3 is also confined to only a small part of the study area along Burgess Creek. This is an old study using the one dimensional steady state HEC-II hydraulic model.

Council were also able to supply some historic flood level information from the November 1996 and March 2009 events.

3 HYDROLOGY

None of the hydrologic or hydraulic models used in the previous studies were readily available. Nor would they entirely meet the needs of this investigation. Fresh hydrologic modelling was undertaken using the WBNM computer model. WBNM was selected as it is well recognised in the industry, is freely downloadable and is EXCEL spreadsheet based. This makes it easily portable and gives the flexibility of a spreadsheet to manipulate the output data into a form compatible with the selected hydraulic model TUFLOW.

The WBNM model was set up with fairly course sub-catchment division of the main creeks upstream and downstream of the study area. However, the division of sub-catchments within the study area was much finer. This allowed the many small tributaries throughout the study area to be modelled. The sub-catchment division is shown in Figure 1a & 1b. Key aspects of the model are:

- Total catchment area of Bonville and Pine Creeks (excluding Middle Creek) at the estuary is 108.7 sq.km. The catchment was divided into 156 sub-catchments of which 121 were within the study area;

- A rainfall gradient was introduced that used the same elevation relationship adopted in recent flood studies of Coffs Creek and Newports Creek by WMA;

- The percentage imperviousness for existing conditions was set at 1% throughout.

- The model's prediction of peak 1% AEP flow at the estuary (1,440 m^3/s for the 9 hr event) was compared with the reported 1,295 m^3/s in from the RORB model used in Ref 1. The 11% increase in flows was considered reasonable given the inclusion of the rainfall gradient which accounted for a 13% increase in rainfall intensity, but biased to the upper reaches.

- Model parameters were typically set to the default as recommended by WBNM, specifically:
  - Catchment lag = 1.6;
  - Impervious lag = 0.1;
  - Initial loss = 0 mm (a wet catchment);
  - Pervious continuing loss = 3.5mm;

The WBNM model was used to prepare hydrographs for input into a TUFLOW hydraulic computer model of the study area. The following ARR87 design events were modelled:

- 1% AEP (100-yr ARI) events (0.5 to 12hr duration);
- 0.2% AEP (500-yr ARI) events (2 & 9 hr);
- Probably Maximum Flood (PMF) events (2 & 6hr).

Hydrographs for a 1% AEP event with climate change (year 2050 prediction) were also prepared. These were the existing condition 1% AEP hydrographs scaled up by 10%, plus the downstream ocean stage hydrograph was increased by 0.5m.

4 HYDRAULICS

Hydraulic modelling of the flood behaviour through the study area was undertaken using the computer program TUFLOW. TUFLOW is a un-steady state two dimensional hydraulic model that reliably accounts for the two dimensional flow distribution of flood waters across a floodplain plus the attenuation effect of floodplain storage.

In this instance the key aspects of the TUFLOW model are:

- The extent of the model is shown in Figure 2. The study area was modelled in 2D. In addition, the model was extended downstream to the estuary using TUFLOW's 1D routines.

- A digital elevation model (DEM) of the existing topography through the study area was generated from Council's aerial laser survey (ALS) data with modifications along the creek channels. The ALS data is most reliable across cleared ground where individual point accuracy is generally within plus or minus 0.2m. However, it is less reliable through thick vegetation, which in this case, is often along the creek lines. In areas of thick vegetation the ALS data tended to miss the narrow creek inverts. Using civil design software (12D and Autocad Civil 3D) long sections were plotted along all the modelled creek lines. Creek channels were then 'burnt' into the DEM by stringing the low points together, creating a channel that continuously fell towards the outlet. The width of these channels was varied based on close inspection of aerial photography and field observations. The approaches and exits from culverts were also burnt into the DEM to ensure they were below the field measurements of the culvert inverts.

  The ALS data also predates the recent Pacific Highway upgrade. The DEM was adjusted to approximate the motorway's embankments.

- A 4 by 4 metre modelling grid was adopted. This size was a compromise between run time of the model and accuracy. While a 4 metre grid is a little course to accurately model some of the smaller creeks, a finer resolution was unworkable. Due to some of the fairly step reaches, a short time step of 1 sec was needed for stability. The 4 m grid at 1 sec required approximately 12 hours of run time to model a 9 hour event. Halving the grid would increase the run time by a factor of eight, which was considered unworkable.

- Manning's n value of hydraulic roughness was assigned the regions based on experience and the aerial photography. The values adopted were:
  - Pavement = 0.02;
  - Open pasture = 0.03;
  - Sparse vegetation = 0.05;
  - Medium vegetation = 0.08;
  - Buildings = 3.0;

  Most of the creek channels were modelled at 0.08.

- Dams were essentially modelled as full.

- 51 culvert crossings were included. Their size and levels were measured in the field. Their levels were generally measured relative to the road centreline. This in turn was determined with reasonable accuracy from the ALS data. The ALS data being far more accurate along the clear road way than along the creek lines. Note, on some of the minor creeks driveway culverts were ignored as were some of the structures within the Bonville Golf Course.

Some of the bridges (such as Pine Creek Way and the Pacific Highway Motorway over Bonville and Pine Creeks) were not modelled using TUFLOW's bridge or culvert routines. In these cases, the bridge decks were determined to be comfortably above the flood surface. As such, their modelling was reliably achieved by accurately modelling the road embankments and bridge abutments in the 2D DEM. Any effect of bridge piers was ignored.

- To provide a reliable basis for the downstream boundary, the model was extended from the study area to the ocean. This extension was modelled using the simpler and faster one dimensional (1d) routines. The 1d model was constructed using the cross sections and channel arrangement from the Bonville Creek Flood Study (Ref 1), although some of these were modified as discussed in the comparison below.

  Extending the model brought all the creeks together to just one downstream boundary. Setting at the ocean allowed the use of long standing and accepted ocean level assumptions. The long extension of the model also ensures that any error in the ocean level assumption has reduced affect within the study area. That is, the flood levels modelled in the study area are not sensitive to the ocean level assumption.

  At the ocean a stage hydrograph with the same AEP as the rainfall event was adopted, with its peak coinciding with peak flow. This is a very conservative, but often used assumption. The peak ocean levels adopted were:

  – 2.5 mAHD for 1% AEP (100-year ARI) under existing conditions;
  – 3.0 mAHD for 1% AEP under year 2050 climate change conditions;
  – 2.7 mAHD for 0.2% AEP (500-year ARI) under existing conditions;
  – 3.0 mAHD for the PMF under existing conditions;

  The merits of this conservative assumption are somewhat irrelevant as the study area is sufficiently upstream to greatly mitigate any effects of the adopted assumption. To demonstrate this a sensitivity test with a normal ocean level (peak of RL 1.0 mAHD) was undertaken as discussed latter.

4.1 Comparison with Past Studies and Historic Flood Levels

Calibration of the WMNM hydrologic and TUFLOW hydraulic models was not attempted. The results were however compared against previous studies and the little historic flood level information available, as summarised in Table 4.1. For the 1% AEP event under existing conditions, this found:

Bonville Creek Flood Study (Ref 1)

Good agreement was found along Bonville Creek from the new highway to Pine Creek Way (the upstream limit of Ref 1). However, there is significant disagreement for Pine Creek, particularly at the downstream limit of the 2d modelling. Here TUFLOW predicts a 1% AEP flood level more than 1 metre below Ref 1. It is noted that this study's peak flow predictions were also lower than in ref 1 (472 vs 536 m^3/s) at Pine Creek Way, which may explain some of the difference but is unlikely to account for all of it.

