PLANNING REPORT CENTRAL COAST DRAFT LOCAL PROVISIONS SCHEDULE

February 2019

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Introduction

This report supports the submission of the draft Central Coast Local Provisions Schedule (draft LPS) prepared and submitted to the Commission under section 35(1) of the *Land Use Planning and Approvals Act 1993* (the Act) for assessment as to whether it is suitable for exhibition, under section 35B(4) of the Act. The report demonstrates that the draft LPS meets the LPS criteria as required by section 34(2) of the Act.

The criteria set out in Section 34(2) of the Act outlines the following requirements to be included in a draft LPS:

- Zone maps;
- Local Area Objectives;
- Particular Purpose Zones;
- Specific Area Plans;
- Site Specific Qualifications;
- Code Overlay Maps for the:
    - Parking and Sustainable Transport Code showing parking precinct plans or pedestrian priority streets;
    - Road and Railway Asset Code;
    - Electricity Transmission Infrastructure Protection Code – buffer areas and transmission corridors;
    - Local Historic Heritage Code;
    - Natural Assets Code;
    - Scenic Protection Code;
    - Attenuation Code;
    - Coastal Erosion Hazard and Coastal Inundation Hazard Codes;
    - Flood Prone Areas Hazard Code;
    - Bushfire Prone Areas Code;
    - Landslip Hazard Code;
    - Airports Code if applicable.

Not all of these components are mandatory for inclusion in the draft LPS but the following are compulsory:

- Zones;
- Code overlay for electricity transmission infrastructure prepared by TasNetworks;
- Code overlay map for the priority vegetation area;
- Code overlay maps for coastal hazards (erosion and inundation) prepared by the State Government;

- Code overlay map for landslip hazard areas prepared by the State Government;
- Code overlay map for noise exposure contours and the obstacle limitation surfaces for airports, if applicable.

The draft LPS contains the mandatory requirements of the State Planning Provisions (SPP) which are discussed below.

Municipal Area

The draft LPS applies to the Central Coast municipal area as specified in the SPP template.

Spatial Application of the State Planning Provisions

Section 32(2) (c) and (e) requires that a LPS must contain maps, overlays, lists or other provisions that provide for the spatial application of the SPP. Section LP1.0 of the SPP outlines the manner in which the spatial application of the SPP is to be represented.

The draft LPS is prepared in accordance with the application and drafting instructions included in the SPP and in *Guideline No. 1 – Local Provisions Schedules: zone and code application* issued by the State Planning Commission.

Sections 11 and 12 of the Act

The draft LPS does not seek to regulate matters outside the jurisdiction prescribed in Sections 11 and 12 of the Act.

Schedule 1 Objectives of the Act (Parts 1 and 2) [section 34(2) (c)]

Part 1

(a) To promote the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity; and

The draft (LPS) relies on zone provisions and Codes to ensure sustainable development occurs. For example, the draft LPS relies on the State Natural Assets Code that provides for protection of water. The Code requirements set standards and provisions regarding distance from waterways, disposal of stormwater, building impacts and clearance of native vegetation in priority vegetation areas.

The Landslide Hazard Code (C15.0) has been prepared with the purpose of ensuring that use and development: is appropriately located to minimise risk to life and property resulting from land instability and, does not cause an increased risk of land instability.

The Natural Assets Code will assist with the protection of biodiversity as it applies to land identified as Priority Habitat in the LPS.

The Coastal Erosion Code (C10.0) includes requirements to minimise the impact of coastal erosion and sea level rise.

The draft LPS also provides for increased environmental protection through a range of zone provisions controlling the removal of habitat and reduction of emissions from

development. The application of specific zonings is also an important mechanism to improve environmental protection and this is enhanced by a consistent regional approach to zoning controls and their application.

(b) to provide for the fair, orderly and sustainable use and development of air, land and water; and

Zones have been allocated where they can be appropriately serviced by existing services or the infrastructure can be generally extended. No large zoning extensions are proposed, although there are some areas that are contemplated for development in the long term. For example, one area that will probably be extended for residential development is adjacent to the Braid subdivision, where infrastructure can be extended and the area is within easy commuting distance to commercial, community and social services located in the central urban centre. However considering the requirements of the regional land use strategy, an amendment, at the appropriate time is the appropriate instrument for changing the zoning.

The shortage of residential land has and will force residential development further from the urban area and its associated regional services and employment opportunities, which only increases carbon emissions from the increased number and length of car journeys. Given the emphasis on global warming and trying to curtail carbon emissions this action appears to be counterproductive if new nearby areas are identified.

The draft LPS recognised a shortage of industrial zoned land, particularly areas which can be accessed by employees. The zone has been extended in East Ulverstone with an extension to the existing Light Industrial zone. There is short access to the Bass Highway, has good access to rail and is within a short commuting distance to residential areas. The area can be serviced with appropriate services.

Provision has been made for open space and recreation areas. Generally there has been a translation of the existing zoned areas. Several areas that are currently zoned Environmental Living, especially on the coast between Ulverstone and Penguin, have now been zoned Landscape Conservation as the Environmental Living zone no longer exists.

(c) to encourage public involvement in resource management and planning; and

The draft LPS is based upon the State Planning Scheme provisions, the Cradle Coast Strategic Land Use Strategy and the Council's Strategic Plan. The Council's Strategic Plan had an extensive public consultation and the Planning Scheme will undergo a public consultation as required by the Act.

(d) to facilitate economic development in accordance with the objectives set out in paragraphs (a), (b) and (c); and

The draft LPS facilitates economic growth through its broad range of provisions that promote the integration of land use and infrastructure, the allocation of zones that allow for development and the protection of significant economic assets and resources and the environment.

(e) to promote the sharing of responsibility for resource management and planning between the different spheres of Government, the community and industry in the State.

The draft LPS has been developed in accordance with the SPP, State Policies, the Cradle Coast Strategic Land Use Plan and the Council's Strategic Plan. The Council's Strategic Plan went through an extensive public consultation process whilst the Cradle Coast Regional Land Use Strategy was developed with Council input.

Part 2

(a) to require sound strategic planning and co-ordinated action by State and local government; and

The draft LPS has been drafted in accordance with the SPP, State Policies and the Cradle Coast Land Use Strategy.

The Cradle Coast Regional Land Use Strategy recognises that the region's economy and population is experiencing limited growth and there is a need to ensure that sufficient amounts of zoned land exist for various purposes.

Generally, most of the zones have been transferred into the draft LPS with some zones such as Light Industrial and General Residential including limited expansion. Growth areas have been identified in the most appropriate locations based on existing uses, infrastructure and demand.

All zoning has been applied that is consistent with the strategic framework provided in the State Policies, Cradle Coast Regional Land Use Strategy, Council's Strategic Plan and the SPP zones.

(b) to establish a system of planning instruments to be the principal way of setting objectives, policies and controls for the use, development and protection of land; and

This draft LPS is a component of a number of planning instruments defined under the Act. It is based upon the State Planning Scheme template, which itself is based upon the objectives of the Act. The draft Scheme contains further specific local policies and mapping of zones to achieve appropriate controls for the use, development and protection of land which are broadly consistent with the regional approach as defined in regional and Council strategies.

(c) to ensure that the effects on the environment are considered and provide for explicit consideration of social and economic effects when decisions are made about the use and development of land; and

The draft LPS, when developed, considered the environmental, economic and social impact of zones. For example, areas of urban expansion were a continuation of existing areas that were serviced or could be serviced and had good access to open space, parks, schools and recreation areas. It is recognised that parks and recreation areas provide important social infrastructure that encourages social interaction and a healthy lifestyle. Business zoning was centred on existing areas and allowed for infill.

(d) to require land use and development planning and policy to be easily integrated with environmental, social, economic, conservation and resource management policies at State, regional and municipal levels; and

The draft LPS is in accordance with the provisions of the Cradle Coast Regional Land Use Strategy. This Strategy is aligned with relevant State Government strategies, which were reviewed during the preparation of the Strategy.

The Cradle Coast Regional Land Use Strategy provides a consistent regional approach to land use planning.

(e) to provide for the consolidation of approvals for land use or development and related matters, and to co-ordinate planning approvals with related approvals; and

The SPP is drafted to co-ordinate with relevant and related approval processes. Matters addressed by other statutory approval processes were largely left out of the draft LPS to minimise duplication of assessment. This includes matters such as building and plumbing approvals, environment and health, statutory services etc. Where duplication of assessment was required, tests of discretion were largely established by reference to permits under the other approval processes. Matters under this assessment process include forestry, threatened species and biodiversity.

(f) to promote the health and wellbeing of all Tasmanians and visitors to Tasmania by ensuring a pleasant, efficient and safe environment for working, living and recreation; and

The SPPs provide a suite of standards that will protect and enhance residential amenity. For example, in the General Residential zone there are controls on:

- Discretionary uses to not create environmental nuisance;
- Commercial vehicle activity;
- External lighting;
- Residential character;
- Privacy;
- Overlooking;
- Private open space;
- Landscaping;
- Solar orientation.

The draft LPS provides two zones – the Recreation Zone and the Open Space zone that have been applied to public recreational land. The application of the zones ensures that people have areas available for open space and active recreation.

With regard to industry, the draft LPS relies on the SPP provisions that establishes attenuation zones that apply to various industries to ensure residents can enjoy a healthy and safe amenity from industrial emissions.

Some Codes ensure protection from hazards and traffic safety, e.g. Railway Assets, Bushfire Prone Areas, Coastal Inundation, Flood Prone Areas, and the Landslip Hazard Code.

(g) to conserve those buildings, areas or other places which are of scientific, aesthetic, architectural or historical interest, or otherwise of special cultural value; and

The draft LPS lists no places, scientific areas, significant trees or historic buildings that should be protected with the Scheme provisions. It is noted that the draft Scheme includes the Local Historic Heritage Code which can be used to protect later identified buildings or areas. The currently listed heritage buildings are protected by State legislation.

The Scenic Management Code provides mechanisms to protect visual amenity of defined tourist road corridors and Local Scenic Management Area. Although the Code is not implemented in this draft LPS, the mechanism is available for use if it is needed at a later date. The Code provides a series of criteria that require consideration of visual qualities of defined area, specific local character statements and impacts on skylines in particular.

In order to afford some protection to those areas that have been identified as having aesthetic and special cultural value, such as regional parks and the coastline, have been zoned Environmental Management.

(h) to protect public infrastructure and other assets and enable the orderly provision and co-ordination of public utilities and other facilities for the benefit of community; and

The draft LPS includes a Utilities zone, which provides and protects sites for major utilities and corridors (and other compatible uses). The zone includes standards to regulate visual impacts, siting and subdivision.

Planned future road, rail, transmission routes or other infrastructure corridors are zoned Utilities in the draft LPS. Electric transmission infrastructure is recognised and protected by the Electricity Transmission Infrastructure Protection Code. Some electrical transmission is shown on the maps. The Road and Railway Assets Code regulates use and development adjacent to existing and future arterial roads and railways.

The draft LPS recognises that some uses will involve emissions that would conflict with sensitive uses and applies the SPP Attenuation Code for this purpose. This Code applies to either land within an area defined on the Planning Scheme map or land at specified distances from listed activities, and will give the Council discretion to consider potential land use conflict between polluting activities and sensitive uses.

The Road and Railway Assets Code includes regulation of road access and classifies roads into five categories according to their function. Access requirements vary according to the road's classification, with access to Class 1, 2 and 3 roads being most restricted to protect their function.

It's noted that in applying new zoning, the draft Scheme creates no new discrete settlements and directs new development to areas with established or committed infrastructure.

(i) to provide a planning framework which fully considers land capability.

The codes and development standards in the SPPs provide for consideration and assessment of land capability of the proposed development. For example, the following include:

- Potential landslide risk (Landslide Code);
- Whether new lots zoned Low Density Residential or Rural Living are suitable for onsite wastewater disposal systems where reticulated services are not available (subdivision standards);
- Whether the land is 'agricultural land' (through the appropriate application of zoning);
- Whether the land is subject to risk or potential contamination.

State Policies

To meet the State Policies the Scheme heavily relies on the provisions of the SPP and zoning.

State Coastal Policy 1996

The State Coastal Policy refers to the coast as one kilometre inland from the high water mark, and therefore is relevant to the draft Scheme. The principles of the *State Coastal Policy 1996* are:

- *Natural and cultural values of the coast shall be protected.*
- *The coast shall be used and developed in a sustainable manner.*
- *Integrated management and protection of the coastal zone is a shared responsibility.*

These three principles will be met through the Planning Scheme provisions and allocation of zones. Apart from the urban settlements, much of the coastline is still in a natural condition, and it is intended that these values will be protected along with any cultural values by allocating the Environmental Management Zone to the coastal areas and various Codes such as the Coastal Erosion and Coastal Inundation Hazard Codes.

The zone purpose of the Environmental Management zone is:

To provide for the protection, conservation and management of land with significant ecological, scientific, cultural or scenic value.

To allow for the compatible use or development where it is consistent with:

(a) the protection, conservation and management of the values of the land; and

(b) applicable reserved land management objectives and objectives of reserve management plans.

There is no intention of expanding the existing urban settlements along the coast.

State Policy on Water Quality Management 1997

The State Policy on Water Quality Management 1997 is concerned with achieving, "*sustainable management of Tasmania's surface water and groundwater resources by protecting or enhancing their qualities while allowing for sustainable development in accordance with the objectives of Tasmania's Resource Management and Planning System*."

The SPP require the mandatory inclusion in the LPS of the State mapped waterway protection areas in the overlay that applies to the Natural Assets Code. The assumption is that this Policy is complied with if the overlay map is applied in conjunction with the associated assessment provisions.

State Policy on the Protection of Agricultural Land 2009

The Policy applies to all agricultural land. "Agricultural land" means all land that is in agricultural use or has the potential for agricultural use. The Council recognises the regional economic importance of preserving the rural land for agricultural production.

The two rural zones (Agriculture and Rural) have been applied in the LPS in order to conserve and protect agricultural land so that it remains available for the sustainable development of agriculture, recognising the particular importance of prime agricultural land and the requirements of the State Policy, particularly in this municipal area.

See the section on zoning Rural areas for methodology and application of the zones.

National Environmental Protection Measures

National Environmental Protection Measures (NEPMs) are broad framework-setting statutory instruments made under the *National Environmental Protection Council (Tasmania) Act 1995*. They outline nationally common objectives to protect or manage certain environmental aspects. In accordance with s.12A of the *State Policies and Projects Act 1993*, an NEPM is taken to be a State Policy. There is no discretion to differentiate a State Policy made under s.12A compared to s.11.

Of the NEPMs only the *Assessment of Site Contamination (1999)* and *Ambient Air Quality (2003)* are relevant to draft Planning Schemes.

With respect to the *Assessment of Site Contamination NEPM*, the relevant part of this measure is the contamination assessment process as specified in Code 14. The Potentially Contaminated Land Code follows the process outlined in Schedule A of the *Assessment of Site Contamination NEPM*, by specifying a preliminary assessment, a Contamination Management Plan and a remedial action plan.

The *Ambient Air Quality NEPM* sets air quality standards and the methodology for assessment. This matter is not specifically relevant to the LPS but the matter of air emission control is broadly addressed through sections 18.3.2 and 19.3.1 in the Light Industrial and General Industrial zones respectively and the Attenuation Code.

The other NEPMS (*Diesel Vehicle Emission 2001, Used Packaging Materials 1999, Movement of Controlled Waste between States and Territories 1998, National Pollutant Inventory June 2000)*; are not relevant to the LPS. For example, the *National Pollutant Inventory NEPM* (NPI)

provides the framework for the development and establishment of the NPI which is an internet database designed to provide publicly available information on the types and amounts of certain chemicals being emitted to the air, land and water.

Cradle Coast Regional Land Use Strategy 2010-2030 (CCRLUS)

The Strategy is a high level strategic document and some of the goals/policies are aspirational.

The strategic document comprises three parts:

Part A – About the Cradle Coast Regional Land Use Planning Framework, "*provides background on the purpose and preparation of the Framework and its function within the Tasmanian land use planning system".*

Part B – Knowing Our Place, "*provides a description of the key regional characteristics and land use issues. … Knowing our Place is a background for introducing and justifying the Cradle Coast Regional Land Use Strategy contained in Part C."*

Part C – The Cradle Coast Land Use Strategy 2010-2030, "*contains the strategic policy requirements for a coordinated and consistent approach to land use policy and decisions in the Cradle Coast Region.*

The Policies must be observed in the preparation of local planning schemes for each of the nine Cradle Coast municipal councils.

The Cradle Coast Land Use Strategy is presented in five integrated parts –

1 Implementation
2 Wise Use of Resources
3 Support for Economic Activity
4 Places for People
5 Planned Provision for Infrastructure."

Implementation –

This section includes the following outcomes:

- *Promotes regional land use policies that respect the natural environment, facilitate a robust and successful regional economy, provide liveable communities and a sustainable pattern of settlement and guide new use and development toward a secure and prosperous future.*

- *Consolidates and aligns land use planning and related strategies for economic, social, environmental, conservation and resource management applying for the Cradle Coast Region and places them into an overall context of an integrated regional land use strategy.*

- *Provides a basis for the coordination of future actions and initiatives related to the growth and development of the Region and promotes arrangements which optimise benefit for regional communities.*

- *Initiates a regional land use planning process to provide a strategic regional perspective and coordinated framework for consistent regulatory action.*

Comments –

The draft LPS is based on the provisions of the SPP whilst zoning is based on an amalgam of State Policies, infrastructure and existing zoning, uses and development. Extension of zones has been based on inferred need to ensure adequate zoned land is available for future needs and development. Considering the Strategy is a snapshot in time and has not been modified despite the rapid changes occurring in society, the draft LPS conforms as much as possible to the Strategy outcomes and policies.

Wise Use of Resources –

The Strategy includes the following outcomes:

Use and development of natural and cultural resources in the Cradle Coast Region –

- *safeguards the life supporting properties of air, water and land*
- *maintains and enhances the health and security of biodiversity and ecological processes*
- *provides sustainable access to natural resources and assets in support of human activity and economic prosperity*
- *recognises and respects natural and cultural heritage*
- *promotes the optimum use of land and resources.*

Comments –

Zoning sensitive areas such as Environmental Management and Landscape Conservation in association with the development Codes provides sensitive areas protection from inappropriate use and development. Areas which contain natural resources such as quarries are appropriately zoned and protected from encroachment.