The difference was surprising as both models initially used the same cross sections. Further investigations revealed that the cross sections from Ref 1 were not modelling the full extent of

floodplain storage or the Railway embankment and bridge. The TUFLOW cross sections were adjusted to better account for these effects, although the resulting TUFLOW flood level predictions within the study area, as summarised in Table 4.1a, were still substantially below those in Ref 1.

Table 4.1a – Comparison of Model Results Against Ref 1 (Peak 1% AEP Levels).

Location	Tuflow Model (mAHD)	Bonville Creek Flood Study (mAHD)
Bonville Creek at Pacific Highway	d/s Bon 1 = 4.39 u/s Bon 2 = 4.46	Stn 85 = 4.31
Bonville Creek u/s Pine Creek Way	Bon 5 = 5.34	Stn BONU/S = 5.26
Ocean	2.50	Stn OCEAN = 2.40
Pine Creek at confluence with Bonville Ck	B112 = 3.82	Stn BON-PINE = 3.38
Pine Creek at d/s boundary of 2d model	Pine 1 = 5.95	Stn 135 = 7.05
Pine Creek u/s Pine Creek Way	Pine 4 = 6.49	Stn PINU/S = 7.68

Bonville International Golf Resort – Flood Study (Ref 2)

The comparison with Ref 2 was mixed. There were significant differences at the downstream limits of Ref 2. Here Ref 2 had to assume 'starting water levels' and those assumptions were generally higher than TUFLOW's calculated levels. Further upstream the agreement was better. The notable exceptions is that TUFLOW predicts greater depth over North Bonville Road.

Table 4.1b – Comparison of Model Results Against Ref 2 (Peak 1% AEP Levels).

Location	Tuflow Model (mAHD)	BIG Flood Study (mAHD)
Cassidys Ck, 250m d/s of North Bonville Rd	Cas 1 = 6.34	Westmain 20 (d/s limit) = 7.46
Confluence of Cassidys & Yarraman Ck, 150m u/s of North Bonville Rd	Cas 4 = 9.32	WestSub1 2.5 = 8.53
Cassidys Rd over creek (Golf Course)	Cas 8 = 19.16	Westmain 1640 = 19.11
Middle Ck (BIG) d/s of North Bonville Rd	BIG 1 = 6.07	Middle Creek 71.96 = 5.80
BIG Club house	6.07	Middle Creek 640 = 5.83
Irvines Ck, d/s of Pine Ck Way	Irv 6 = 5.74	Eastmain 86.08 = 6.70
Irvines Ck, u/s of Pine Ck Way	Irv 7 = 6.81	Eastmain 110.63 = 7.28
Irvines Ck, 300m u/s of Pine Ck Way	Irv 9 = 7.62	Eastsub 20 = 7.67

Burgess Creek Flood Study (Ref 3)

The TUFLOW predictions are substantially higher than Ref 3. The difference is greatest at the Braford Drive bridge over Burgess Creek, which was the downstream boundary of the Burgess Creek Flood Study. Here TUFLOW predicts a flood level nearly 2 metres higher that the Burgess Creek Flood Study. A review of the Burgess Creek Flood Study found no discussion as to its downstream boundary assumption and it is difficult to see how the authors could justify such a low level.

The TUFLOW model predictions are considered more accurate than Ref 3.

Table 4.1c – Comparison of Model Results Against Ref 3 (Peak 1% AEP Levels).

Location	Tuflow Model (mAHD)	Burgess Creek Flood Study (mAHD)
Burgess Ck at:		**Burgess Creek Flood Study (Ref 2)**
Braford Drive	u/s (Bur 2) = 6.21	XS 1 = 4.26
Confluence of dam overflow trib	Bur 5 = 7.16	XS 3 = 6.25
Confluence of dam outlet	Bur 7 = 9.02	XS 4 = 7.69
Dam u/s of Bakker Dr	Bur Dam = 12.19	XS 11 = 11.76

Historic flood levels.

The historic flood levels were supplied from Council's GIS for the November 1996 and March 2009 events. In some instances the exact location of the recorded flood level was not clear from the description and some error in the comparison is possible.

Further, the historic flood levels are not directly comparable with the design 1% AEP TUFLOW levels as the actual probability of the historic events is not known. It is known that these were major rainfall events in the order of 100-year ARI. They were however not major ocean events.

Even though they are not directly comparable, they can be used as a gross check for consistency. In this case, the TUFLOW 1% AEP predictions generally appear a little higher, but more importantly, are reasonably consistent with the historic levels.

Table 4.1d – Comparison of Model Results Against Historic (Peak 1% AEP Levels).

Location	Tuflow Model (mAHD)	Historic Flood Levels (mAHD)
		November 1996 Historic Flood
Pine Creek Way over Bonville Creek	5.20	4.60
7 Braford Park Dr	6.15	5.52
North Bonville Rd, east Bridge	Cas 3 = 7.32	7.46
North Bonville Rd, west Bridge	NB 6 = 18.64	18.85
Pine Ck Way Culvert, 200m South Irvines	Irv 7 = 6.72	6.69
Pine Ck Way Culvert, near Titan Close	Irv D5 = 6.69	6.62
		March 2009 Historic Flood
257 Pine Ck Way (d/s of Bonville Ck bridge	4.90	5.07
Pine Ck Way bridge over Bonville Ck	4.82	4.99
282 Pine Ck Way (u/s of Bonville Ck bridge	5.72	5.48
7 Braford Park Dr	6.15	5.98 & 6.03
20 Bakker Drive (d/s of dam overflow)	Bur C1 = 7.47	7.59
62 Bakker Dr	Approx 9.5	9.99
173 Braford Dr	Approx 14.8	15.20

4.2 Sensitivity to Downstream Boundary

A sensitivity test was undertaken to test the impacts of the ocean level assumptions. The critical 1% AEP event (9hr duration) was modelled with a normal tidal ocean level, (peaking at RL 1.0 mAHD) and with the adopted 1% AEP ocean level (peaking at 2.5 mAHD). The results are summarised in Table 4.2

Table 4.2 - Ocean level sensitivity

Peak flood level at:	Normal high tide ocean (mAHD)	Adopted 1% ocean level (mAHD)
Ocean Level.	1.00	2.50
Confluence of Bonville and Pine Creeks. (XS112)	3.71	3.82
Bonville Creek at the downstream boundary of study area. (Bon 2)	4.39	4.45
Bonville Creek, just upstream of Pine Creek Way. (Bon 5)	5.28	5.33
Pine Creek at the downstream boundary of the study area. (Pine 3)	6.20	6.21

The results found that the ocean level assumption little influence of the modelled flood levels within the study area, being a maximum of 60mm along Bonville Creek at the downstream boundary of the study area.

5 FLOOD MAPPING

Design rainfall temporal patterns from Australian Rainfall and Runoff (ref 3) were adopted. Events ranging in duration from 30 minutes to 12 hours were modelled. The event causing the greatest flood level varied throughout the study area. As expected short duration events caused the greatest flood in the upper reaches of minor creeks, where as longer duration events caused the greatest flood level in the major creeks. The 9 hour event was found to be critical for Bonville and Pine Creeks. In all, the 2 hour and 9 hour events caused the greatest flood level over 75% of the study area.

The existing conditions 1% AEP flood extents and flood contours are shown on Maps 1 to 7. Note, these are the maximum levels from all the durations modelled.

Maps 1 to 7 also show:

- The additional flood extents for the 1% AEP flood with predicted climate change by the year 2050. Being 10% greater flows and the ocean level increased by 0.5 m;
- The additional extents of the 0.2% AEP (500-year ARI) flood under existing conditions; and;
- The extents of the probable maximum flood (PMF) under existing conditions.

Note, for clarity the flood contours are only shown for the 1% AEP flood under existing conditions. Also note that the flood extents up minor creeks is limited to the discrete locations of the modelled inflow.

6 REFERENCES

1. Bonville Creek Flood Study, (Slattery de Groot & Partners P/L & Bewsher Consulting P/L, October 1995).

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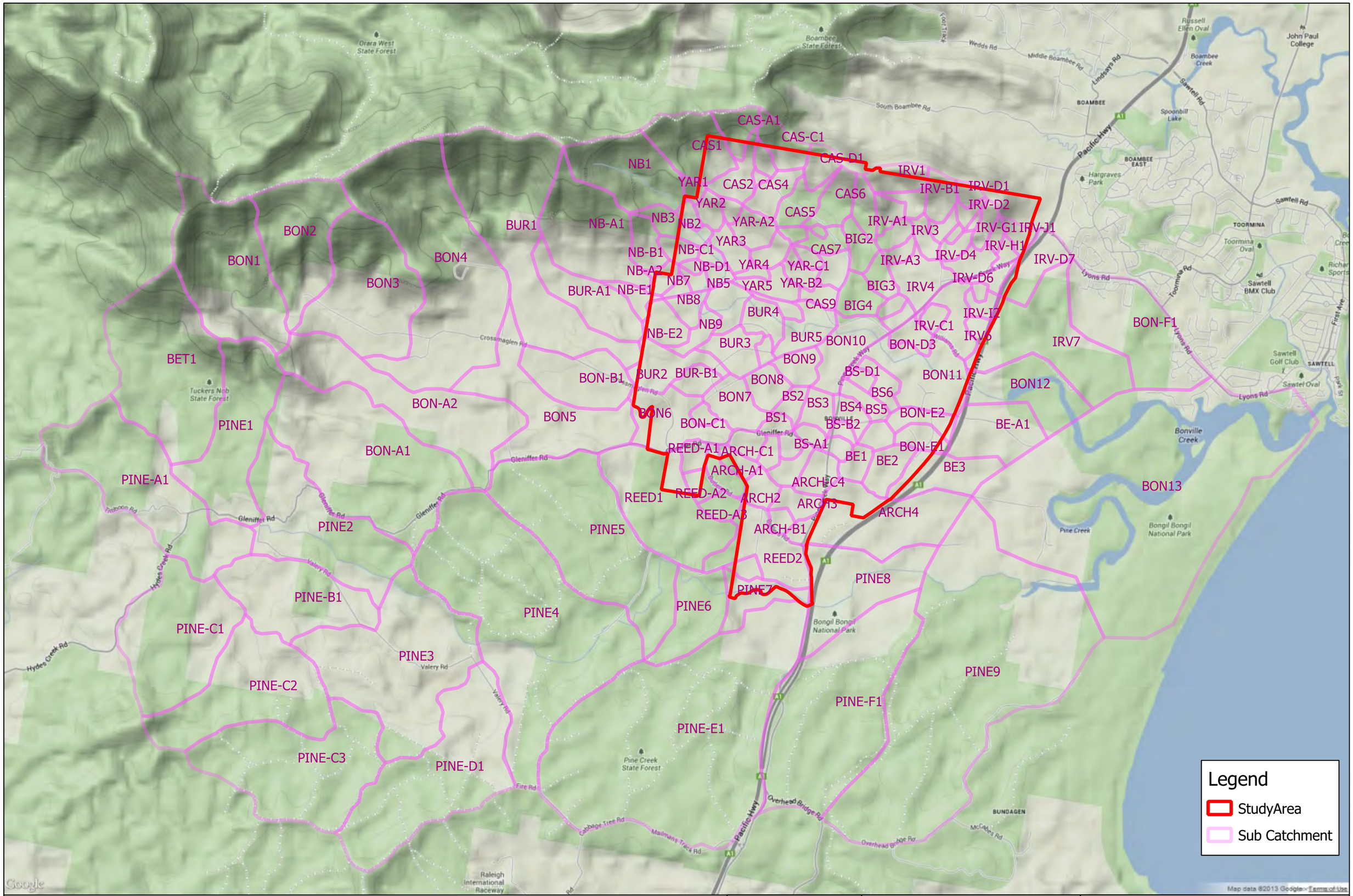
3. Burgess Creek Flood Study, (GHD 1989).

4. Australian Rainfall and Runoff, (Institute of Engineers, Australia, 1987)

MAPS



1 0 1 2 3 4 km

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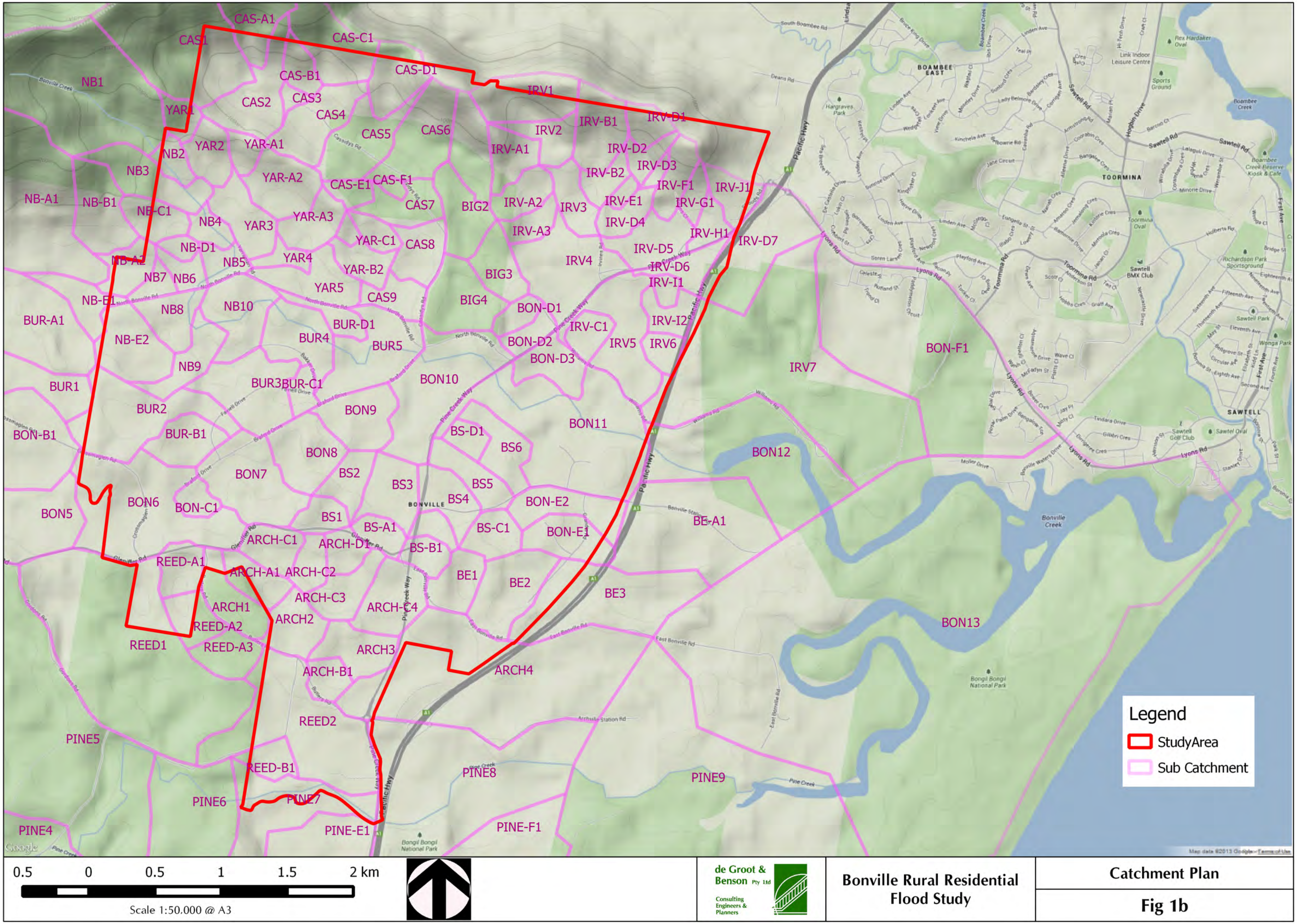
Bonville Rural Residential Flood Study