Support for Economic Activity –

The outcomes for this section are:

"…Land use planning –

- *facilitates regional business through arrangements for the allocation, disposition and regulation of land use which promote the diversification, innovation and entrepreneurism and avoid unnecessary restraint on competition and cost for compliance*
- *promotes use and development which maximises the Region's economic potential in key sectors with deep capacity and potential for sustained growth and economic return or a clear strategic advantage*

- *improves the social and environmental sustainability of the State and regional economy by allowing economic development and employment opportunities in a range of locations while respecting the link between a healthy environment and a healthy economy*

- *supports and grows liveable regional communities through coordinate action aligned with State and regional economic development plans specific to the issues, challenges and opportunities of the Region."*

Comments –

Issues such as the protection of rural land and agricultural activity, including allied uses and natural resources are encouraged.

Industrial land is to be protected from inappropriate nearby land uses. Uses such as transport and storage facilities are to have access to strategic transport infrastructure.

Industrial facilities are to be clustered and not fragmented.

The draft LPS zones identify where tourism operations and facilities can be considered.

In order to support economic activity, areas have been zoned Light Industrial, General Industrial, Commercial, Local Business, General Business, Rural and Agriculture. An infill area at West Ulverstone in Queen Street has been zoned General Business whilst a small extension to the existing Light Industrial zone in Penguin is proposed.

Additional zoned land is generally an extension of existing serviced land as required by the Strategy. Infrastructure costs have been kept to a minimum.

The draft LPS recognises the need to protect resources and environmental areas through appropriate zoning, e.g. quarries and agriculture.

The wellbeing of communities is recognised through the appropriate zoning of land for health, recreation, education and community services.

Places for People –

The outcomes are to ensure regional settlements are, *"liveable and sustainable communities where:*

- *the growth and development of centres is contained to create functional places which optimise use of land and infrastructure services and minimise adverse impact on resources of identified economic, natural or cultural value*

- *the pattern of settlement provides a network of compact, well connected and separate centres each with individual character and identity*

- *land supply is matched to need and there is a balance of infill and expansion*

- *there is coordinated and equitable access to provision of regional level services*

- *each settlement provides an appropriate level of local development and infrastructure facilities to meet locally specific daily requirements in employment, education, health care, retail, and social and recreation activity for its residential population*

- *each settlement provide a healthy, pleasant and safe place in which to live, work and visit*

- *there is diversity and choice in affordable and accessible housing*

- *people and property are not exposed to unacceptable levels of risk*

- *transport, utility and human service infrastructure is planned and available to meet local and regional need*

- *energy and resource efficiency is incorporated into the design, construction and operation of all activities."*

Comments -

The draft LPS promotes compact urban settlements and urban nodes with land supply matched to the required need within a 10-20 year timeframe. It is against linear and lateral expansion, particularly in coastal and rural areas.

Resources are protected from conflicting uses and sensitive areas are protected from inappropriate use and development. For example, the coast is zoned Environmental Management whilst prime rural land is zoned Agriculture or Rural.

Land Use and Infrastructure Planning -

The outcomes of this section are:

"Economic prosperity, liveable settlement and environmental health is underpinned by integrated land use and infrastructure planning to facilitate provision of adequate, appropriate and reliable infrastructure in a manner that -

- *ensures infrastructure is planned and available commensurate with the use and development of land*

- *prioritises optimum use of existing infrastructure over provision of new or expanded services*

- *protects the function, capacity and security of existing and planned infrastructure corridors, facilities and sites."*

Comment -

Zone extensions are generally an increment of existing serviced zones and developed areas. No large areas which are not contingent on existing services or zones are envisaged. In order to protect infrastructure facilities they have been identified and appropriately zoned or included in the provisions of a Code, e.g. gas pipeline.

For some zonings or Specific Area Plans, specific strategic clauses that support the changes are highlighted in the specific sections of the report.

Council's Strategic Plan prepared under section 66 of the *Local Government Act 1993*

Central Coast Council Strategic Plan 2014-2024

The *Central Coast Strategic Plan 2014-2024* (the Strategic Plan) identifies the key strategic directions, strategies and actions that the Council plans to pursue over a 10 year period. The Strategic Plan is an integrated document that frames the Council's Annual Corporate Plan. Reference is also made to the non-statutory document *Strategic Framework for Settlement and Investment* prepared for the Council in 2010. This document provided a framework for the Strategic Plan.

A key value identified by the community in the *Strategic Framework for Settlement and Investment* report was the importance of the range of existing landscapes, and the key qualities that give them their sense of place. These need to be maintained and enhanced to maximise the opportunities that this level of choice provides for living, employment and recreation. This includes maintaining spaces between places to enhance the distinctiveness between places.

The Strategic Plan recognises the distinctiveness, character, capability and resources already embedded in the area and which can be further built upon within four distinctive platforms. These are:

Liveability; e.g. quality of life, character of the place, health and well-being of the community;

Sustainability; this means that that within the planning and decision making processes an implicit consideration of the environmental, social and economic sustainability of all development, now and into the future occurs;

Innovation; the importance of the role of innovation and entrepreneurship in social and economic growth is recognised; and

Distinctiveness; this is about recognising the qualities and combinations of qualities that define Central Coast and protecting and growing those attributes that matter most to the community.

The Plan recognises:

"*Central Coast comprises Ulverstone, Penguin, Turners Beach, Forth, and other towns and localities that each has a distinctive character. The character of these places is largely influenced by the relationship between the coastline, the rivers and ranges and fertile agricultural land to the south. The major towns are distinguished by the dominant landforms within which they sit."*

The natural values that are particularly valued include the coastline, the beaches, diversity of flora, fauna and natural features, and the picturesque and productive rural landscape.

The outcomes include:

- sustainable population growth;
- socio-economic well-being;
- economic prosperity and resilience;
- resilient and engaged community;
- healthy community and healthy lifestyle; and
- healthy environment.

The draft LPS has allocated sufficient and various sites for residential and industrial development. The municipal area is well served with large expanses of developed and natural land that is zoned for public and private recreation that encourages a healthy community and social interaction amongst the community.

Gas Pipelines Act 2000

The gas pipeline traverses the rural areas in the municipal area. The draft Scheme does not contain specific controls relating to the pipeline but relies on the *Gas Pipelines Act 2000* for protection against land use conflict. This Act includes a declared statutory notification corridor for use and development within proximity to the pipeline to ensure safety and protection. This Act also requires the planning authority to give notice to the pipeline licensee about development within the corridor. In turn the licensee may provide advice to the planning authority as to safety conditions that are to be included on any issued permit. The Scheme will show the location of the pipeline.

Consistent and coordinated with adjacent municipal area

The draft LPS is required to be [s.34 (g)], as far as practicable, consistent and co-ordinated with LPS that apply to adjoining municipal areas. The adjoining Councils were consulted in an effort to ensure the adjoining zones were similar or at least compatible. The proposed zoning at the boundaries of the Devonport, Latrobe, Kentish and Burnie Planning Schemes did not create conflict problems with the Central Coast boundaries. Meetings between respective Council planners have discussed the boundary zonings. No conflict issues were evident. It is noted that at this stage no draft LPSs for adjoining municipal areas have been finalised.

Land reserved for public purposes

No undeveloped land has been reserved for future public purpose other than that provided for in the Open Space and Community Purpose zones.

Statement LPS is consistent with provisions in section 11 and 12 of the Act

The draft LPS complies with sections 11 and 12 of the Act.

The draft LPS relies on the SPP and no additional provisions have been included in the draft Scheme which affect forestry, fishing, mineral exploration or marine farming operations or existing uses and developments.

Zones

Background -

Population growth rate over the last 10 years in the municipal area has varied between -.05% and 1.6%. Currently the annual growth rate is estimated to be 0.2% compared with the State rate of 0.64% and the National rate of 1.43%.

The estimated population of Central Coast in 2014 was 22,411. Population projections based on mortality rates, births and migration rate indicate that the Central Coast population by 2030 could be as high as 23,260 persons.

Central Coast's population is reflecting the national trend of an ageing population. This will impact on the style and size of dwellings, lot sizes and required services.

The number of people per dwelling is dropping with occupancy rates expected to be 2.1 persons per dwelling by 2030.

A reduction in the number of people per dwelling combined with the expected population growth means approximately another 750 dwellings will be required over the next 10 years. Dwellings will comprise an unknown mixture of units and single dwellings.

Excluding infill areas there is over 173ha of vacant residential zoned land within the municipal area[1]. In gross terms, at a density rate of 15/30 dwellings per hectare, this represents approximately 25 years of supply[1]. However this figure is not a realistic indication of land available for development as much is undeveloped, not for sale, cannot be developed or unsuitable for the prevailing market.

Central Coast includes a number of settlements;

- Ulverstone
- Penguin
- Sulphur Creek
- Turners Beach
- Leith
- Forth
- Sprent
- Riana and South Riana
- Heybridge
- North Motton

The settlement pattern reinforces one of the main values the community holds about living in the region: the small-town feel.[1] The size and distribution of urban centres across the coastal strip and throughout the rural hinterland are very conducive to engendering a "small town" living environment (SFSIR). Each settlement has unique characteristics which restrict or guide expansion options. In some areas residential expansion is limited because of the surrounding prime land, topography, coastline and the lack of infrastructure. Most urban growth will continue to occur in Ulverstone and Penguin due to the availability of physical and social infrastructure, employment opportunities and recreation facilities.

[1] Strategic Framework for Settlement and Investment Report SFSIR 2010

Zone Allocation

The following zones were used in the draft LPS.

- General Residential
- Low Density Residential
- Rural Living
- Village
- Local Business
- General Business
- Commercial
- Light Industrial
- General Industrial
- Agriculture
- Rural
- Landscape Conservation
- Environmental Management
- Utilities
- Community Purpose
- Open Space
- Recreation

General Residential

Zone Purpose & Local Area Objectives (LAO)

The General Residential zone is used.

Zone purpose statements of the SPP and Central Coast Interim Planning Scheme 2013 (IPS) are similar in that they both provide for a range of residential development types in locations where full infrastructure services are available, i.e. suburbia. It also allows for the provision of other compatible and supporting uses.

LAO are not included in the SPP but may be used where objectives cannot be delivered through the SPP.

Existing LAOs of the IPS are general in their nature and include statements regarding building height, spacing of buildings, use and lot size. These are matters covered by the Development Standards and associated Objectives and provide little additional assistance in achieving the Objectives.

There are three areas where additional General Residential zoning was considered:

(a) The Turners Beach residential area north of the Western Rail Line is currently zoned Low Density Residential in the IPS. It is proposed to rezone this area General Residential.

(b) Approximately 40ha of land in the Braid's Estate has been considered to be rezoned from Rural Resource to General Residential, to allow for development of land on lower slopes until a reservoir for the provision of water is viable.

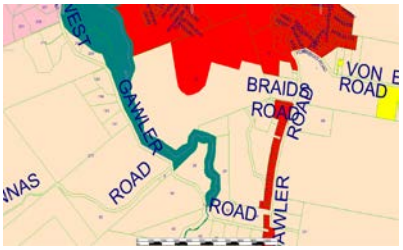
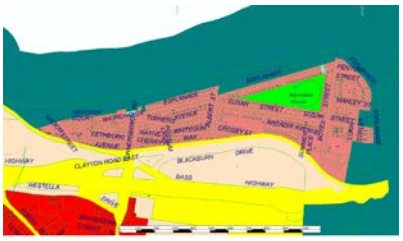
(c) An area of land located adjacent to the Blythe River now zoned Environmental Living. The area was formally a Crown Land shack area which was part of the State Government's shack program. The area is serviced with water and sewerage infrastructure.

Use, Development and Subdivision Provisions

These standards are similar in many respects to those contained in the IPS but include some minor variations to standards for discretionary uses, development and subdivisions. The new standards are not local area provisions and cannot be altered.

Zoning

There are various areas regarding which an assessment of zoning is appropriate, as follows:

LOCATION	MAP	ISSUE
Gawler – Braid's Estate		The current General Residential zoning has been transferred to the draft scheme. See below for discussion
Turners Beach north of highway		Change from Low Density Residential zone to General Residential

Braid's Estate

Subdivision of the Braid's Estate continues at a steady pace and now occupies approximately half of the zoned area of the Estate. A staged development layout for the northern part of the Braid's Estate has been approved by the Council while a sketch plan for the whole Estate indicates an intention to develop the whole Estate for residential purposes. Development of the Estate is appropriate because it is now within the urban area of Ulverstone. On the current development rate of 10 new lots per year, the approved subdivision is expected to be completed in around 10 years. However, lots on the higher elevations of this land are dependent on construction of a reservoir which would be expensive (about $1 million) and make some areas unviable for development. Even though the Council recognises the area as a residential growth area it is appropriate that further rezoning of land for residential purpose be achieved through the amendment process. Development of the rural zoned land within

the estate for residential purposes could yield approximately 400 lots which at the current rate of take up is 40 years supply.

Turners Beach north of highway to General Residential

Under the Council's 2005 Planning Scheme, the residential area of Turners Beach north of the Western Rail Line was zoned Residential. The minimum lot size in the Residential zone was then 650m². In the translation exercise from the 2005 Scheme to the Interim Planning Scheme the area was rezoned Low Density Residential which carried with it a minimum site area of 500m², instead of General Residential for which the minimum site area was 330m².

Low Density Residential zoning was chosen because the minimum site area standard for this zone was higher than the General Residential standard and would limit re-subdivision potential in the area. The purpose of limiting re-subdivision was to provide a minimum lot size that was consistent with the existing character and to limit coastal erosion and inundation risk, i.e. less households would mean less people subject to risk. A common lot size in the Turners Beach area north of the Bass Highway, is between 600m² and 799m². Of a sample of approximately half the properties in Turners Beach, 69% of lots are within this range. The prevalence of larger sized suburban residential lots is despite a minimum lot size of 500m² which applied under previous Planning Schemes (1993 and 2005).

The SPP provides for a minimum site area of 450m² in the General Residential zone and 1,500m² in the Low Density Residential zone. The site area standard closest to the existing standard is General Residential, i.e. 450m². For this reason, it is considered that the Turners Beach area north of the Western Rail Line, currently zoned Low Density Residential, be rezoned to General Residential.

It is submitted that land at Turners Beach area north of the Western Rail Line, be rezoned from Low Density Residential to General Residential.

The following clauses from the CCRLUS support the rezoning;

The CCRLUS identifies the Turners Beach settlement as having a medium growth scenario.

A medium growth scenario is one where "demand is driven by internal population change and growth and /or moderate positive inward migration. Growth relies on intensification of existing land supply within designated urban boundaries and /or expansion."

The CCRLUS aims to build (p.66) on established centres in order to support local and regional communities, concentrate investment into the improvement of infrastructure and services, and to maintain and enhance identity, character and quality of life without compromise to health of natural systems and significant economic resources.

The zoning of Turners Beach to General Residential will afford the opportunity to achieve some limited growth in an area which is already serviced and will not impact on economic or natural resources.

Other areas - General Residential

There are areas of Ulverstone, Turners Beach, West Ulverstone, Penguin, Sulphur Creek and Heybridge which are currently zoned General Residential. There has been no assessment of demand and supply undertaken for additional lots in these areas. Consequently, at this stage and excluding Turners Beach, discussed above, there should be no additional large scale expansion of land zoned for residential purposes in or around these areas.

Areas currently zoned General Residential under the Interim Planning Scheme should be zoned General Residential under the LPS.

Some individual properties at Turners Beach (Stubbs Road and Westella Drive) and Heybridge (Haig Street, Blythe Street and River Avenue), that adjoin and have characteristics of the General Residential Zone, such as, small lot, and existing residential use and development are proposed to be included in the General Residential Zone. These properties are within the established settlement areas, and promote established settlement areas as the focus for growth and higher dwelling density to optimise use of land, consistent with the CCRLUS.

Rural Living

When considering allocating the Rural Living Zone to specific areas several strategic documents and policies were applied, including the: Cradle Coast Regional Land Use Strategy 2010-2030 (CCRLUS), State Policy on the Protection of Agricultural Land 2009, the Council's Rural Living Strategy October 2016 and State government produced mapping for Land Potentially Suitable for the Agriculture Zone.

The Cradle Coast Regional Land Use Strategy 2010-2030 includes a section on Land use Policies for Housing Land (section 4.7 p. 148). Housing in rural areas is specifically dealt with in section h. p.149.

The strategy recognises that opportunity for housing in rural areas where-

"*i. Required as part of a rural resource use.*

ii. There is no adverse effect for access to and use of rural resource land, including to land significant for agriculture.

iii. There is no adverse effect on key natural resource values, including areas of biodiversity significance and land scape aesthetics.

iv. Adequate arrangement is available for transport and there is convenient access to basic retail need, community services and employment opportunities, whether or not in an alternate settlement area.

v. There is no restraint on options for settlement expansion or provision of employment land

vi. There is an acceptable level of risk from exposure to natural or man -made hazard.

vii. Capacity is available to meet basic utility needs art reasonable cost or there is capacity for self- sufficiency in on- site generation collection and disposal without risk to human or environmental health."

State Policy on the Protection of Agricultural Land 2009 (PAL)

The policy is to conserve and protect agricultural land so that it remains available for the sustainable use and development of agriculture, recognising the particular importance of prime agricultural land.

As part of the PAL Policy land has been classified with classes 1, 2, 3 being recognised as prime agricultural land.

While some new areas proposed to be zoned Rural Living contain land classified as prime agricultural land, agricultural use of the land is either unreasonably confined or restrained by Residential use and development or not practicably useable for agriculture due to topographic or access constraints.

Several salient principles of the policy are:

"5. Residential use of agricultural land is consistent with this Policy where it is required as a part of an agricultural use or where it does not unreasonably convert agricultural land and does not confine or restrain agricultural use on or in the vicinity of that land;

7. The protection of non-prime agricultural land from conversion to non- agricultural use will be determined through consideration of the local and regional significance of that land for agricultural use.

8. Provision must be made for the appropriate protection of agricultural land within irrigation districts proclaimed under Part 9 of the Water Management Act 1999 and may be made for the protection of other areas that may benefit from broad-scale irrigation development. "

Within the municipal area several areas have been designated irrigation districts.

New areas proposed to be zoned Rural Living are considered to:

- not unreasonably convert agricultural land or restrain agricultural use in the vicinity;
- not have local or regional significance for agriculture;
- be unlikely to benefit from or be accessible to irrigation schemes.

State Rural mapping

The State Government have conducted a mapping exercise to identify land as potentially suitable for the Agriculture or Rural zones. This mapping also identifies land that is potentially constrained.

New areas proposed for the Rural Living Zone are either identified as constrained in the State government mapping; or local analysis has identified them:

- as constrained for agricultural use by topography, access or the existence of dwellings; or
- Suitable for the Rural Living Zone in accordance with the Rural Living Strategy 2016.

Council Rural Living Strategy October 2016

The Council intends to implement its *Rural Living Strategy (Oct 2016*) through the planning scheme. It intended no further rezoning of land to Rural Living would be approved by Council unless a proposal meets the following criteria. The exceptions to this relate to a small number of areas which are effectively now functioning as rural living areas by virtue of the lot pattern, lot size and existing dwellings.