Catchment Plan

Fig 1a



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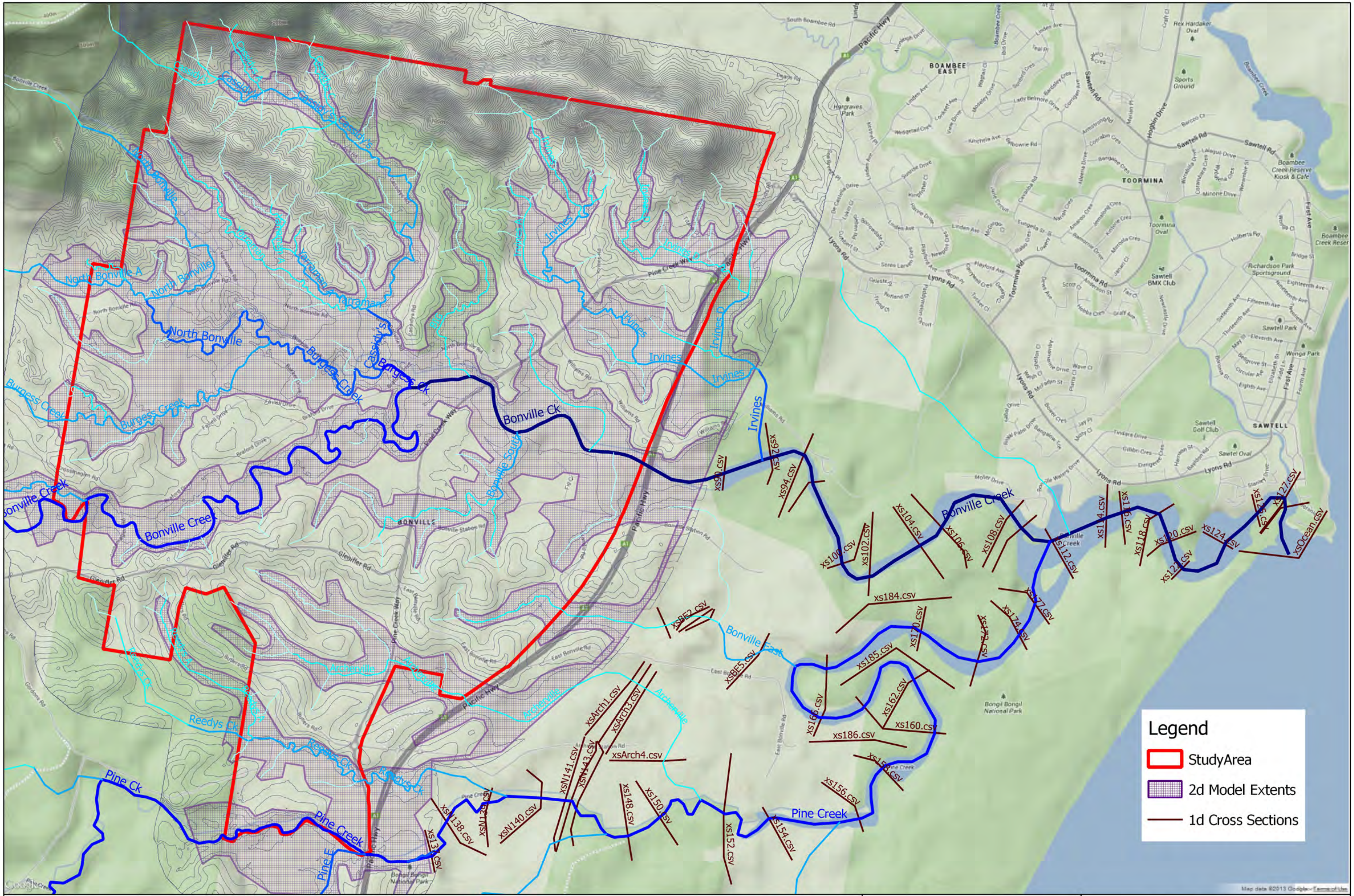
Catchment Plan

Fig 1b



0.5 0 0.5 1 1.5 2 km

Scale 1:50,000 @ A3

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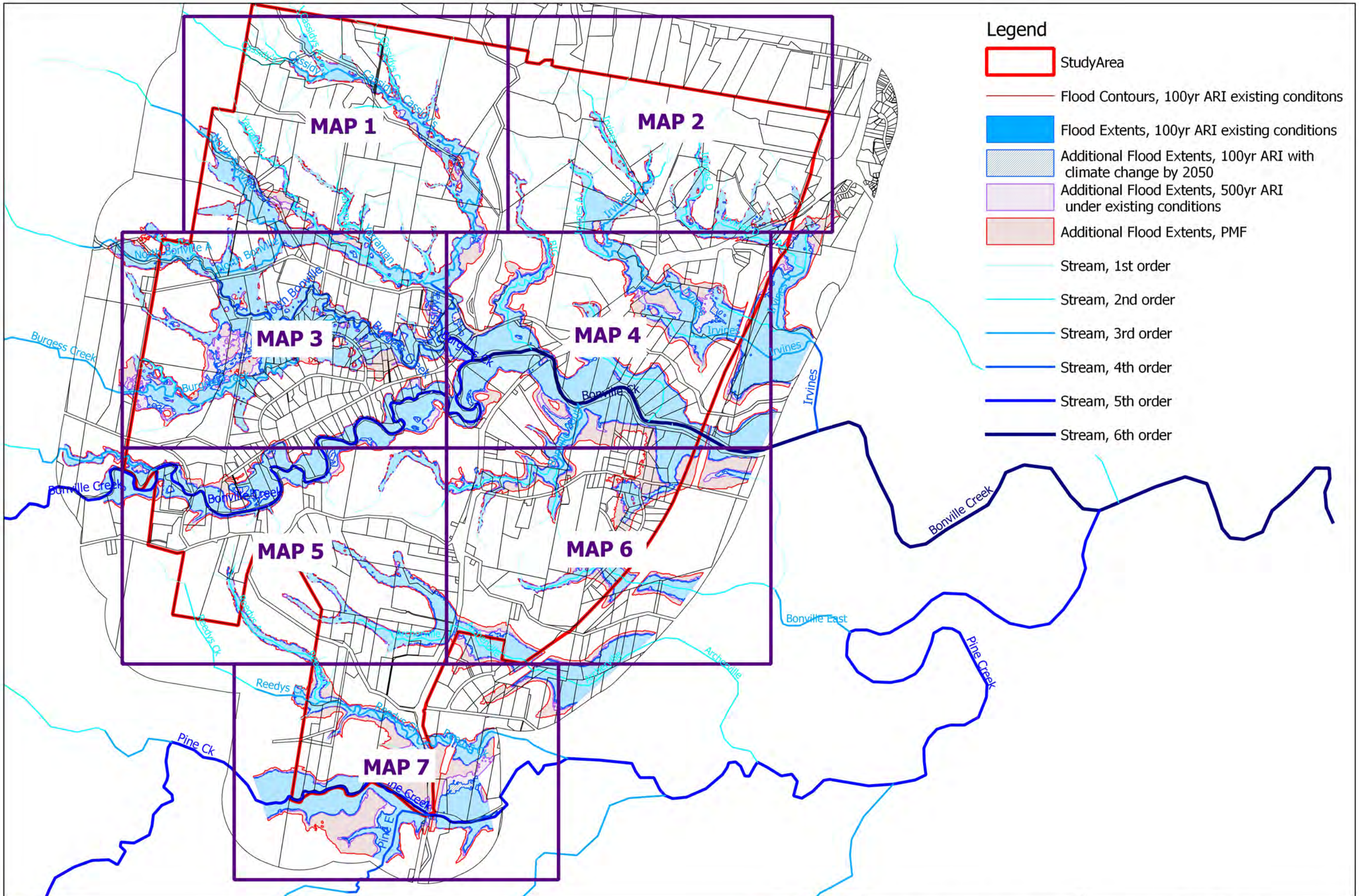
TUFLOW Model