The criteria as outlined in the strategy for considering new areas to be zoned Rural Living are:

"The area is not to be located within an area which will benefit from irrigation, a private timber reserve or in a mining lease. ·

No damage to threatened flora or fauna on the site will occur. If threatened flora or fauna are present then appropriate management regimes must be enacted. ·

Not be located on prime land – classes 1 to 3, unless the PAL policy is amended. ·

Be located approximately within 10 kilometres from a settlement that will service the area with social and community infrastructure (e.g. shops, health and community services and schools). ·

Not be in a high profile landscape area such as ridgelines and coastal headlands. The land capability of soils, road access, water, drainage, and sewage and stormwater disposal is adequate for the proposed development. ·

Be void of unacceptable risk from natural hazards such as landslide, flooding, bushfire, sea level rise and storm surge. ·

Not be located within an area that will create conflict with an existing or potential resource development or use, such as agriculture. ·

Not be in an area containing construction or mineral resources or will impact on existing mining operations. ·

Not to adversely impact on a vulnerable environmental area such as a marshland or river bank.

Has adequate existing service infrastructure or appropriate infrastructure will be provided at the proponents cost. ·

Not adversely impact on cultural or built heritage. ·

The area is not required for future urban development."

New areas proposed to be zoned Rural Living are considered too broadly meet these criteria, or specific site constraints, or are effectively now functioning as rural living areas by virtue of the lot pattern, lot size and existing dwellings.

Existing IPS Provisions

The zone statements in the SPP and the IPS are similar in that they both provide for residential development in a rural setting where services are limited and both allow for other types of compatible development.

The SPP minimum lot size standard of 1ha, 2ha, 5ha and 10ha for the zone are significantly larger than the 4,000m^2 that currently applies in Rural Living areas at Ulverstone, West Ulverstone and Leith. The current Rural Living areas at East Ulverstone, West Ulverstone and Leith are proposed to be zoned Low Density Residential, this change detailed in the Low Density Residential Zone discussion.

As shown in the following Table, the SPP contains four categories of lot sizes for the Rural Living zone.

RURAL LIVING CATEGORY	MINIMUM LOT SIZE
Rural Living Zone A	1ha
Rural Living Zone B	2ha
Rural Living Zone C	5ha
Rural Living Zone D	10ha

The IPS provides lot sizes of 1ha in all other Rural Living areas. All existing Rural Living areas, excluding ones proposed for a different zone, and new areas proposed for the Rural Living Zone are proposed to be zoned Rural Living Zone A or B to:

. reflect the existing pattern and density of development; or

. to provide for growth consistent with the scenarios and strategies in the CCRLUS.

In addition to maintaining the current Rural Living areas as the Rural Living Zone, additional properties listed in the table below, are proposed to be zoned Rural Living.

Proposed Rural Living Lots

Address	**Folio of the Register**	**Area (ha)**	**Proposed Rural Living Zone Area**	**Irrigation District**	**Land capability class**	**Land potentially suitable for the Agriculture Zone**	**Comments**
151 West Gawler Road	12774/5	2.0	B	Kindred North Motton	4	Potentially constrained criteria 2A	dwelling
153 West Gawler Road	12774/4	1.99	B	Kindred North Motton	4	Potentially constrained criteria 2A	dwelling
159 West Gawler Road	12774/3	2.0	B	Kindred North Motton	4	Potentially constrained criteria 2A	Dwelling, heavily forested
165 West Gawler Road	122240/2, 122240/1	3.53	B	Kindred North Motton	4	Potentially constrained criteria 2A	One lot has a dwelling
200 West Gawler Road	17927/2	0.8	A	No	4	Not mapped	dwelling
210 West Gawler Road	17927/1	1.1	A	No	4	Not mapped	dwelling

Address	Folio of the Register	Area (ha)	Proposed Rural Living Zone Area	Irrigation District	Land capability class	Land potentially suitable for the Agriculture Zone	Comments
268 West Gawler Road	249981/1	0.83	A	No	4	Not mapped	dwelling
268A West Gawler Road	50332/1	1.2	A	No	4	Not mapped	dwelling
727 West Gawler Road	123590/1	1.4	A	No	4	Not mapped	dwelling
261 Top Gawler Road	102592/1	5.85	B	Kindred North Motton	4, 5, 2 and 2+3 (~9ha prime Ag)	unconstrained	Dwelling & sheds, steep bushland cover, not suitable for agricultural pursuits
Top Gawler Road	154473/1	5.8	B	Kindred North Motton	4,5 and 2+3 (~2.5ha prime Ag)	unconstrained	Mostly land capability class 5
3 Mc Naughton Drive	245122/1	14.9	B	No	4, 5 and 2+3 (~1.5 ha of prime Ag)	unconstrained	Mostly land capability class 5 Predominately very steep land, Dwelling adjoins Rural Living zone.
21 Blue Wren Lane	10310/1	4.074	A	No	4	Potentially constrained criteria 3	Adjacent to quarry / mining lease dwelling
Castra Road Ulverstone (Part of 172 Main Street)	Part of 152582/1	2.2 ha of 17.97	B	No	4	unconstrained	Surrounded by highway / ramps / Castra Road
69 Stubbs Road	156781/2	1.74	B	No	5	Potentially constrained criteria 3	Dwelling area already converted to residential
71 Stubbs Road	156781/1	1.78	B	No	5	Potentially constrained criteria 3	Dwelling area already converted to residential
105 Stubbs Road	156781/3	2.6	B	No	5	Potentially constrained criteria 3	Dwelling area already converted to residential

Address	Folio of the Register	Area (ha)	Proposed Rural Living Zone Area	Irrigation District	Land capability class	Land potentially suitable for the Agriculture Zone	Comments
107 Stubbs Road	156781/4	2.2	B	No	5	Potentially constrained criteria 3	dwelling area already converted to residential
123 Stubbs Road	156781/5	2.5	B	No	5	Potentially constrained criteria 3	dwelling area already converted to residential
135 Stubbs Road	226035/1	7.6	B	No	5	Potentially constrained criteria 3	Dwelling area already converted to residential
261 Stubbs Road	15174/1	1.06	B	Kindred North Motton	4	Potentially constrained criteria 3	dwelling area already converted to residential
275 Stubbs Road	15174/2	0.858	B	Kindred North Motton	4 and 3 (~0.38ha prime Ag)	Potentially constrained criteria 3	Prime Ag is predominately located under the dwelling curtilage. Dwelling, area already converted to residential
270 Stubbs Road	7906/3	3.65	B	Kindred North Motton	3,4 and 5 (~0.12ha prime Ag)	Potentially constrained criteria 3	Prime Ag is predominately located under the dwelling curtilage
298 Stubbs Road	35510/1	8.09	B	Kindred North Motton	3 and 4 (~2.8ha prime Ag)	Potentially constrained criteria 2A	dwelling area already converted to residential
Lot 2 Stubbs Road	7334/2	7.9	B	Kindred North Motton	4, 3 and 4+3	Potentially constrained criteria 2B	Predominately prime Ag land but constrained area already converted to residential
(Lot 4) 332 Stubbs Road	7334/4	7.9	B	Kindred North Motton	4, 3 and 4+3	Potentially constrained criteria 2B	Predominately prime Ag land but constrained area already converted to residential

Address	Folio of the Register	Area (ha)	Proposed Rural Living Zone Area	Irrigation District	Land capability class	Land potentially suitable for the Agriculture Zone	Comments
360 Stubbs Road	101639/1	8.2	B	Kindred North Motton	4, 3 and 4+3	unconstrained	Predominately prime Ag land dwelling
164 Hardys Road	119768/2	15.8	B	Dial Blythe	Predominately class 2+3	unconstrained	Dwelling and sheds, adjoins existing Rural Living zone, due to topography and existing residences adjoining rural area will not be fettered.
Part of 76 Reynolds Road	Part of 168973/1	4ha part of 8.2	A	No	4 and 5	Potentially constrained criteria 3	IPS include site specific provisions
Part 822 South Road Penguin	Part of 119921/2	5.3ha part of 10.6	A	No	4 and 3 (~0.85ha Prime Ag)	Potentially constrained criteria 3	Dwelling on portion proposed to be zoned light industrial, adjoins residential and nearby light industrial
Lot 1 Wilmot Road	11917/1	0.82	A	No	4	Potentially constrained criteria 3	Adjacent to Forth settlement and nearby housing.

Low Density Residential

The current minimum lot size in the Rural Living zone of the IPS is 1ha except in the following areas:

- Leith – north and south of the Bass Highway – where the Lots size ranges from 2,000m^2 to 5,000m^2;
- East Ulverstone – Merinda Drive, Kimberleys Road, Gumnut Place, Froms Road and Waverley Road, where the average Lot size is 4,000m^2; and

- West Ulverstone – Knights Road, Bladen-Lee Crescent, Levenview Court, Grange Court, Brockmarsh Place, Maxwell Street, Reid Street and 13 Ellis Street, where the average Lot size id 4,000m^2

These three areas are proposed to be rezoned Low Density Residential.

The Zone Purpose Statement of the Low Density Residential Zone is considered to have a greater level of consistency with the above areas than the Zone Purpose Statement for Rural Living because the areas are more residential in character and form than Rural Living, which in contrast, provides for residential use in a rural setting. Apart from Leith the areas are largely serviced and have been developed for residential purposes.

In those areas mentioned above, a common size for existing lots is around 4,000m^2. Front setbacks of 6m and side and rear setbacks of between 3 and 6m are also common.

Under the SPP, most development involving such properties is likely to involve exercises of discretion involving lot size and/or setbacks for minor work. This was considered an unreasonable imposition during the development of the IPS and the Council argued, successfully, for a table to be inserted into the zone provisions reducing the minimum site area to 4,000m^2 and lesser setbacks.

The SPP makes no provision for such tables and an alternative rezoning to Low Density Residential is submitted. The Zone Purpose for this zone is to "*provide for residential use and development in areas where there are infrastructure or environmental constraints that limit density, location or form of development".*

There are similarities in the type of uses allowed in both zones with the main differences being that in the Rural Living zone Resource Development, Resource Processing and Vehicle Fuel Sales and Service uses as discretionary uses whereas they are prohibited in the Low Density Residential zone. The areas currently zoned Rural Living in the Leith; East Ulverstone and West Ulverstone areas are essentially residential and are unlikely to be developed for other uses.

The minimum size for a lot in the Low Density Residential zone is 1,500m^2. Required setbacks are 8m to the frontage and 5m to side and rear boundaries.

Lots in most of the areas are largely developed with houses. The lesser minimum lot size requirement would allow for some subdivision of existing lots, potentially increasing the density by around double.

In cases where full services are provided, particularly East and West Ulverstone, zoning the land to Low Density Residential (compared to the existing Rural Living) is an appropriate outcome as a greater level of efficiency in the use of land and services would be achieved within the suburban area of Ulverstone.

Due to the physical and development attributes of Leith, including high water table, lack of stormwater and wastewater infrastructure, large lots and limited development potential, a Specific Area Plan in combination to zoning the land Low Density Residential is proposed for the area. See details in SAP section for details regarding the Leith SAP.

In addition to the areas at Leith, East Ulverstone and West Ulverstone, two properties (totalling approximately 5000m²) at Forth Road, Forth are proposed to be zoned Low Density Residential, from the Rural Resource Zone. These properties adjoin the Low Density Residential Zone and are separated from the Rural Zone by Forth Road. The site is not used for agricultural uses, and is constrained from future agricultural use and development due to size, topography and proximity to sensitive uses.

Village

The townships of North Motton, Sprent and South Riana are currently zoned Village in the IPS.

The Zone Purpose Statements in the IPS and SPP are similar in that they provide for small rural centres with a mix of residential, community services and commercial activities.

It is proposed that the currently defined Village zone areas in each settlement to also be zoned Village under the new Scheme. The central area of the Riana settlement is zoned Rural Resource under the IPS. Riana is a small settlement with a centre that includes various uses including a primary school, a general store/post office, housing, a recreation ground and a community hall. Riana is a similar size and within the same functional level as the other settlements zoned Village, i.e. Sprent, North Motton and South Riana. However the settlement is not recognised in the Cradle Coast Regional Land Use Strategy 2010-2030. Furthermore the strategy stated no" new discrete settlements are supported'. As such the zoning remains Rural.

Local Business

The commercial areas of Penguin and West Ulverstone, plus five individual sites at Turners Beach north and south of the Bass Highway (three), Gawler and Penguin, are currently zoned Local Business. Each location is suitable for business, retail, administrative, professional community and entertainment functions.

The Zone Purpose Statements of the IPS and SPP are similar in that they provide for business, retail, administrative, professional, community and entertainment functions to meet the needs of a local area.

Local Business zoned areas of the IPS are zoned Local Business in the new Scheme, plus three lots in Hobbs Parade have been rezoned from Commercial to Local Business, primarly due to lot size and the unsuitability of land for Commercial zone use

Queen Streetis a small retail strip centre that services West Ulverstone. Some infill lots in this area are currently zoned General Residential. It is proposed these lots be zoned Local Business. In terms of loss of amenity, due to the adjoining zoning, uses and traffic, it's not appropriate the lots remain zoned General Residential.

There is no obvious demand for other land to be zoned for Local Business purposes.

General Business

It is proposed to zone the existing General Business zoned areas in Ulverstone to General Business in the new Planning Scheme. The Zone Purpose Statements of the IPS and the SPP are similar in that they are intended to provide for business, administrative, professional, community and entertainment functions within Tasmania's main suburban and rural centres.

It is appropriate the General Business zoned areas of the IPS also be zoned General Business in the SPP.

A small area in Grove Street, Ulverstone has been rezoned from General Residential to General Business. The area consists of approximately 6 houses that are being converted from residential into commercial activities. The area to the rear and to the east adjoins the existing General Business zone. Rezoning the area General Business is viewed as a consolidation of that zone. The area is fully serviced.

Land on the opposite side of Grove Street is to remain General Residential.

The rezoning is supported by the Cradle Coast Regional Land Use Strategy with the following guidelines,

"Ulverstone is recognised as a centre which "serves a distinct geographic district with essential and some optional economic and community functions.

Facilitate supply of employment land in all settlements areas for industrial, business and institutional use including residential locations.

It's important to maintain the integrity, viability and vitality of established centres by locating new business and commercial development onto land within or immediately contiguous with existing town centres and commercial zones."

The General Business zone in central Ulverstone is compact, centred on and expanding out from Reiby Street. Within the subject zone there is very limited opportunity for infill development. For Ulverstone to remain a viable service centre for the surrounding Ulverstone area it's important that some land is available for limited commercial development. It's noted that the Council previously commissioned an Urban Design study of the Ulverstone CBD. A set of guidelines were developed and consequently included in the General Business zone in the IPS. However the SPP provisions for the General Business zone include provisions similar to the guidelines.

Commercial

The Commercial zone is proposed to be used in the new Scheme. The Zone Purpose Statements of the IPS and SPP are similar in that they are intended to accommodate large floor area retailing, storage and warehousing involving large floor and/or site and high levels of vehicle access and parking. Existing Commercial zoned areas are to be zoned Commercial under the SPP.

Open Space

The Open Space zone is to provide land for passive recreation and natural or landscape amenity and other compatible uses, such a Visitor Accommodation As the zone provisions

are similar in both the SPP and IPS, the Open Space zone has been transferred from the IPS into the draft Scheme.

Coastal caravan parks are proposed to be included in the Open Space Zone, for consistency with the zone purpose and to manage the sites and development on them primarily, for their visual impact on the coastal landscape. These sites are discussed in more detail below.

Recreation

The Recreation zone is to provide for active and organised recreational use and development ranging from small community facilities to major sporting facilities. Complementary uses are permitted where new recreational uses should not cause unreasonable impacts on adjacent sensitive uses.

Generally the Recreation zone in the IPS has been transferred across into the draft Scheme. Three Council owned properties at Montgomery Road and Ironcliffe Road, Penguin, that contain a mountain bike park and community gardens are proposed to be zoned Recreation.

For these properties, application of the Recreation Zone reflects the current use of the land and provides for the provision of future recreational capacity within the Penguin settlement, consistent with the CCRLUS.

Landscape Conservation

The Landscape Conservation zone is to provide for the protection, conservation and management of landscape values. The zone allows some uses that do not adversely impact on conservation or landscape values such as a qualified single residence.

The zone was not available in the existing IPS but is proposed for:

- 12 residential properties on Penguin Road currently zoned Environmental Management, which form part of the coastal landscape that contains houses within the scenic coastal landscape. Consideration of these properties against the Environmental Management Zone is provided below;
- a portion of one property at Penguin Road, West Ulverstone, located between Penguin Road and the Railway that adjoins residential properties on Penguin Road, that contains a coastal walking track; and
- steep embankments which provides a coastal backdrop to the Heybridge, Leith, Penguin, Sulphur Creek and Ulverstone, urban areas, that are currently zoned Environmental Living or Environmental Management. The land at Penguin is also subject to potential landslip and has very limited development potential.;

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Environmental Management

The Environmental Management zone is to:

- provide for the protection, conservation and management of land with significant ecological, scientific, cultural and scenic value.
- allow for compatible use or development where it is consistent with:

    (a) the protection, conservation and management of the values of the land; and

    (b) applicable reserved management objectives and objectives of reserve management plans.

The zone has been largely transferred across from the existing IPS. It includes the coastal reserve which is supported by the State Coastal Policy and the areas reserved as a park controlled by the Crown.

The areas which contain houses such as the coastal area near Penguin which is currently zoned Environmental Management have been zoned Landscape Conservation.

The IPS currently uses the zone for management of areas with ecological value. The Zone Purpose Statements of the existing IPS and the SPP are similar in that they are both intended to protect, conserve and manage land with significant ecological, scientific, cultural or scenic value.

There are some differences in the use tables between the IPS and SPP. The SPP lists a range of uses (including residential) as Permitted where the use is for reserve management staff or an authority under the *National Parks and Reserved Land Regulations 2009* or approved by the Director-General of Lands.

A review of uses and their status under the use table for land currently zoned Environmental Management under the IPS indicates there are 12 single dwellings and three caravan parks at Penguin, Ulverstone and Turners Beach that are likely to be non-conforming uses under the same zone in the SPP. Refer to following Table.

ADDRESS OF ENVIRONMENTAL MANAGEMENT ZONED PROPERTIES		DEVELOPMENT
a)	184 Penguin Road	1 x dwelling
b)	204 Penguin Road	2 x dwellings
c)	404 Penguin Road	1 x dwelling
d)	406 Penguin Road	1 x dwelling
e)	408 Penguin Road	1 x dwelling
f)	410 Penguin Road	1 x dwelling
g)	412 Penguin Road	1 x dwelling
h)	414 Penguin Road	1 x dwelling

i)	508 Penguin Road	1 x dwelling
j)	532 Penguin Road	1 x dwelling
k)	534 Penguin Road	1 x dwelling
l)	650 Penguin Road	1 x dwelling
m)	Picnic Point Road, West Ulverstone	Caravan Park (Visitor Accommodation)
n)	Beach Road, Ulverstone	Caravan Park (Visitor Accommodation)
o)	45 Esplanade, Turners Beach	Caravan Park (Visitor Accommodation)
p)	6 Johnsons Beach Road Penguin	Caravan Park (Visitor Accommodation)
q)	17A Helen Street West Ulverstone	Parkland
r)	1 and 1A Wharf Road Ulverstone	Restaurant (Food Services)

Most of these sites are privately owned. There is little likelihood of them reverting to their undeveloped state and/or managed for their environmental values.

The more appropriate land use policy would be to manage the sites and development on them primarily for their visual impact on the coastal landscape. The Environmental Management Zone purpose does not reflect this policy. It has a broader intention being to protect, conserve and manage land with significant ecological, scientific, cultural or scenic values.

Other zones which provide an avenue for approval of such development, e.g. as extensions and/or replacements of such uses and buildings, would be Landscape Conservation or Open Space. In the Landscape Conservation Zone a single dwelling, Visitor Accommodation (particularly caravan parks) and Food Services (<200m²) are all Discretionary uses. In the Open Space Zone, Visitor Accommodation and Food Services are discretionary uses while a single dwelling is Prohibited.

Zoning Proposals

(a) It is proposed that each of the 12 single dwellings listed above currently within the Environmental Management zone, be rezoned to Landscape Conservation, for consistency with the Zone Purpose Statements.

(b) The caravan parks at Picnic Point Road and Beach Road (Fairway Park) in Ulverstone are rezoned to Open Space, to accommodate them as discretionary uses and for consistency with the Zone Purpose Statements.

(c) The caravan park at Johnsons Beach Road in Penguin is rezoned to Open Space, to accommodate the facility as a discretionary use, to match the existing adjoining zone, and for consistency with the Zone Purpose Statements.

(d) The OC Ling caravan park at Turners Beach be rezoned to Open Space for consistency with the Zone Purpose Statements.

(e) The land at 17A Helen Street is owned by the Crown and has been mostly developed as parkland, incorporating vehicle parking, walking paths, picnic facilities and a memorial. It is currently zoned Environmental Management but is more closely aligned with the Zone Purpose Statement for the Open Space zone. The land at 17A Helen Street, Ulverstone should be rezoned Open Space.

(f) 1 and 1A Wharf Road includes several restaurants to be zoned Central Business.

Industrial zones

Background –

The AEC Group in March 2012 undertook an assessment of available industrial land in the municipal area and developed projections based on a 15–20 year time horizon.

The assessment found that:

- Manufacturing and employment in Central Coast is closely linked to agricultural activity.
- Burnie and Devonport with their ports, larger industrial bases and large areas of vacant industrial zoned land are preferred locations for industry.
- There is a significant net outflow of workers from the Central Coast Local Government Area (LGA) in every industry with the largest outflows in manufacturing, health care and social assistance, transport and warehousing and construction, in that order.
- The historical trends suggest there are an ever increasing number of workers communing to work outside the LGA.
- The majority of lots are 4,000m^2 in area or less, although they comprise only 22% of the total area. The largest lot is 8.8ha occupied by Simplot.
- There is a scarcity of zoned Industrial land in Central Coast, particularly lots over 1ha in area.

Industrial Zoned Land in 2012

	AREA (HA)	% AREA
Ulverstone		
Occupied land	41.7	65.7
Vacant land	8.8 (13 lots)	13.9
Total	50.5	79.7

Penguin		
Occupied land	12.9	20.3
Vacant land	0.0	0.0
Total	12.9	20.3
TOTAL	**63.4**	**100.0**

Source: Council Records

Approximately 4.4ha has planning approvals over it, so in reality only 4.4ha over 10 lots is vacant.

Demand –

The following table from the AEC report indicates the industrial land requirements for Penguin and Ulverstone up until 2031.

It must be noted however that the predictions need to be treated with caution as they were based on population projections which may be flawed and depending on economic factors there is not always a direct correlation between population growth and industrial activity.

Apart from the sale of one parcel of 4.0ha in 2011, the average take up rate of vacant land sales between 2006 and 2011 has been approximately 0.5ha per annum.

Additional Industrial Zoned Land requirements

AREA	CURRENT VACANT LAND (HA)	ADDITIONAL INDUSTRIAL ZONED LAND REQUIREMENTS		
		0–5 YEARS	5–20 YEARS	TOTAL
Penguin	0	5	5	10
Ulverstone	4.4	5	10–15	15–20
TOTAL	**4.4**	**10**	**15–20**	**25–30**

Source: AEC Group Central Coast Settlement Strategy–Industrial Land Assessment Report 2012

The table indicates there is sufficient supply of industrial zoned land for Ulverstone in the short term but potential for growth in Penguin is extremely limited with only limited vacant land available.

The region also has an insufficient number of vacant lots with a variety of sizes, in particular lots larger than 1ha; this in turn may constrain potential growth and investment in the municipal area. There is a need to conduct a strategic investigation to determine the need and location for industrial development in the municipal area.

Light Industrial

The purpose of the Light Industrial zone is

(a) to provide for manufacturing, processing, repair, storage and distribution of goods and materials where off site impacts are minimal or can be managed to minimise conflict with, or unreasonable loss of amenity to, any other uses.

(b) To provide for use or development that supports and does not adversely impact on industrial activity.

Two areas have been selected for expansion of the Light Industrial zone.

The Penguin Industrial Estate at South Road has limited expansion opportunities but requires a rezoning. The 9.1ha block has a small creek running through it which would need some engineering treatment. Because the area south of South Road includes rural residential type properties, only a Light Industrial zoning would be appropriate. At the moment the industrial area is reasonably well screened with a vegetation buffer along the Bass Highway.

The 9ha area adjacent to Maskells Road at East Ulverstone has been selected for expansion of the zone. It adjoins an existing industrial area. It is flat but drainage needs upgrading and as direct access from the land to the Bass Highway is prohibited, a purpose-built road from Industrial Drive is required. Also the junction of Maskells Road and the Bass Highway will need upgrading if it is used.

While there are clear differences in standards used in the two Planning Schemes, none are, by their nature, in conflict with character or development objectives for Light Industrial areas, to the extent that any additional alternative standards are necessary through, for example, a SAP.

General Industrial

The General Industrial zone will apply in the Industrial Drive-Kilowatt Court area in East Ulverstone. Zone Purpose Statements of the IPS and SPP are similar in that they accommodate manufacturing, processing, repair, storage and distribution of goods and materials type activities where there may be impacts on adjacent uses.

There is no proposal to expand the area of General Industrial zoning. Existing General Industrial zoned areas of the IPS will be zoned General Industrial under the SPP.

Utilities

The Utilities zone is to provide for major utilities installations and corridors and other compatible uses that do not impact on the utility.

There are various major utility installations and corridors throughout the municipal area that should be zoned Utilities in the new Planning Scheme, including Category 1-5 roads, rail lines, reservoirs, sewerage treatment plants and electrical sub-stations.

Rural Areas

The rural areas have been zoned Agriculture and Rural.

The purpose of the Agriculture zone is:

- To provide for the use or developments of land for agricultural use.
- To protect land for the use or development of agricultural use by minimising:
  - (a) Conflict with or interference from non- agricultural uses;
  - (b) Non -agricultural use or development that precludes the return of the land to agricultural use; and
  - (c) Use of land for non -agricultural use in irrigation districts.
- To provide for use or development that supports the use of the land for agricultural use.

Rural zone -

The purpose of the Rural zone is:

- To provide for a range of use or development in a rural location:
  - (a) Where agricultural use is limited or marginal due to topographical, environmental or site or regional characteristics;
  - (b) That requires a rural location for operational reasons;
  - (c) Is compatible with agricultural use if occurring on agricultural land;
  - (d) Minimises adverse impacts on surrounding uses.
- To minimise conversion of agricultural land for non-agricultural uses.
- To ensure that use or development is of a scale and intensity that is appropriate for a rural location and does not compromise the function of surrounding settlements.

Allocation Methodology -

The methodology, process and analysis to determine the areas for the Agriculture and Rural is as follows

Firstly the data provided by the State government on the feasibility of allocating either zone for the municipal area was taken and where necessary modified based on the following criteria;

- Current agricultural use, e.g. forestry, horticulture, grazing.
- Topography.
- Existing Dwellings.
- Vegetation.
- Land ownership (Crown/private).
- Soils.
- Titles.

- On site field inspections looking at adjacent use, reserves.
- State Policy on the Protection of Agricultural Land2009 (PAL).
- Private Timber Reserves.
- Rural Settlements zoned Village.
- Mining Leases.
- Gazetted Irrigation areas.

The forestry area, which is extensive in the southern part of the municipal area, has been zoned Rural. The soil types, climate and topography are better suited to forestry compared to the more intensive agricultural crops found on the better coastal soils.

Site inspections/analysis reviewed existing and surrounding use, size of title, ownership of surrounding titles. For example, a relatively small title with a house constructed on it, but divorced from the surrounding prime agricultural operations, was zoned agriculture rather than being spot zoned Rural. The criteria also assisted in determining whether titles were categorised in the broad categories of commercial farms, hobby farms and life style blocks. Although no in depth economic analysis was conducted the categorisation of farms gave an indication of their agricultural potential. The areas were mapped accordingly.

Zone boundaries were usually clipped to the cadastre rather being split across a title boundary, although in exceptional circumstances a title had split zoning. Wherever possible a zone was aggregated across a number of titles. Areas with a mining lease, a Private Timber Reserve and resource development activities were zoned Rural.

It's noted the Dial/Blythe Irrigation District covers much of the area, although some areas will unlikely be irrigated.

Zones Not Used

The following zones were not used:

ZONE	REASON NOT USED
Inner Residential	No higher density areas proposed.
Urban Mixed Use	No mixed use areas comprising residential and commercial uses identified or proposed.
Central Business	Ulverstone and Penguin are not identified higher order business and administrative centres such as Devonport and Burnie.
Major Tourism	No large scale tourist facilities which include a range of use and development have been identified or proposed.
Port and Marine	No major port and marine activity exists or proposed in the municipality.
Future Urban	Residential zoned areas are sufficient areas for expected population growth demands.

Codes

The SPP lists the following Codes:

CODE	COMMENTS
Signs	Applies but no mapping requirements.
Parking and Sustainable Transport	Applies, and a precinct plan for the Ulverstone and Penguin CBDs has been proposed in accordance with C 2.7.1 A1.
Roads and Railway Assets	Applies but no mapping required
Electricity Transmission Infrastructure Protection	Map included.
Telecommunications	Applies but no mapping is required.
Local Historic Heritage	Not used. The protection of listed buildings relies on State legislation. No trees or sites are listed.
Natural Assets	See following discussion and Appendix 1.
Scenic Protection	Not used as no areas identified.
Attenuation	No mapping required.
Coastal Erosion Hazard	Map included.
Coastal Inundation Hazard	Map included.
Flood Prone Hazard	Map included.
Bushfire Prone Areas	dMap included and unaltered from mapping provided by the Tasmanian Fire Service.
Potentially Contaminated Land	No sites have been identified.
Landslip Hazard	Map included.
Safeguarding of Airports	Not used as no airport impacted.

Natural Assets Code –

The Natural Assets Code applies to priority vegetation areas, future coastal refugia areas and waterway and coastal protection areas.

Central Coast has not identified areas for future coastal refugia or waterway and coastal protection, as a consequence these areas have not been mapped.

While the code may apply in areas identified in a waterway and coastal protection areas, the SPPs definition of the waterway and coastal protection area, also provide for the application of the code without mapping.

The State government has provided a waterway and coastal protection areas guidance map (the guidance map), which provides a basis for mapping the waterways and coastal protection areas.

The draft LPS relies on the definition of waterway and coastal protection area, in favour of reviewing the guidance map, and removing anomalies, errors and inaccuracies, such as, areas of existing development, piped watercourses or drainage lines, and aligning the overlay to match the definition.

The LPS requirements of the SPPs set of t the draft LPS must include a priority vegetation area overlay in the draft LPS.

The priority vegetation area overlay must:

- include threatened native vegetation communities as identified in TASVEG Version 3 (DPIPWE); and

- be derived from threatened fauna and flora data from the Natural Values Atlas (DPIPWE).

The overlay may also be further modified to address errors and anomalies, to reflect more recent or detailed information, or to include vegetation of local importance.

The Councils in the North West Region have engaged Rod Knight of Natural Resource Management Pty Ltd to provide a priority vegetation area overlay, in accordance with the LPS requirements of the SPPs. Details of Natural Resource Management Pty Ltd's methodology is set out in Appendix 1. Maps showing greater detail of priority vegetation areas are attached as Appendix 2.

Specific Area Plans

The Specific Area Plans (SAPs) in the IPS , subject to the Minister's declarations, may transition into the draft LPS under Schedule 6 of the Act.

The following IPS SAPs are proposed to transition:

- Forth SAP
- Penguin SAP;
- Revell Lane SAP; and
- Turners Beach SAP;

The IPS Ulverstone Wharf SAP, is not proposed to transition.

The Ulverstone Wharf SAP was included in the existing IPS because at the time the ownership of the area was being transferred from the Crown to the Council which had well advanced plans to extensively redevelop the area into a community space with associated facilities such as a restaurant, car park and open space areas. The area has now been developed and the uses now established. The proposed zoning is General Business. Furthermore, by owning the area the Council has extensive control over future uses and development. As a result this SAP has been removed as it is no longer required.

Schedule 6 of the Act provides for transitioning SAPs to include permitted alterations. Permitted alterations are modifications for the purposes of conforming to the requiremetns of the SPPs, reflect SPP terminology, correct numbering and cross references and to achirve the effect intended before they were included in the draft LPS,

It is proposed that the Forth Specific Area Plan, Penguin Specific Area Plan and Revell Lane Specific Area Plan be included in the draft LPS without amendment[2].

Proposed permitted alterations to the remaining transitioning SAPs include:

- the Use Table in the Turners Beach Specific Area Plan has been removed[3];
- minor revisions to incorporate desired future character statements as local area objectives;

- a new SAP for Leith has been incorporated to control lot size because there are no reticulated waste water services in the area and the soil profile type and high water table makes it difficult to implement on site waste water systems; and

Turners Beach Specific Area Plan

It hasbeen recommended that the Turners Beach area be rezoned General Residential. Under the Use Table of the General Residential zone in the SPP, Visitor Accommodation is a Permitted

[2] The Commission's direction under section 35(5) of the Act, required various permitted alterations be made to these SAPs.

[3] The Commission's direction under section 35(5) of the Act, required the reinsertion of the Use Table for the Turners Beach SAP in accordance with the Use Table in the IPS, along with additional modifications, including changing the Visitor Accommodation Use Class from Discretionary, to Permitted with no qualification.

use. There is no difference or disadvantage in the Use Tables of the General Residential and Low Density Residential zones and the status of Visitor Accommodation in the SPP.

The reason for continuing with a SAP for the settlement is that previously some years ago the Turners Beach community participated in a community study of the settlement which revealed that various aspects of it were important and gave a sense of belonging. These aspects were translated into a SAP for the area.

The Cradle Coast Regional Land Use Framework supports the inclusion of the SAP with the following statement;

"Provision of appropriate design and development guidelines for development, including subdivision layout, building density, height and mass and urban spaces .... can assist capture and understanding of the essential character and attributes for each centre. Standards can assist to ensure new development is reflective and courteous to existing character without compromise adaptability, innovation, performance and attractiveness as a place to live, work or visit" (p.69)

New Specific Area Plans

Two new SAPs are proposed: The proposed SAPs are the Ulverstone CBA SAP and the Leith SAP.

Ulverstone CBD Specific Area Plan[4]

The SPP contains various urban design provisions, intended to establish and maintain a traditional development form in regional centres. However the provisions are general and do not take account of more detailed townscape characteristics of Ulverstone. As such there is a risk that such elements and specific character of Ulverstone could be lost through insensitive or inappropriately designed buildings.

Additional standards are included in the IPS General Business Zone, and were derived from the Urban Design Guidelines for Ulverstone, 2009 prepared by GHD. These provisions have been included in the draft LPS as a Specific Area Plan as it was the only mechanism to include them.

Leith Specific Area Plan

The Leith area covered by the Specific Area Plan is bisected by the Bass Highway and the main northern rail line and characterised by:

- large often treed lots;
- parts of it adjoins the Forth River and Bass Strait;
- the area south of the highway rises and development follows the escarpment;
- services include water but no sewerage; and

[4] The Commission's direction under section 35(5) of the Act, required the Ulverstone CBD SAP to be removed from the draft LPS.

. lots on flatter areas area are difficult to service for wastewater due to the geological nature of the area and high water table which makes further subdivision problematic.

The Low Density Zone Residential Zone appropriately reflects the character of the area in purpose and in allowable uses. The issue is that the 1500m^2 lot size for subdivision allowed in the zone is unsuitable in terms of settlement character and particularly physical incapability to accommodate on site waste water treatment.

The CCRLUS document does not recognise Leith as an individual settlement so it falls within the All Other Settlements" class with a low growth scenario and stable settlement strategy. A low growth scenario is one where demand is driven largely by internal population change and very low rates of inward migration. Growth relies on existing land supply (including vacant zoned land) and available infrastructure within the designated urban boundary without need for intensification.

A stable strategy restricts new development to existing land supply within the designated urban boundary without priority for intensification. The strategy is appropriate for low growth settlements." (p.65)

The planning authority advises:

(a) that Leith has no reticulated sewer infrastructure, and none is planned in the immediate future;
(b) there is existing problems with the management of wastewater and stormwater within Leith; and
(c) the existing subdivision configuration with some comparatively small lots, soil type and topography are creating issues for the management of wastewater and stormwater.

The concern is that waste and stormwater will have an adverse cumulative effect on the environment. To alleviate this planning authority submits that intensification of development in Leith will require major investment in infrastructure. An upgrade of the transport network would also be required.

Section 32(4) of the Act requires that an LPS (e.g. a SAP) meets the following;

"4) An LPS may only include a provision referred to in subsection (3) in relation to an area of land if–

(a) a use or development to which the provision relates is of significant social, economic or environmental benefit to the State, a region or a municipal area; or

(b) the area of land has particular environmental, economic, social or spatial qualities that require provisions that are unique to the area of land, to apply to the land in substitution for, or in addition to, or modification of, the provisions of the SPPs."

The proposed SAP is supported by sections 32(4)(a) and (b).

32(4)(a) Significant economic benefit

Public economic benefit would arise because the SAP limits further subdivision that requires a large investment in public infrastructure for sewerage, stormwater and roads.