Fig 2



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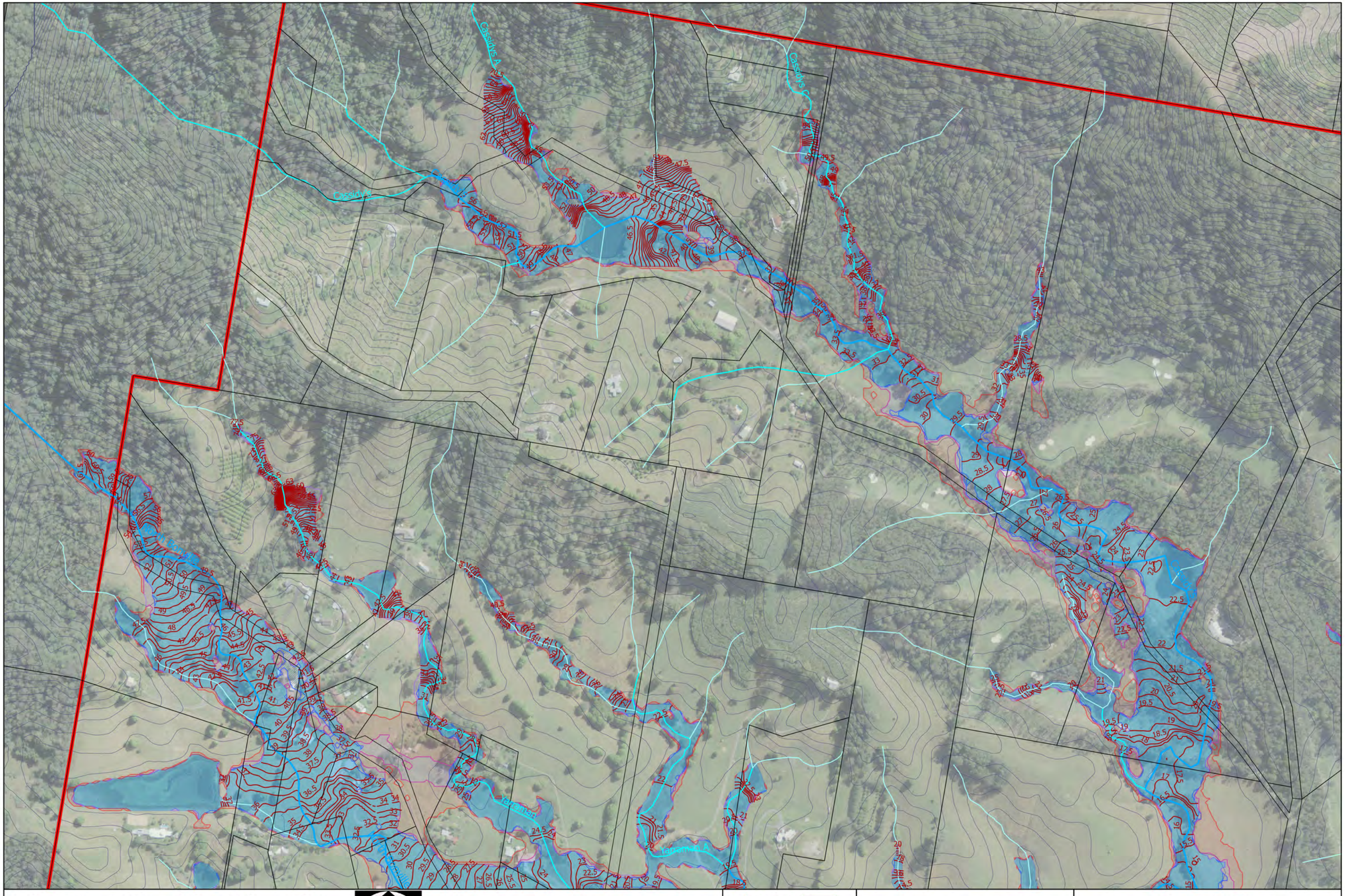
Bonville Rural Residential Flood Study

Flood Extents

Map Index & Legend



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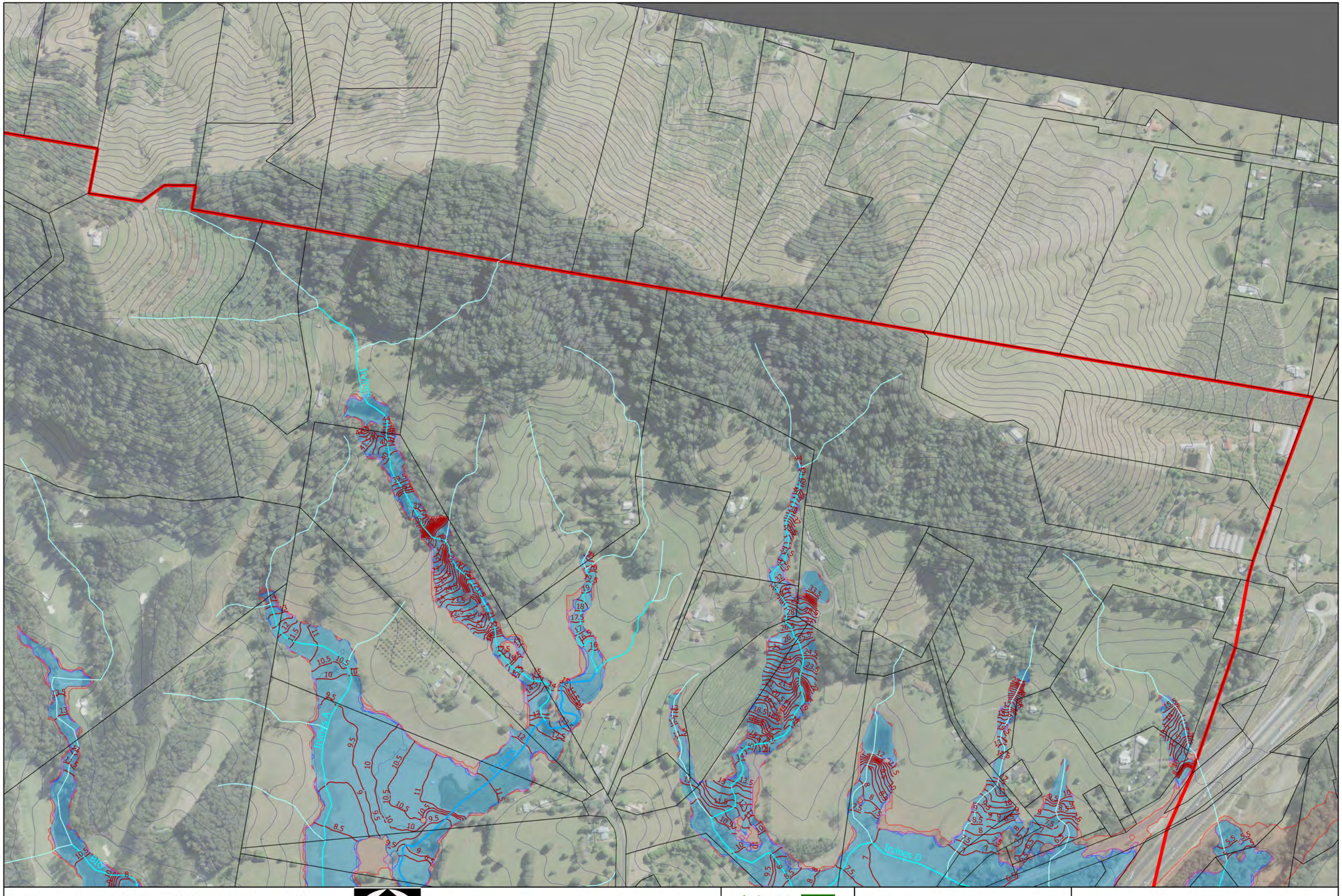
Bonville Rural Residential Flood Study

Flood Extents

Map 1



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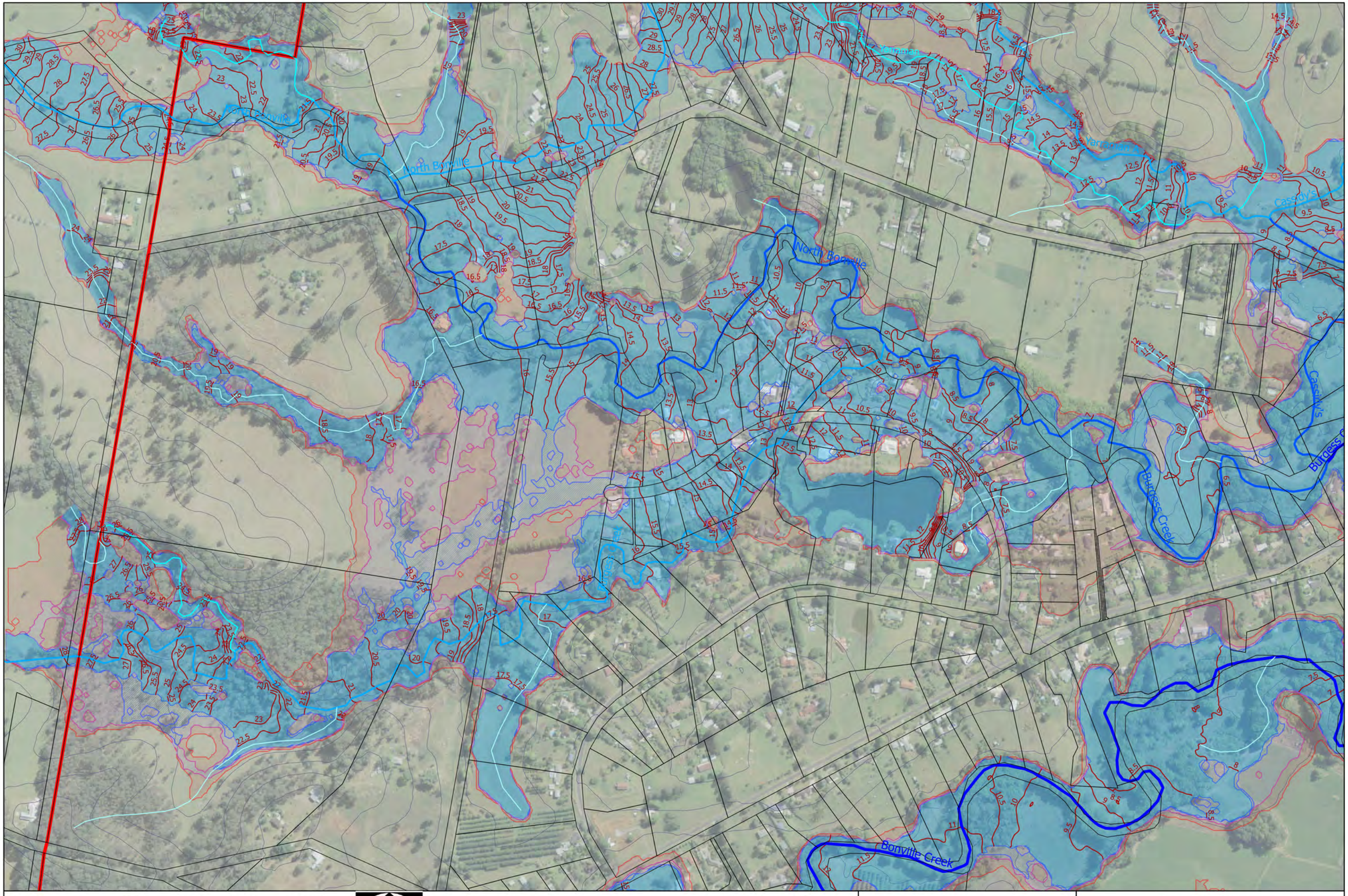
Bonville Rural Residential Flood Study