The prevention of allowing the intensification of the number of lots and dwellings requiring the associated development of infrastructure is prevented. As mentioned earlier there is little opportunity for the disposal of storm and wastewater within the SAP area. This would also focus further development in the serviced areas such as Ulverstone and Turners Beach.

32(4)(b) particular environmental and spatial qualities requiring unique provisions

Much of the subject area is relatively flat, has a high water table, the soil has poor water dispersal qualities and the lot sizes vary from 600m^2 through to 2500m^2 and larger.

These environmental and spatial elements often make the disposal of wastewater and stormwater difficult to achieve without having an adverse cumulative environmental effect. The spatial qualities of particularly, the smaller urban type lots are at times reliant on other land to adequately dispose of wastewater and stormwater.

The subdivision provisions of the Low Density Residential Zone do not provide for consideration of the cumulative impact of the disposal of wastewater and stormwater, where existing small lots may be a reliance on disposal outside the lot boundary. Thus particular provisions are required to provide for consideration of cumulative impacts of wastewater and storm water disposal at the time of subdivision.

The following is the draft Leith SAP for inclusion.

CCO–S2.0 Leith Specific Area Plan

CCO-S2.1 Plan Purpose

The purpose of the Leith Specific Area Plan is:

CCO-S2.1.1 To provide for a subdivision density for Leith consistent with existing spatial character.

CCO-S2.1.2 To maintain the quality of the land, air and water resources of Leith.

CCO-S2.2 Application of this Plan

CCO-S2.2.1 This specific area plan applies to the area of land designated as Leith Specific Area Plan on the overlay maps.

CCO-S2.2.2 In the area of land this plan applies to, the provisions of the specific area plan are in substitution to, the provisions of the Low Density Residential Zone, as specified in the relevant provision.

CCO-S2.3 Local Area Objectives

CCO-S2.3.1 Local Area Objectives

Sub-clause	Area Description	Local Area Objectives
CCO-S2.3.1.1	Leith Specific Area Plan shown on an overlay map as CCO-S2.3.1.1	The local are objectives of the Leith Specific Area Plan are to: (a) protect and conserve the existing spatial characteristics and dwelling densities of Leith; and (b) provide for development that is able to be serviced without an adverse impact on the land, air and water resources of Leith.

CCO-S2.4 Definition of Terms

This sub-clause is not used in this specific area plan.

CCO-S2.5 Use Table

This sub-clause is not used in this specific area plan.

CCO-S2.6 Use Standards

This sub-clause is not used in this specific area plan.

CCO-S2.7 Development Standards for Buildings and Works

This sub-clause is not used in this specific area plan.

CCO-S2.8 Development Standards for Subdivision

CCO-S2.8.1 Lot design

This clause is in substitution for Low Density Residential Zone – clause 10.6.1 Lot design A1 and P1, and clause 10.6.3 Services A2, A3 and P2, P3.

Objective:	That each lot: (a) has an area and dimensions appropriate for use and development in Leith; (b) is provided with appropriate access to a road; (c) contains areas which are suitable for residential development; and (d) can accommodate on-site drainage and waste water and stormwater disposal without adversely impacting adjoining land..

Acceptable Solutions	**Performance Criteria**
A1 Each lot, or a lot proposed in a plan of subdivision, must: (a) have an area of not less than 4000m^2 and: (i) be able to contain a minimum area of 10m x 15m with a gradient not steeper than 1 in 5, clear of: a. all setbacks required by clause 10.4.3 A1 and A2; and b. easements or other title restrictions that limit or restrict development; and (ii) existing buildings are consistent with the setback required by clause 10.4.3 A1 and A2; (b) be required for public use by the Crown, a council or a State authority; (c) be required for the provision of Utilities; or (d) be for the consolidation of a lot with another lot provided each lot is within the same zone	**P1** Each lot, or a lot proposed in a plan of subdivision, must have sufficient useable area and dimensions suitable for its intended use having regard to: (a) the relevant requirements for development of buildings on the lots; (b) the intended location of buildings on the lots; (c) the topography of the site; (d) adequate provision of private open space; (e) the pattern of development existing on established properties in the area; (f) the capability of accommodating on-site waste water treatment systems and on-site stormwater management systems; (g) cumulative impacts of on-site waste water and stormwater disposal on the land, air and water resources of the Leith Specific Area Plan; (h) any constraints to development; (i) the local area objectives in this Specific Area Plan, and must have an area not less than 2500m^2

CCO-S2.9 Tables

This sub-clause is not used in this specific area plan.

CENTRAL COAST COUNCIL

Appendix 1

Tasmanian Planning Scheme

Explaining the Priority Vegetation Area Overlay – the Regional Ecosystem Model

Section LP1.7.5 of the State Planning Provisions requires that each Local Provisions Schedule must contain an overlay map of Priority Vegetation Areas (PVA).

Section LP1.7.5 (c) stipulates that the PVA must:

- include Threatened Native Vegetation Communities as identified in TASVEG Version 3;
- be derived from threatened flora data identified in the Tasmanian Natural Values Atlas; and
- be derived from threatened fauna data the Tasmanian Natural Values Atlas for the identification of significant habitat for threatened fauna species .

'Significant Habitat' is the habitat within the known and core range of a threatened fauna species where it is known to be of high priority for the maintenance of breeding populations or its conversion to 'non-priority' (presumably non-native) vegetation would result in a long term negative impact on breeding populations.

When compiled, the mapped known and core range of the State's threatened fauna covers virtually the full extent of Tasmania's land mass.

There is no State data set that identifies the vegetation within that extent that would meet the definition of Significant Habitat (noting that some significant habitat exists in non-native vegetation).

Section LP1.7.5 (d) provides that the PVA can be modified, based on analysis at a local or regional level for:

- anomalies or inaccuracies in the data described above; or
- more recent or detailed local assessment of the data and mapping described above; or
- identification of native vegetation of local importance, including habitat for native fauna of local importance.

The Regional Ecosystem Model (REM) is a comprehensive, high resolution spatial analysis that identifies:

- native vegetation and threatened species and their relative conservation status and management priority;
- the characteristics of the landscape that may affect its ability to sustain these elements.

The REM forms the basis of the PVA to be incorporated into Local Provisions Schedules. Individual planning authorities may also supplement the REM with more detailed, on-ground information. This will be described by the relevant planning authority.

A subset of attributes and indicators from the REM has been used to produce the PVA overlay and includes a more detailed local assessment of the data that is consistent with the provisions for modification of the PVA:

- Threatened native vegetation communities is based on TasVeg 3.0, but has been corrected for inherent logical consistency issues and includes credible field-based mapping where it was available.
- Threatened flora and fauna species locations and habitat are modelled using two methods:
    - Rules applied to Natural Values Atlas (NVA) records that are customised for each species to reflect their patterns of local distribution (e.g. riparian species), based on a limited number of habitat variables; and
    - More detailed habitat models for about 100 threatened fauna species that reflect agreed habitat definitions used by the Forest Practices Authority but utilise a much wider range of data, including landforms and vegetation structural maturity, to more accurately identify habitat and potential habitat.
- Native vegetation of local importance includes:
    - a subset of threatened fauna species habitat models,
    - native vegetation with limited bioregional reservation and extent and native vegetation remnants on heavily cleared types of land where local factors affect ecological sustainability of the landscape.

Undertaking this analysis inevitably results in the identification of native vegetation (including fauna habitat) of local importance, recognising that habitat is not confined to local administrative boundaries and is more relevant to localised and landscape-scale habitat attributes, bioregional level representation and ecosystem function. Each local area contributes to the survival of threatened vegetation communities, threatened flora and threatened fauna within a State wide mosaic that enables the distribution of species to be maintained and provides for mobility of fauna through connected habitat.

The Priority Vegetation Area overlay map resulting from the REM is made up of the data outlined in Table 1. The attributes in the overlay are elaborated further below.

Table1 – Attributes of the Priority Vegetation Area

Definition in SPP	Attribute	What are they?
Forms an integral part of a threatened native vegetation community as prescribed under Schedule 3A of the *Nature Conservation*	Threatened native vegetation communities	Vegetation communities listed as threatened under the *Nature Conservation Act (Tas)* or *EPBC Act (Comm)*
A threatened flora species	Threatened flora species	Flora species listed under the *Threatened Species Protection Act (Tas)* or *EPBC Act.*
Forms a significant habitat for a threatened fauna species	Threatened fauna species habitat	Fauna species listed under the *Threatened Species Protection Act (Tas)* or *EPBC Act.*
	Landscape dependent threatened fauna species habitat	Fauna species listed under the *Threatened Species Protection Act (Tas)* or *EPBC Act* and classified as landscape dependent fauna
	Relative reservation	Native vegetation community <30% reserved in bioregion
	Relative rarity	Native vegetation community <2,000 ha extent in bioregion
	Remnant vegetation	Native vegetation patches <200ha contiguous extent and On land components >70% cleared of native vegetation

Threatened Native Vegetation Communities

Threatened Native Vegetation Communities (TNVC) are vegetation communities with legislative recognition of being threatened.

The attribute comprises vegetation communities listed as threatened under the Tasmanian Nature Conservation Act 2002 or the Commonwealth Environment Protection and

Biodiversity Conservation Act 1999. Listing under these acts is based on historical vegetation loss since European settlement, natural limited extent or vulnerability to particular factors.

Why is it included?

- Heavily cleared – generally greater than 70% of pre-1750 extent has been cleared;
- Rarity – generally less than 1,000 hectares remaining

Data Source:

- TasVeg 3.0 (minor exceptions)

Reliability:

- Extremely variable – aerial identification and/or on-ground field verification

Management:

- Check TasVeg for field verification
- Consider local extent, condition & management options

Threatened Flora Species

These are species listed as threatened under the Tasmanian Threatened Species Protection Act (1975) or Commonwealth Environment Protection and Biodiversity Conservation Act (1999).

Listed threatened species have statutory recognition that they are likely to become extinct if the factors causing them to be threatened are not managed. Species may be listed due to historical loss since settlement, natural rarity giving rise to potential risk, or impacts of particular land use and land management practices.

Threatened flora habitat characteristics are mostly localised and are modelled solely on Natural Values Atlas records with a limited number of habitat variables.

Why is it included?

- Statutory recognition that species extinction is likely

Data Source:

- NVA records combined with REM point-based modelling rules
- Generally highly localised

Reliability:

- Reasonably reliable – on-ground field verification

Management:

- Check species observation source
- Potentially require on-ground field verification

Threatened flora can be grouped into types, which assists in understanding preferred management approaches.

Flora			
Type		Management objective	What is assessed?
Singletons and highly restricted species	Species known from one location only or from a particular land system component	Maintenance of species population	Assessment of species population and habitat condition (specialist required)
Localised	Species tend to occur in small localised areas across their range	Persistence of species at site	Assessment of species population and habitat condition (specialist may be required)
Riparian	Species occur predominantly in riparian zones	Maintenance of healthy riparian zones	Assessment of health of riparian vegetation
More extensive	Species occur relatively extensively in a local area	Persistence of species in locality	Assessment of species population and habitat condition (specialist MAY be required)

Threatened Fauna Species and Significant Habitat

These are species listed as threatened fauna under the Tasmanian Threatened Species Protection Act (1975) or Commonwealth Environment Protection and Biodiversity Conservation Act (1999).

Listed threatened species have statutory recognition that they are likely to become extinct if the factors causing them to be threatened are not managed. Species may be listed due to historical loss since settlement, natural rarity giving rise to potential risk, or impacts of particular land use and land management practices.

Threatened fauna habitat characteristics are extremely varied and are modelled as significant based on Natural Values Atlas records with a limited number of habitat variables or more detailed customised models for about 100 fauna species. Some species habitat occurs across the landscape but not all sites may be essential for species survival and not all suitable habitats may be occupied. Species that rely on this type of habitat are classified as landscape-dependent and are regarded as being of local importance; however the relative importance of the site to the survival of the species can only be known in response to field verification, the context and the nature of a proposal.

Why is it included?

- Statutory recognition that species extinction is likely, however not all sites are important or occupied

Data Source:

- NVA records combined with REM point-based modelling rules
- Habitat-based models

Reliability:

- Variable

Management:

- Check species observation source
- Check data on habitat and local context
- Potentially require on-ground field verification

Threatened fauna and their significant habitat can be grouped into types which assist in understanding preferred management approaches.

Fauna and significant habitat			
Type		Management objective	What is assessed?
Localised species[5]	Species tend to occur in small localised areas across their range	Maintenance of species population	Assessment of species population and habitat condition (specialist required)
Aquatic species	Species habitat is in waterways, wetlands and associated riparian vegetation	Maintenance of healthy riparian zones and water quality	Assessment of species population, habitat condition and potential water quality impacts (specialist MAY be required)
Riparian species	Riparian zones an important part of species habitat	Maintenance of healthy riparian zones	Assessment of species population and habitat condition (specialist may be required)

[5] Species in this category will also often fit into other categories. The difference is that the risk of significant loss is higher as there are very few replicate sites.

Highly restricted species	Species known from one location only or from particular land system components	Maintenance of species population	Assessment of species habitat extent and population size (specialist required)
Obligate log dwellers	Species survival dependent of coarse woody debris (CWD) on forest floor	Maintenance of logs and large branches on forest floor and mature forest for ongoing supply of CWD	Assessment of abundance and relative size of CWD and mature eucalypts
Hollow dependent fauna	Species depend on hollows in mature trees for critical parts of the life cycle	Maintenance of mature trees	Assessment of relative abundance of mature eucalypts
Ground dwelling species with particular habitat requirements	Species utilise highly localised on ground habitat features for critical parts of the life cycle	Maintenance of the features critical for the life cycle	Assessment of presence of den sites, CWD, rock overhangs and mature trees
Highly specialised species (habitat well understood)	Species with highly specialised habitat requirements that do not correlate with coarser scale environmental variable or is highly restricted locally	Maintenance of species population	Dependent on species (specialist required)
Other fauna species (habitat not well understood)	Species where the factors contributing to local populations are not well understood or identifiable	Maintenance of healthy population size in general area	Dependent on species (specialist required)

Poorly Reserved Vegetation Communities

Reservation status is a measure of the degree to which vegetation communities are included in the Comprehensive, Adequate and Representative (CAR) reserve system.
Higher levels of reservation give greater confidence that the species for which vegetation communities are surrogates are likely to be protected, subject to appropriate geographic and biophysical distribution in the landscape. Reservation provides greater certainty of the maintenance of better condition vegetation and hence maintenance of ecological function at local and landscape scales.

Why is it included?

- Less than 30% of extent in bioregion is in reserves

Data Source:

- TasVeg 3.0 (minor exceptions)

Reliability:

- Highly variable

Management:

- Check TasVeg for field verification
- Consider local extent, condition & management options
- Potentially require on-ground field verification

Vegetation Communities of Limited Bioregional Extent

Relative rarity, or extent, is scaled to reflect increased importance for vegetation types which are more restricted, and less importance for those which are relatively extensive. The threshold of 2,000 ha is used by the Forest Practices Authority.

Why is it included?

- Less than 2000 hectares of the community in the bioregion

Data Source:

- TasVeg 3.0 (minor exceptions)

Reliability:

- Highly variable

Management:

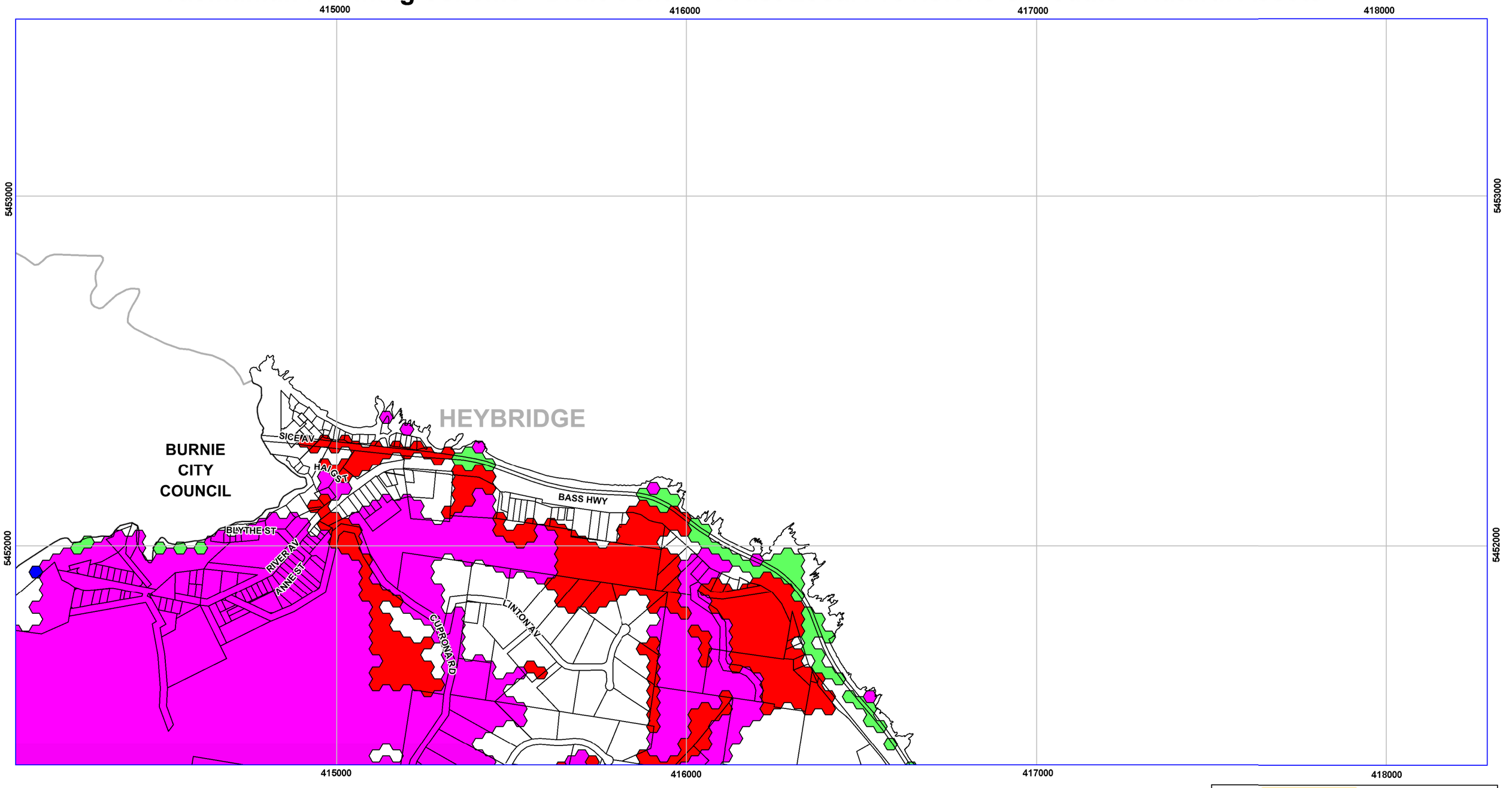
- Check TasVeg for field verification
- Consider local extent, condition & management options
-

Appendix 2

Tasmanian Planning Scheme

Detailed Mapping of Priority Vegetation Areas

Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

- THREATENED VEGETATION
- RESERVED NATIVE VEGETATION LESS THAN 30%
- NATIVE VEGETATION LESS THAN 2ha
- VEGETATION REMNANT
- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

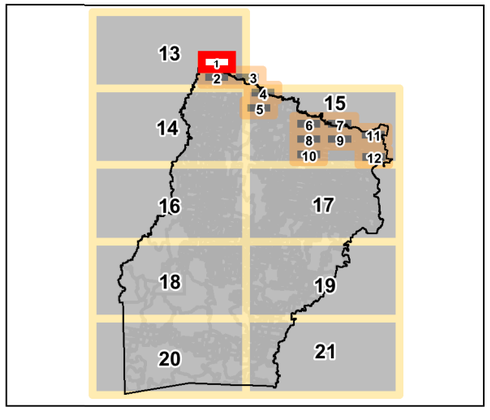
Map 1 of 21

0 — 500 m

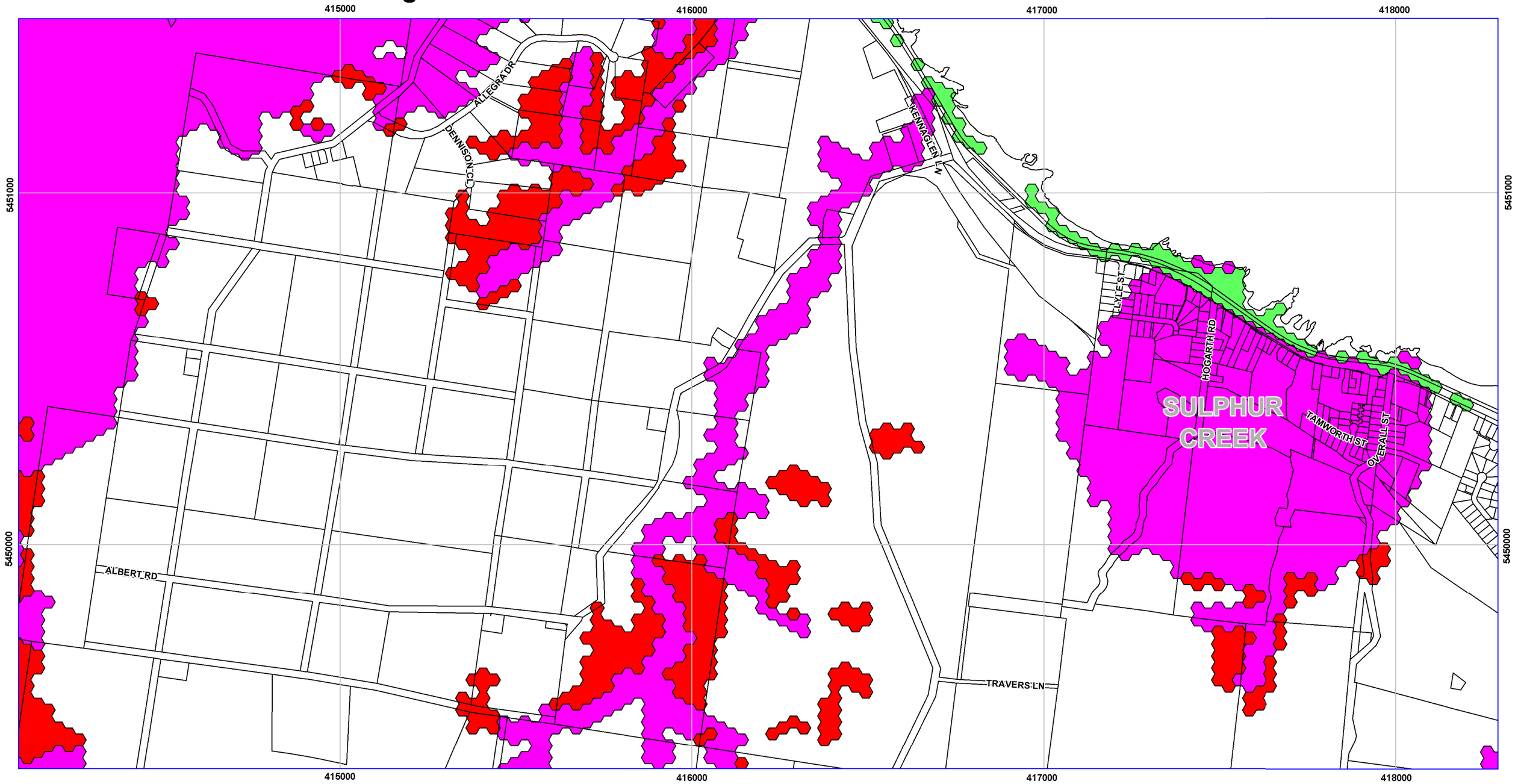
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

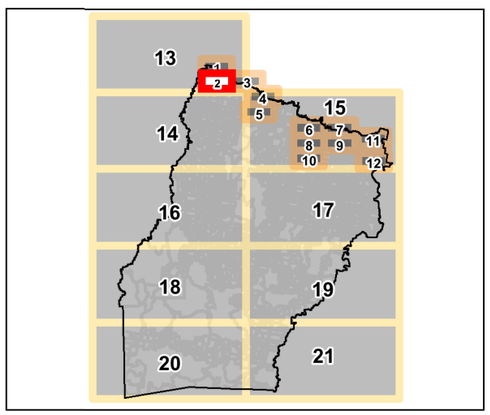
Map 2 of 21

0 500 m

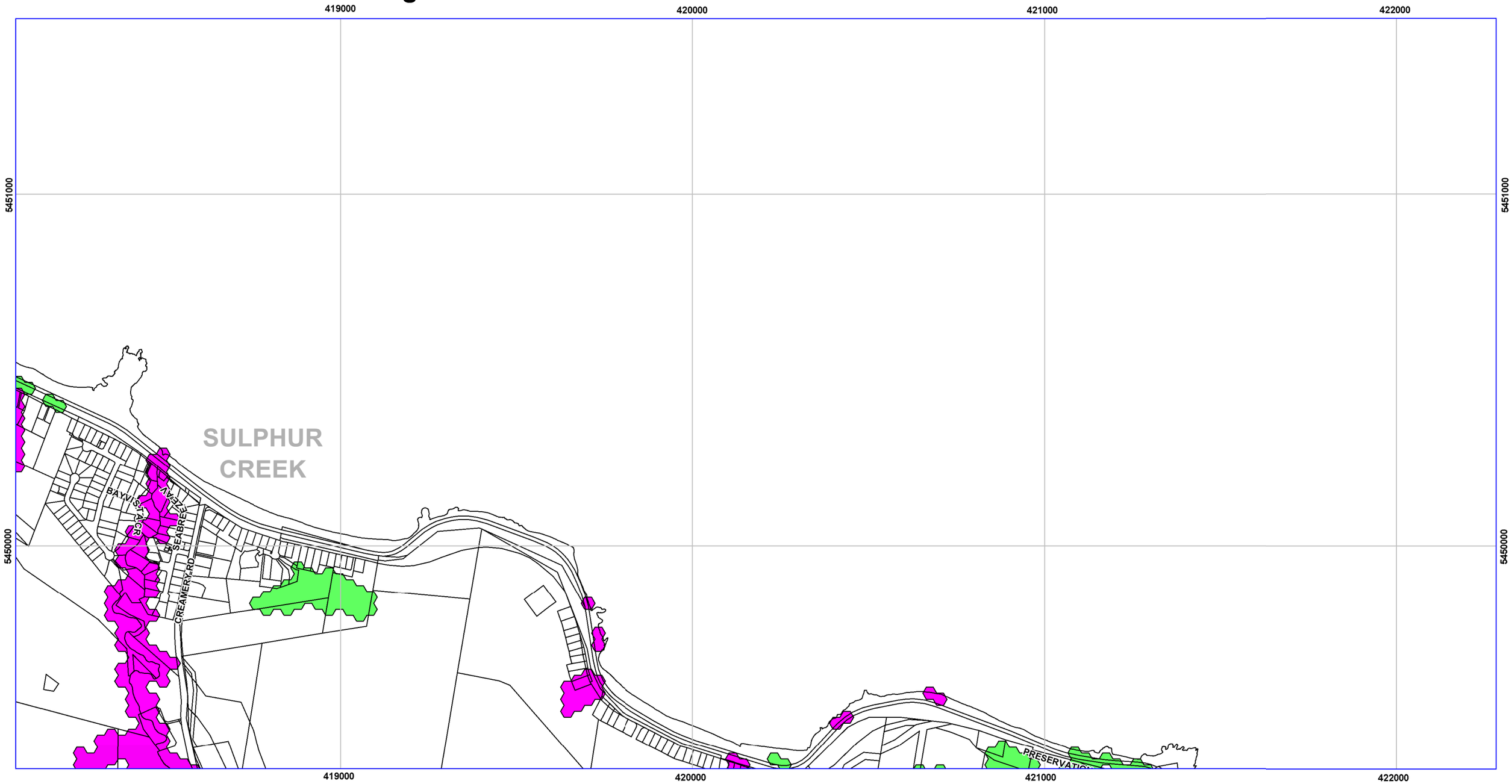
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

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- VEGETATION REMNANT
- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

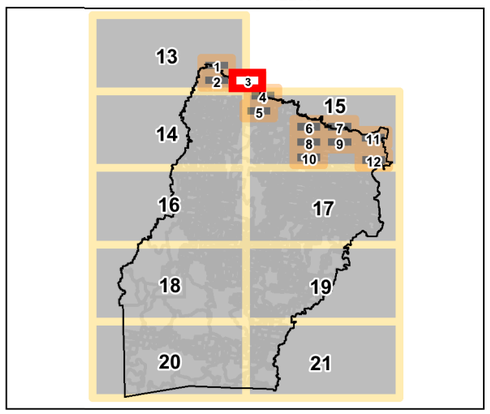
Map 3 of 21

0 500 m

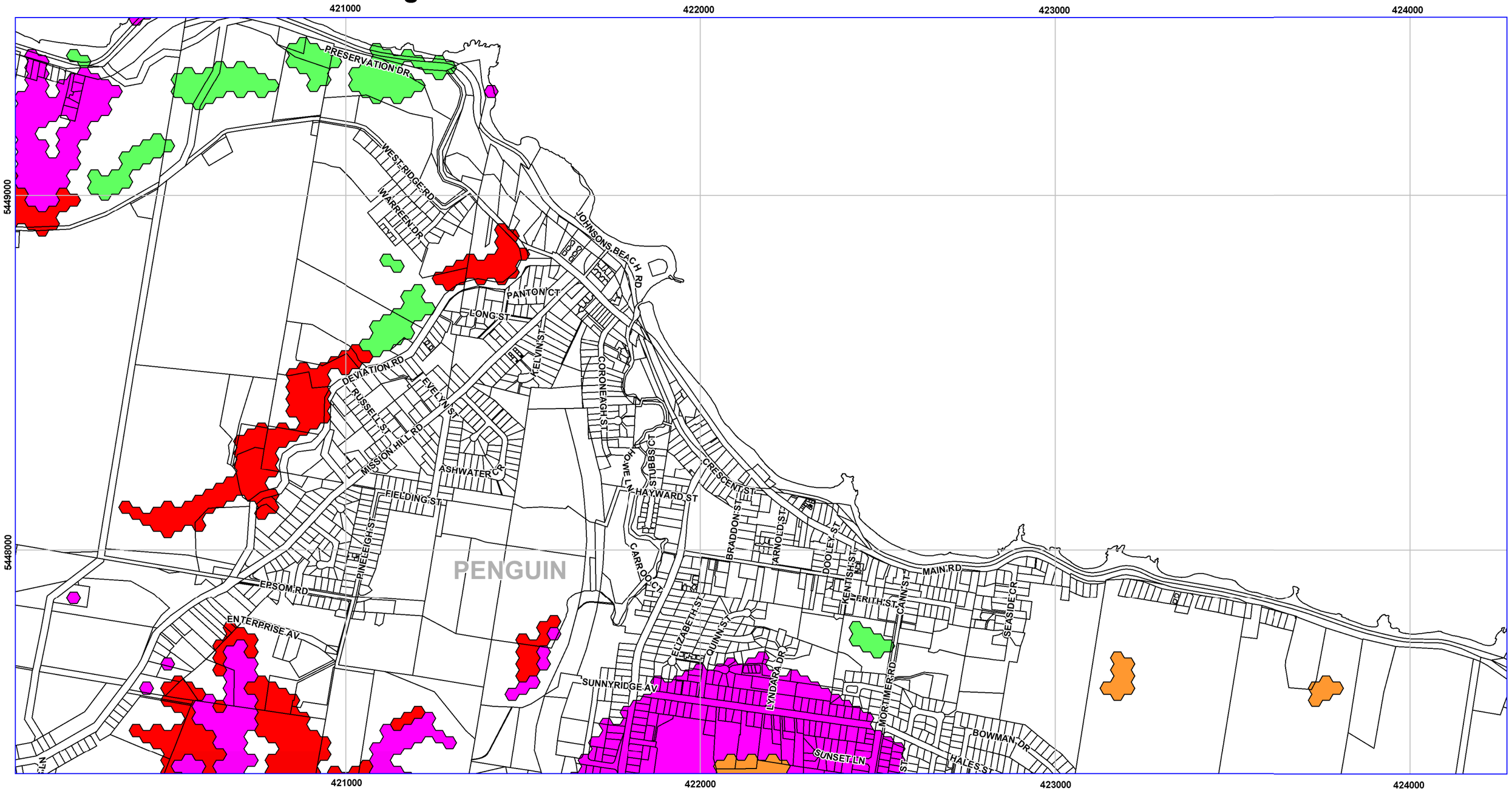
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

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Map 4 of 21

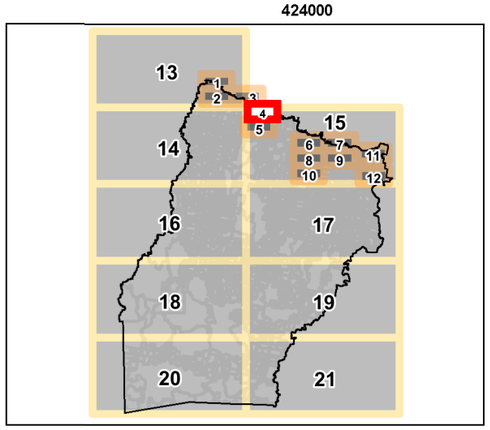
0 500 m

N W E S

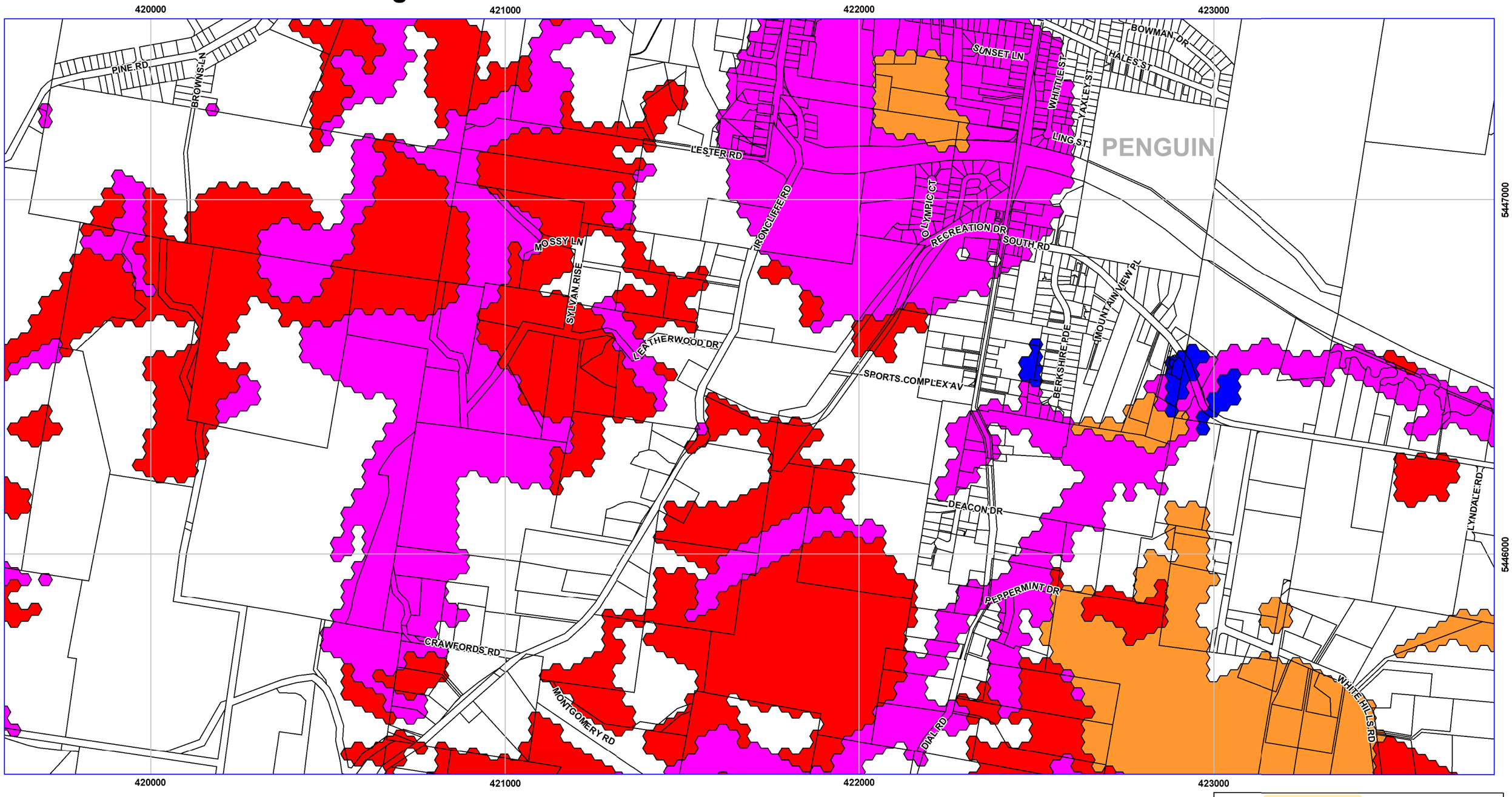
Coordinate System: GDA 94 MGA Zone 55

Natural Assets data from The LIST © State of Tasmania
Base topographic data from The LIST © State of Tasmania
Cadastre from The LIST © State of Tasmania as of 18/04/2019