Flood Extents

Map 2



100 0 100 200 300 400 m

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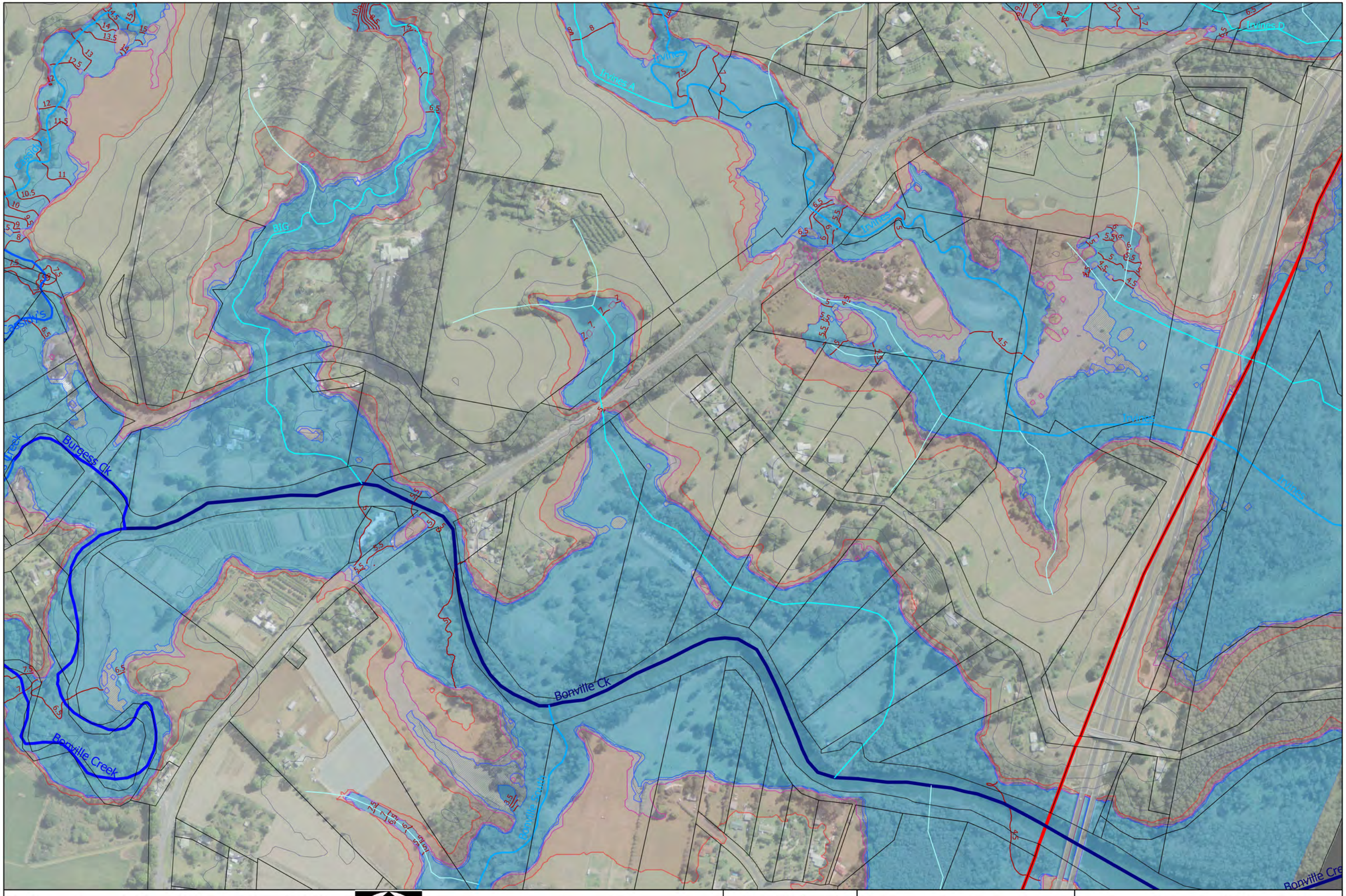
Flood Extents

Map 3



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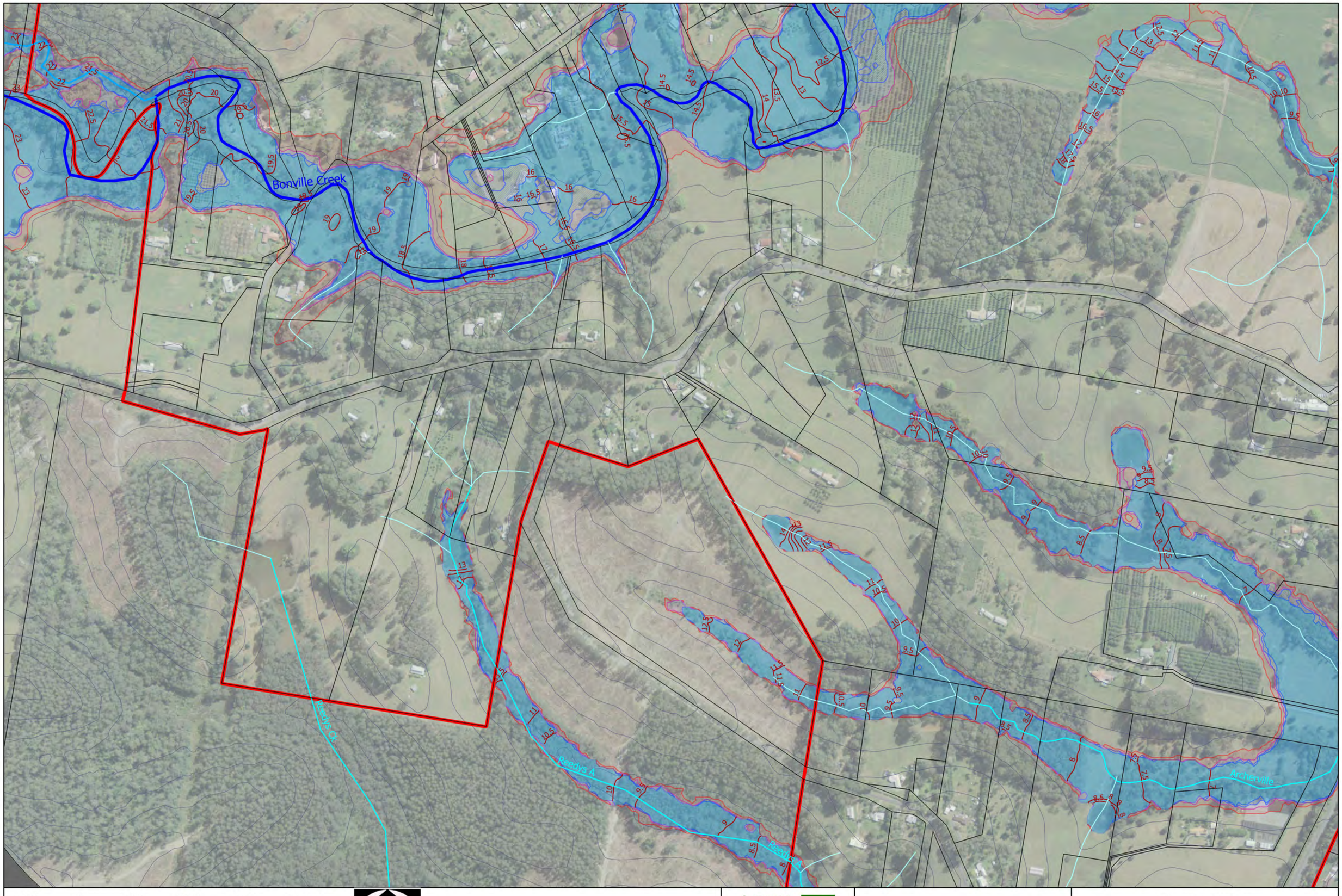
Bonville Rural Residential Flood Study