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

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- THREATENED FAUNA WIDESPREAD

Map 5 of 21

0 500 m

N W E S

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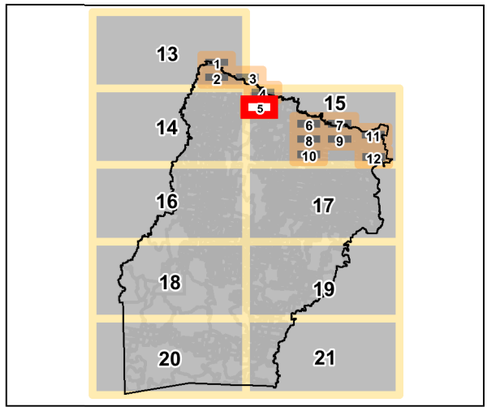
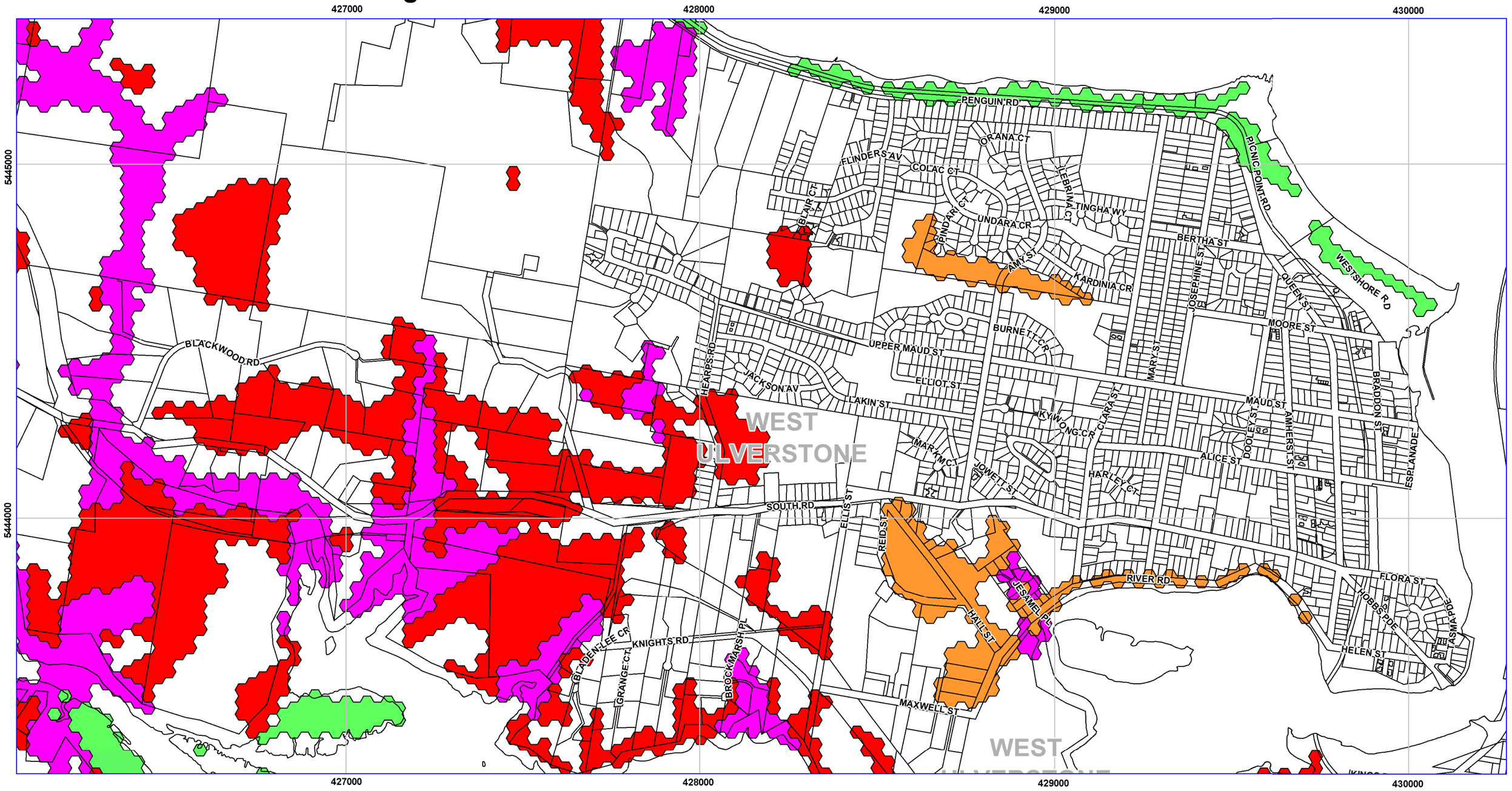


Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

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- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

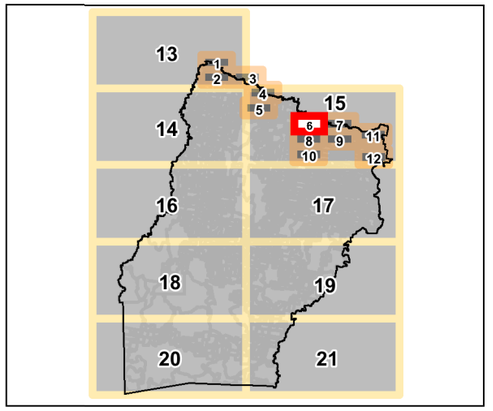
Map 6 of 21

0 500 m

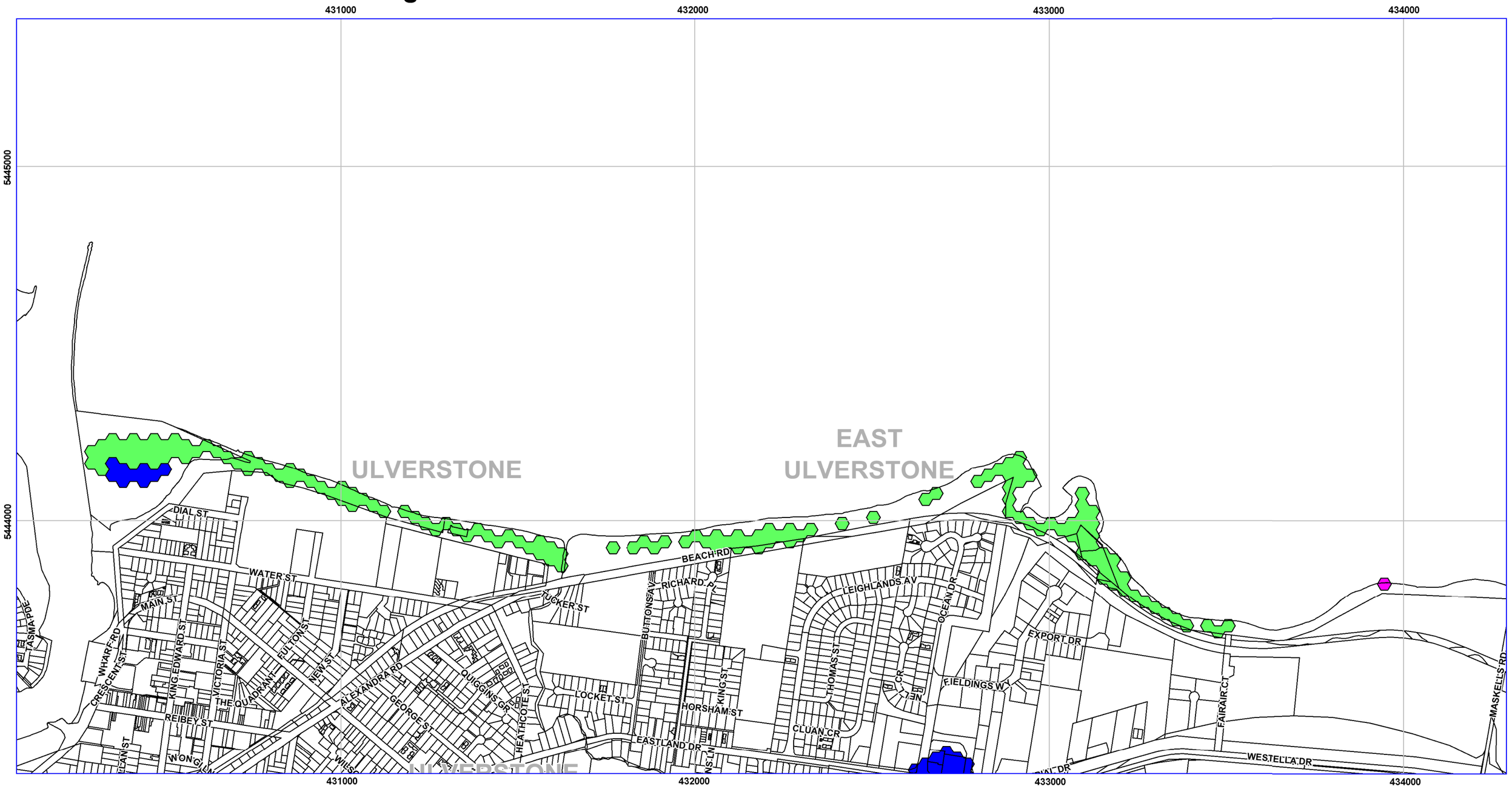
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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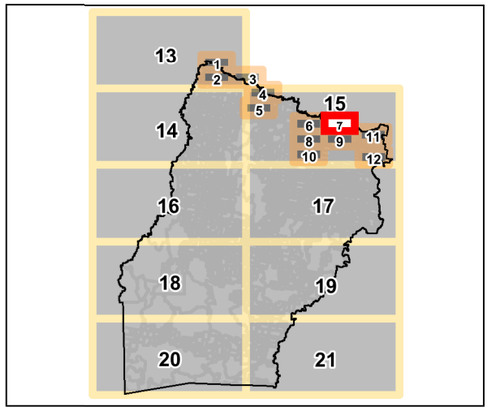
Map 7 of 21

0 — 500 m

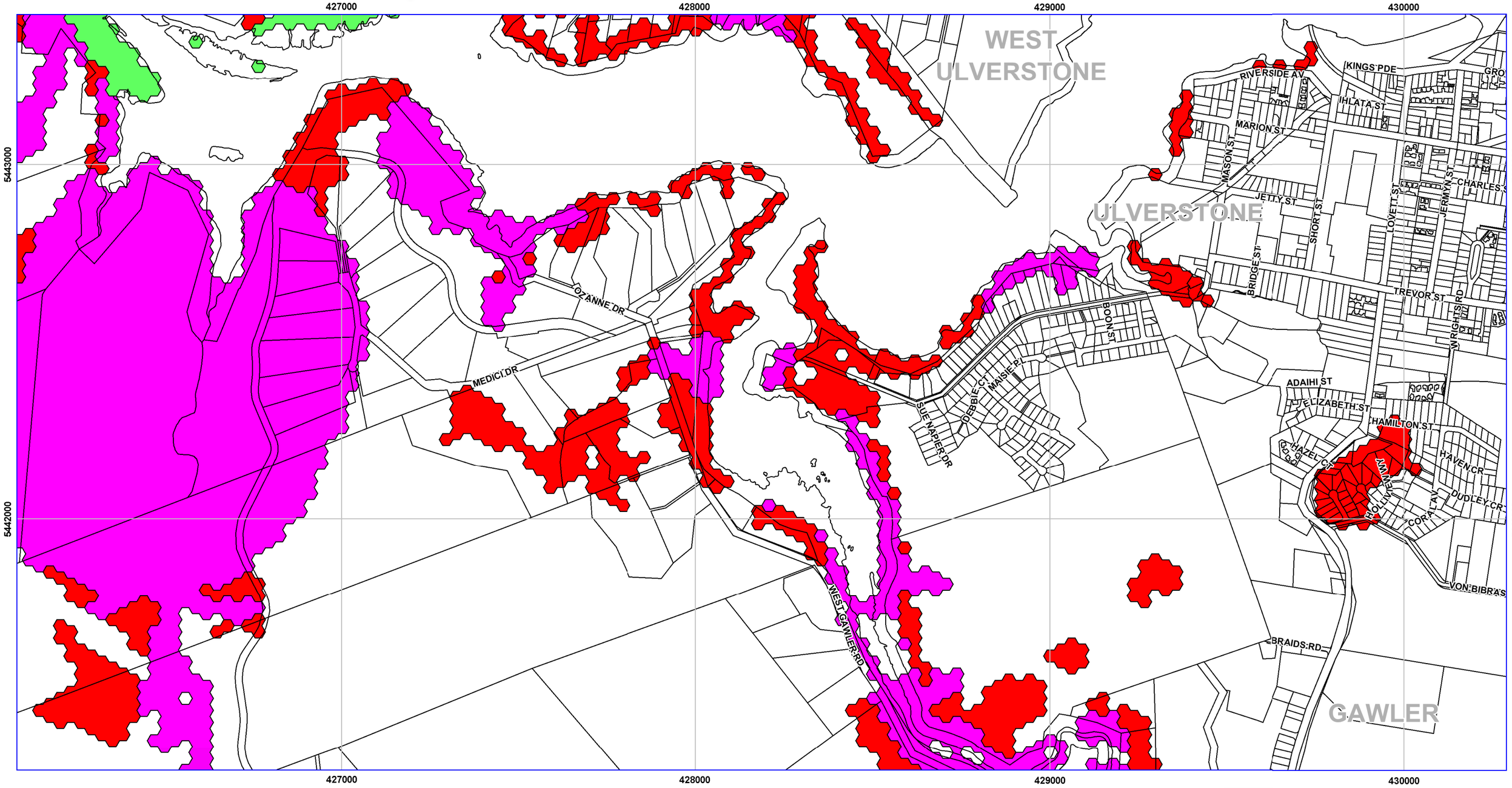
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- THREATENED FAUNA WIDESPREAD

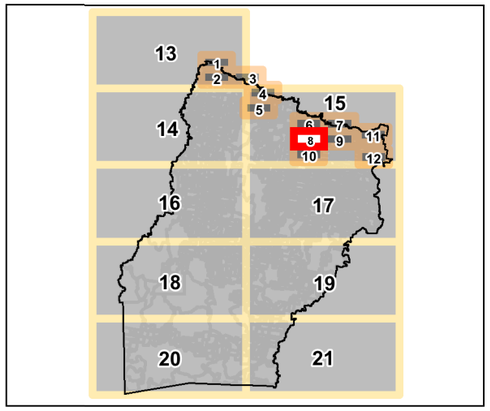
Map 8 of 21

0 — 500 m

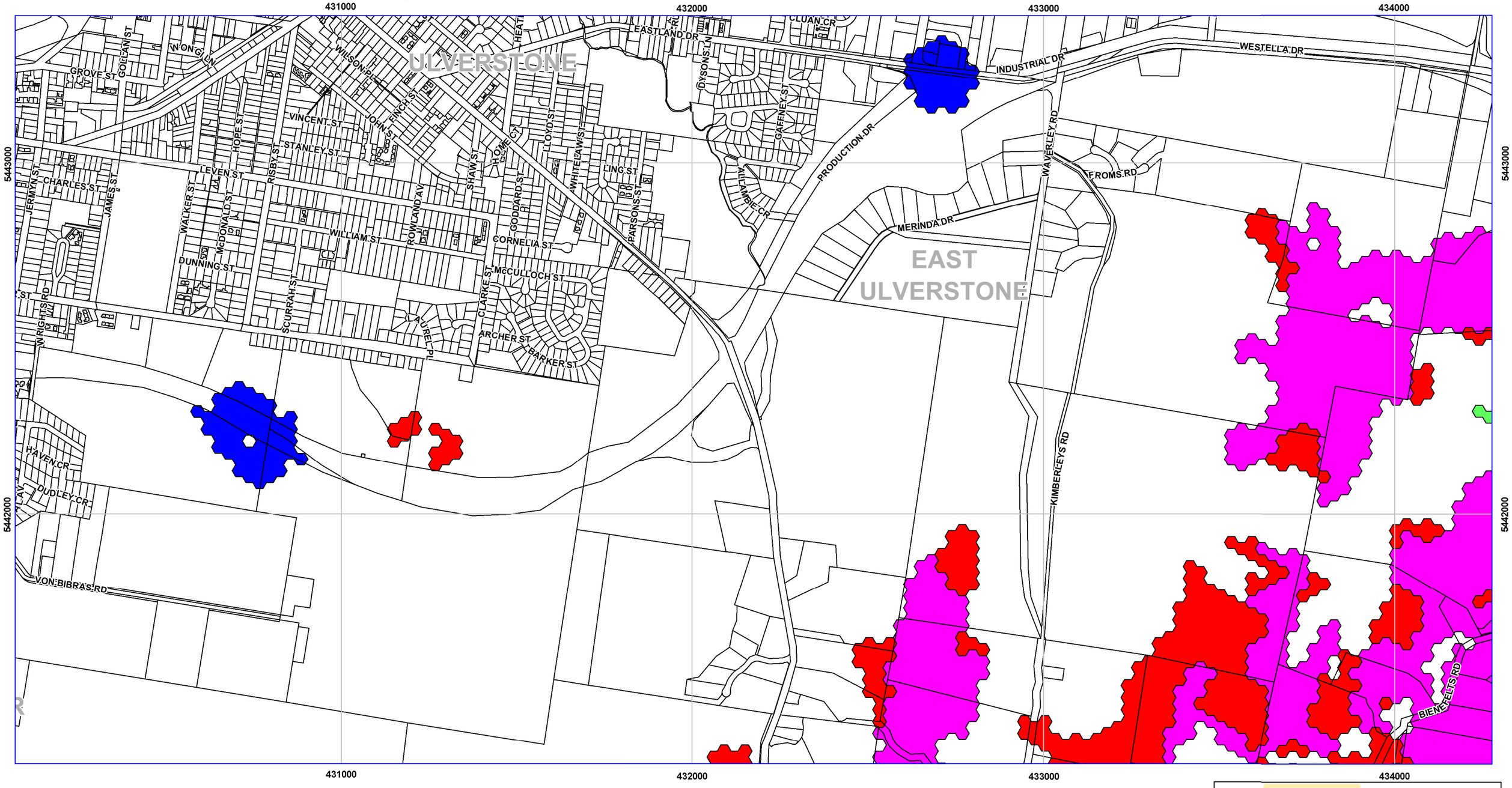
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