Flood Extents

Map 4



100 0 100 200 300 400 m

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Flood Extents

Map 5

100 0 100 200 300 400 m

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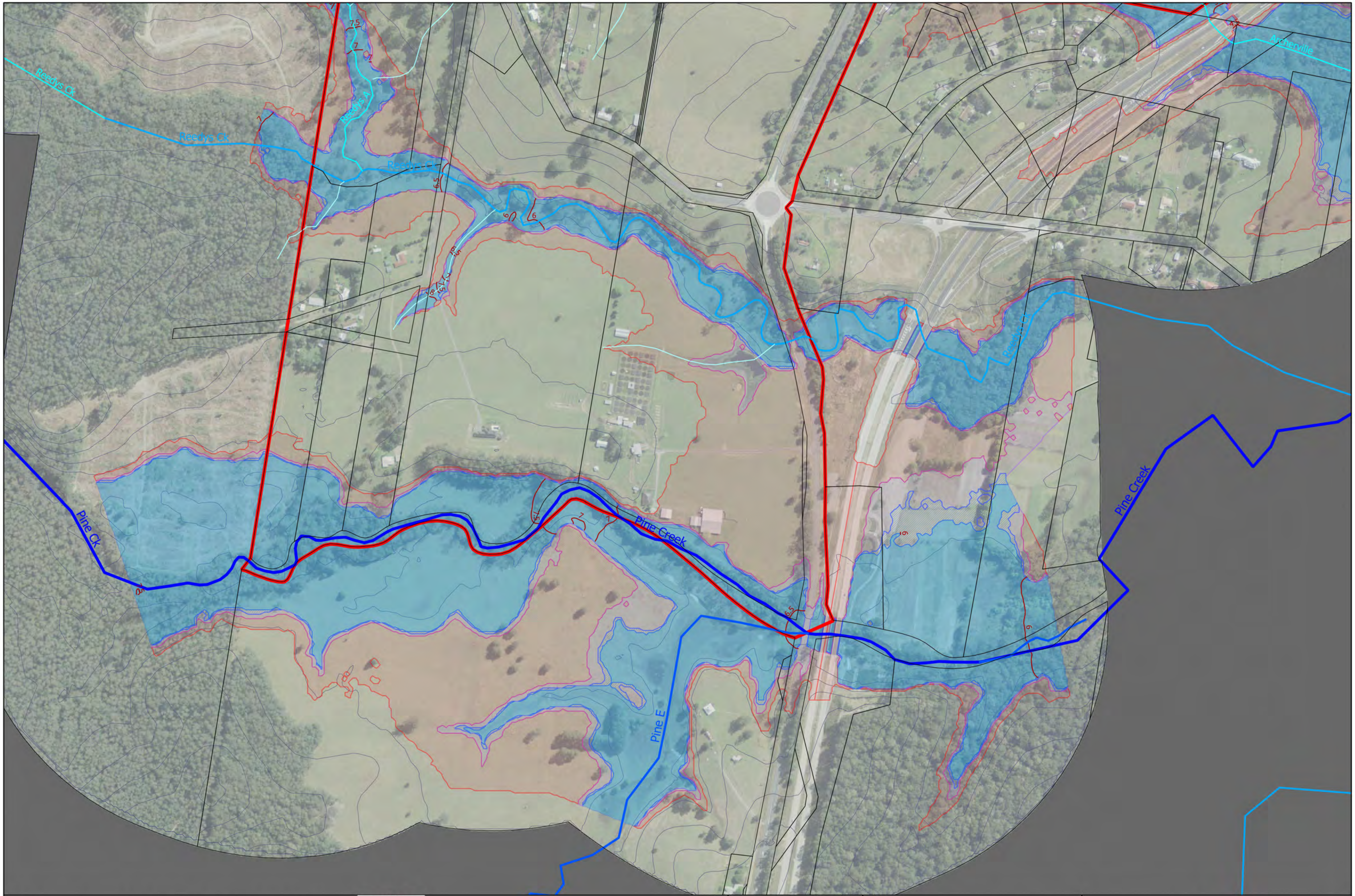
Bonville Rural Residential Flood Study

Flood Extents

Map 6



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de Groot & Benson Pty Ltd
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Bonville Rural Residential Flood Study

Flood Extents

Map 7

APPENDIX H –Coffs Harbour LEP 2013 (draft Amendment No. X)

Coffs Harbour Local Environmental Plan 2013 (Amendment No x)

under the

Environmental Planning and Assessment Act 1979

I, the Minister for Planning and Infrastructure, make the following local environmental plan under the *Environmental Planning and Assessment Act 1979*.

XXXXXXXXXXXXXX
As delegate for the Minister for Planning and Infrastructure

Coffs Harbour Local Environmental Plan 2013 (Amendment No x)

under the

Environmental Planning and Assessment Act 1979

1. **Name of Plan**

   This Plan is *Coffs Harbour Local Environmental Plan 2013 (Amendment No x)*.

2. **Commencement**

   This Plan commences on the day on which it is published on the NSW legislation website.

3. **Land to which Plan applies**

   This Plan applies to the land to which *Coffs Harbour Local Environmental Plan 2013* applies.

4. **Maps**

   Each map adopted by *Coffs Harbour Local Environmental Plan 2013* that is specified in Column 1 of the following table is declared by this Plan to be amended or replaced, as the case requires, by the map specified opposite in Column 2 of the table as approved by the Minister on the making of this Plan.

Column 1	**Column 2**
Name of map being amended or replaced	**Name of amending or replacement map**
Coffs Harbour Local Environmental Plan 2013 Land Zoning Map (1800_COM_LZN_006_080_20130501)	Coffs Harbour Local Environmental Plan 2013 Land Zoning Map (1800_COM_LZN_006_080_2014XXXX)
Coffs Harbour Local Environmental Plan 2013 Land Zoning Map (1800_COM_LZN_006B_080_20130501)	Coffs Harbour Local Environmental Plan 2013 Land Zoning Map (1800_COM_LZN_006B_080_2014XXXX)
Coffs Harbour Local Environmental Plan 2013 Land Zoning Map (1800_COM_LZN_006C_080_20130501)	Coffs Harbour Local Environmental Plan 2013 Land Zoning Map (1800_COM_LZN_006C_080_2014XXXX)
Coffs Harbour Local Environmental Plan 2013 Lot Size Map (1800_COM_LSZ_006_080_20130501)	Coffs Harbour Local Environmental Plan 2013 Lot Size Map (1800_COM_LSZ_006_080_2014XXXX)
Coffs Harbour Local Environmental Plan 2013 Lot Size Map (1800_COM_LSZ_006B_080_20130501)	Coffs Harbour Local Environmental Plan 2013 Lot Size Map (1800_COM_LSZ_006B_080_2014XXXX)
Coffs Harbour Local Environmental Plan 2013 Lot Size Map (1800_COM_LSZ_006C_080_20130501)	Coffs Harbour Local Environmental Plan 2013 Lot Size Map (1800_COM_LSZ_006C_080_2014XXXX)
Coffs Harbour Local Environmental Plan 2013 Terrestrial Biodiversity Map - Drinking Water Catchment Map - Riparian Lands and Watercourses Map (1800_COM_CL2_006_080_20130326)	Coffs Harbour Local Environmental Plan 2013 Terrestrial Biodiversity Map - Drinking Water Catchment Map - Riparian Lands and Watercourses Map (1800_COM_CL2_006_080_2014XXXX)
Coffs Harbour Local Environmental Plan 2013 Terrestrial Biodiversity Map - Drinking Water Catchment Map - Riparian Lands and Watercourses Map	Coffs Harbour Local Environmental Plan 2013 Terrestrial Biodiversity Map - Drinking Water Catchment Map - Riparian Lands and Watercourses Map

Column 1	Column 2
Name of map being amended or replaced	**Name of amending or replacement map**
(1800_COM_CL2_006B_080_20130326)	(1800_COM_CL2_006B_080_2014XXXX)
Coffs Harbour Local Environmental Plan 2013 Terrestrial Biodiversity Map - Drinking Water Catchment Map - Riparian Lands and Watercourses Map (1800_COM_CL2_006C_080_20130326)	Coffs Harbour Local Environmental Plan 2013 Terrestrial Biodiversity Map - Drinking Water Catchment Map - Riparian Lands and Watercourses Map (1800_COM_CL2_006C_080_2014XXXX)

FIGURES:

DRAFT LAND ZONING MAP

DRAFT LOT SIZE MAP

DRAFT TERRESTRIAL BIODIVERSITY MAP; DRINKING WATER CATCHMENT MAP - RIPARIAN LANDS AND WATERCOURSES MAP