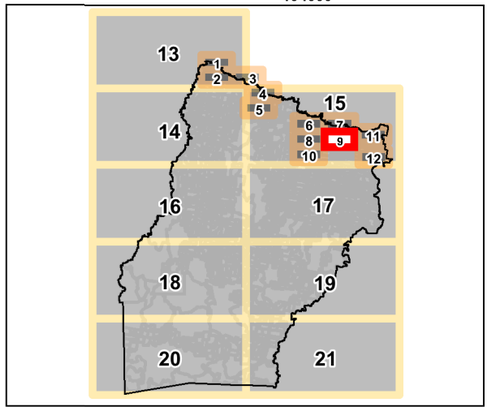
Map 9 of 21

0 — 500 m

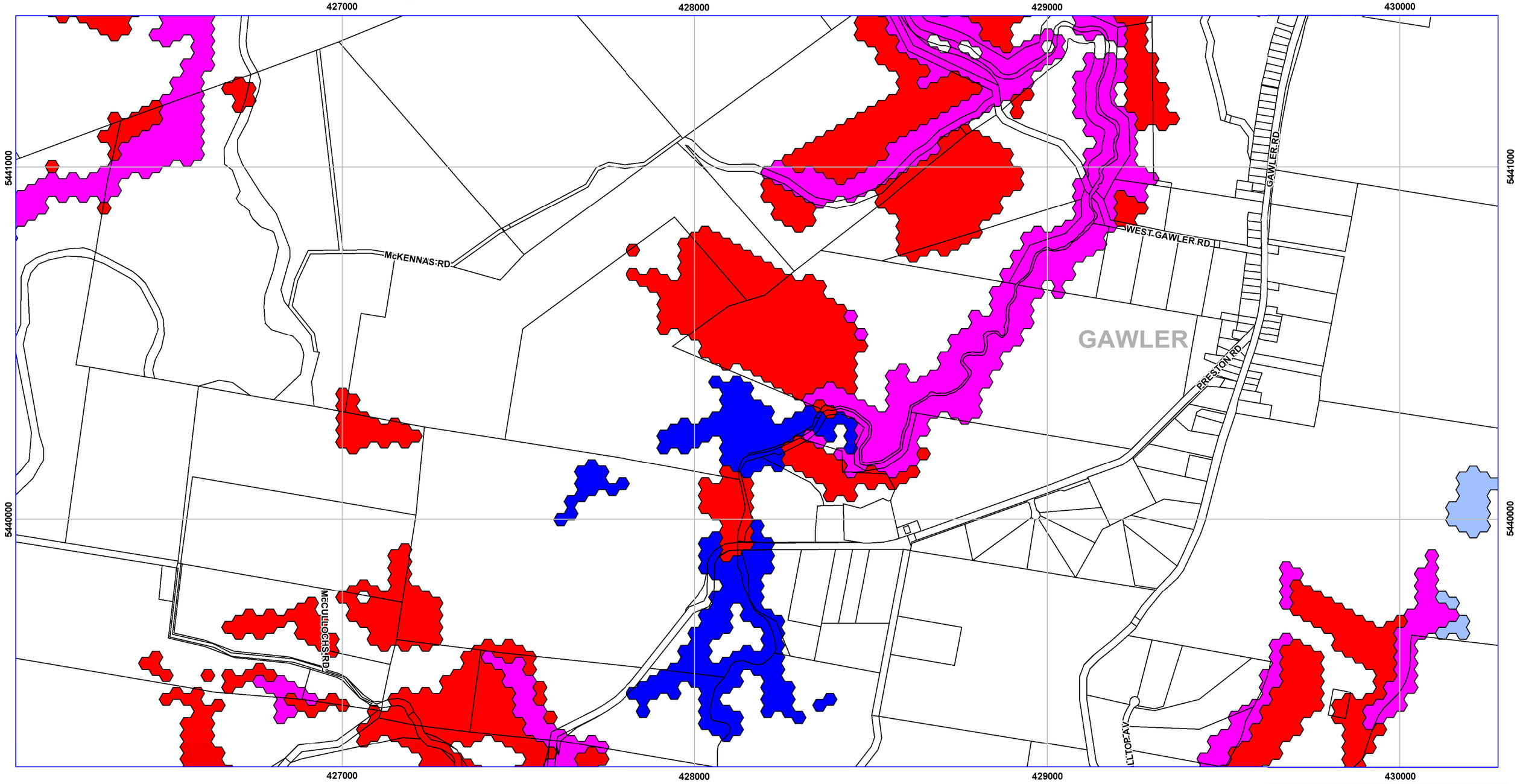
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

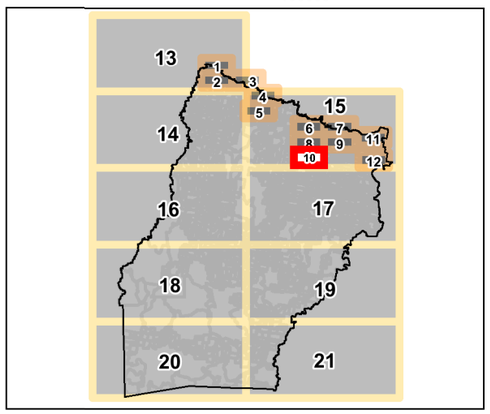
Map 10 of 21

0 500 m

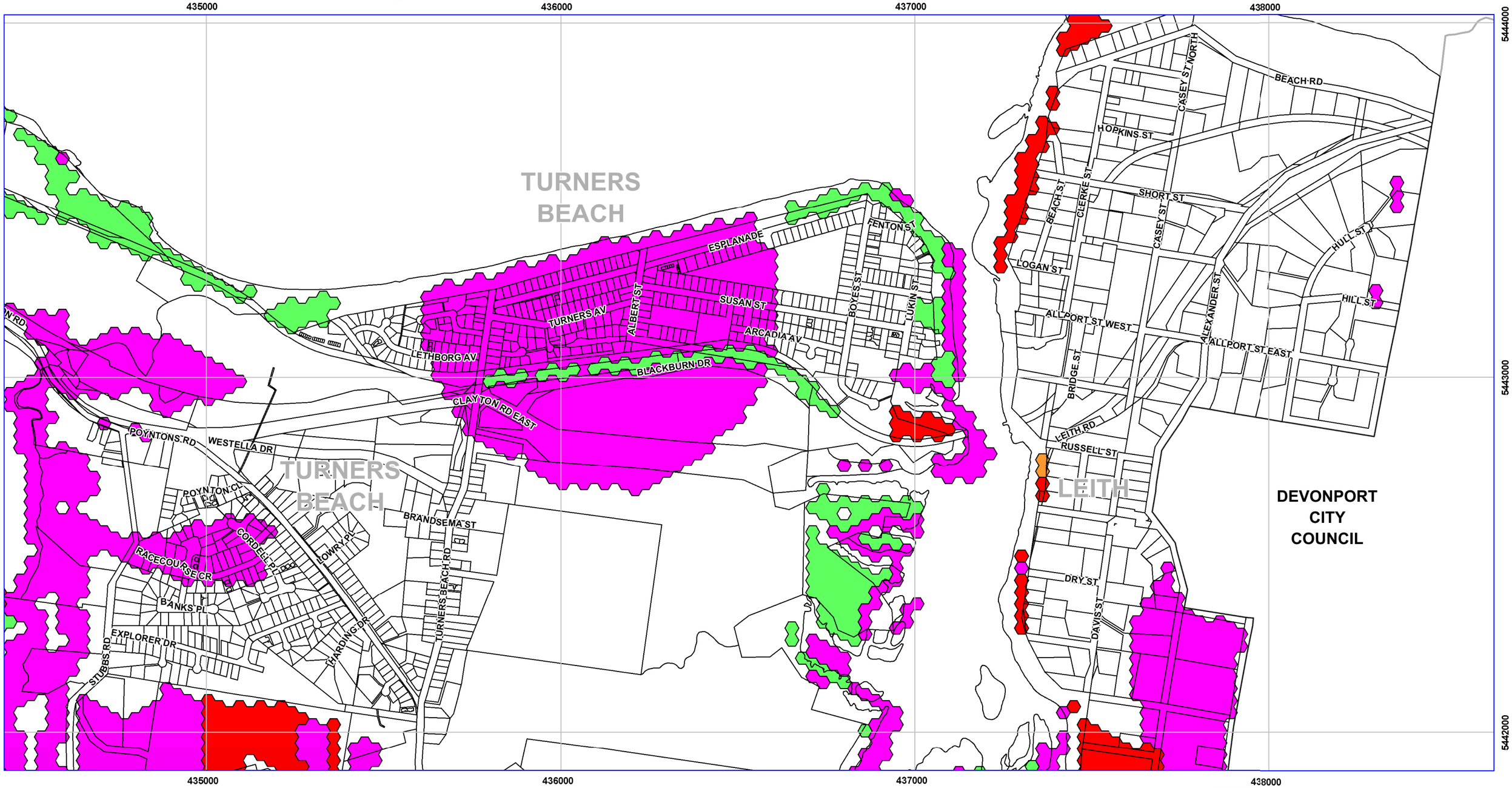
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

- THREATENED VEGETATION
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- VEGETATION REMNANT
- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

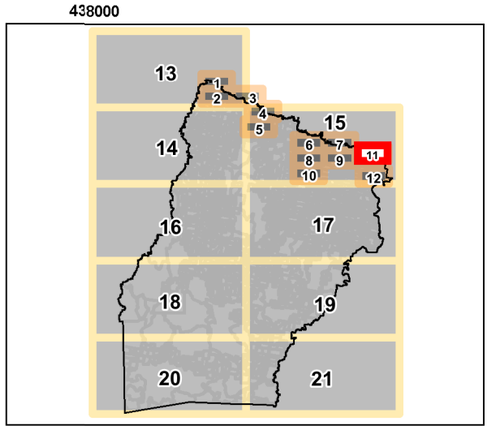
Map 11 of 21

0 500 m

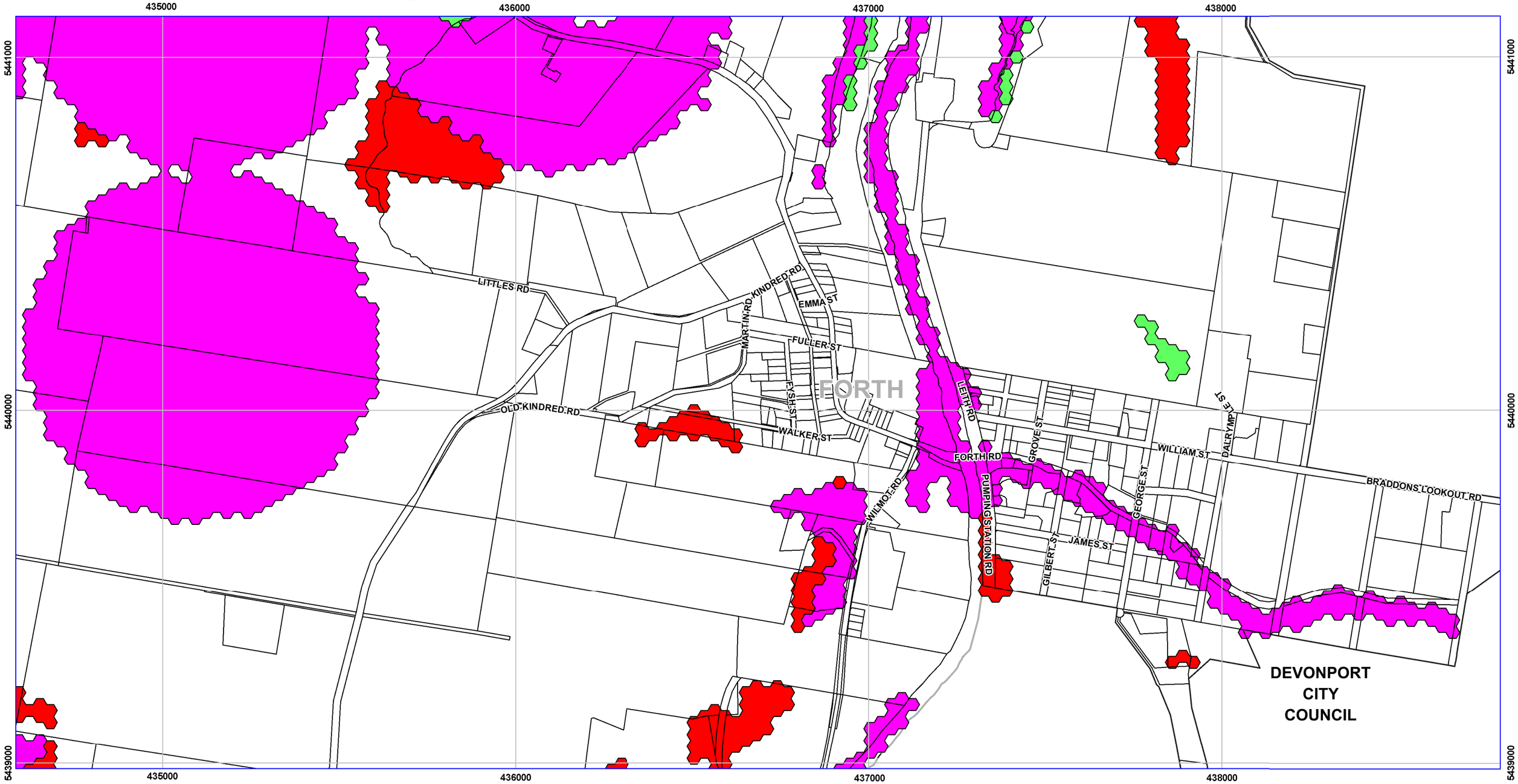
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

Map 12 of 21

0 500 m

N W E S

Coordinate System: GDA 94 MGA Zone 55

Natural Assets data from The LIST © State of Tasmania
Base topographic data from The LIST © State of Tasmania
Cadastre from The LIST © State of Tasmania as of 18/04/2019

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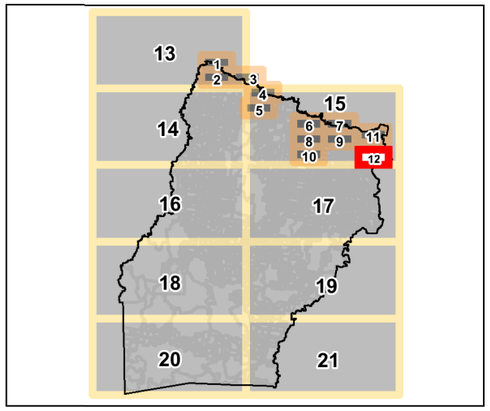
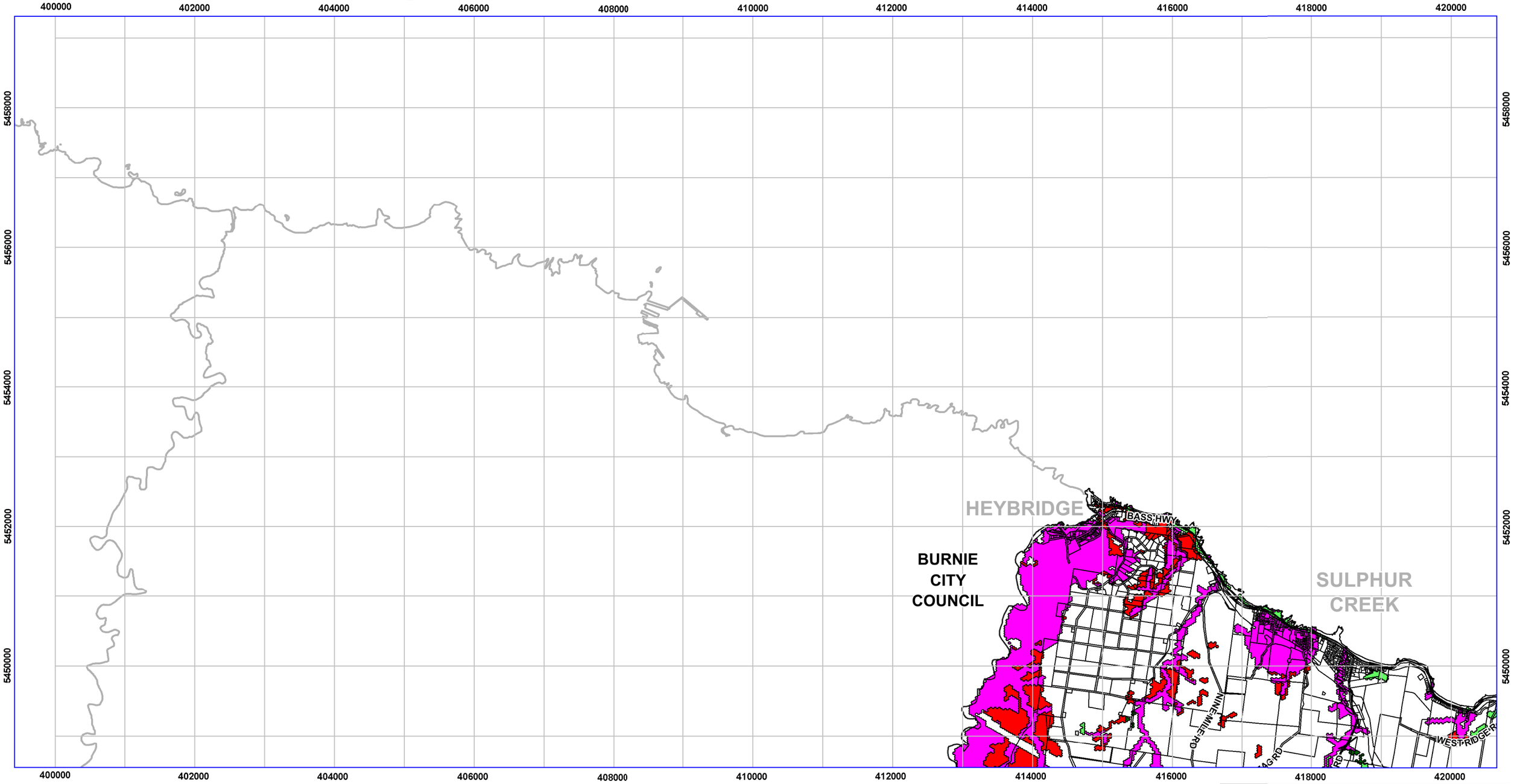


Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

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- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

Map 13 of 21

1000 0 1000 m

N W E S

Coordinate System: GDA 94 MGA Zone 55

Natural Assets data from The LIST © State of Tasmania
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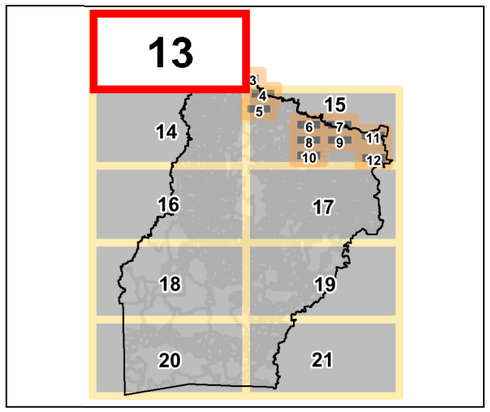
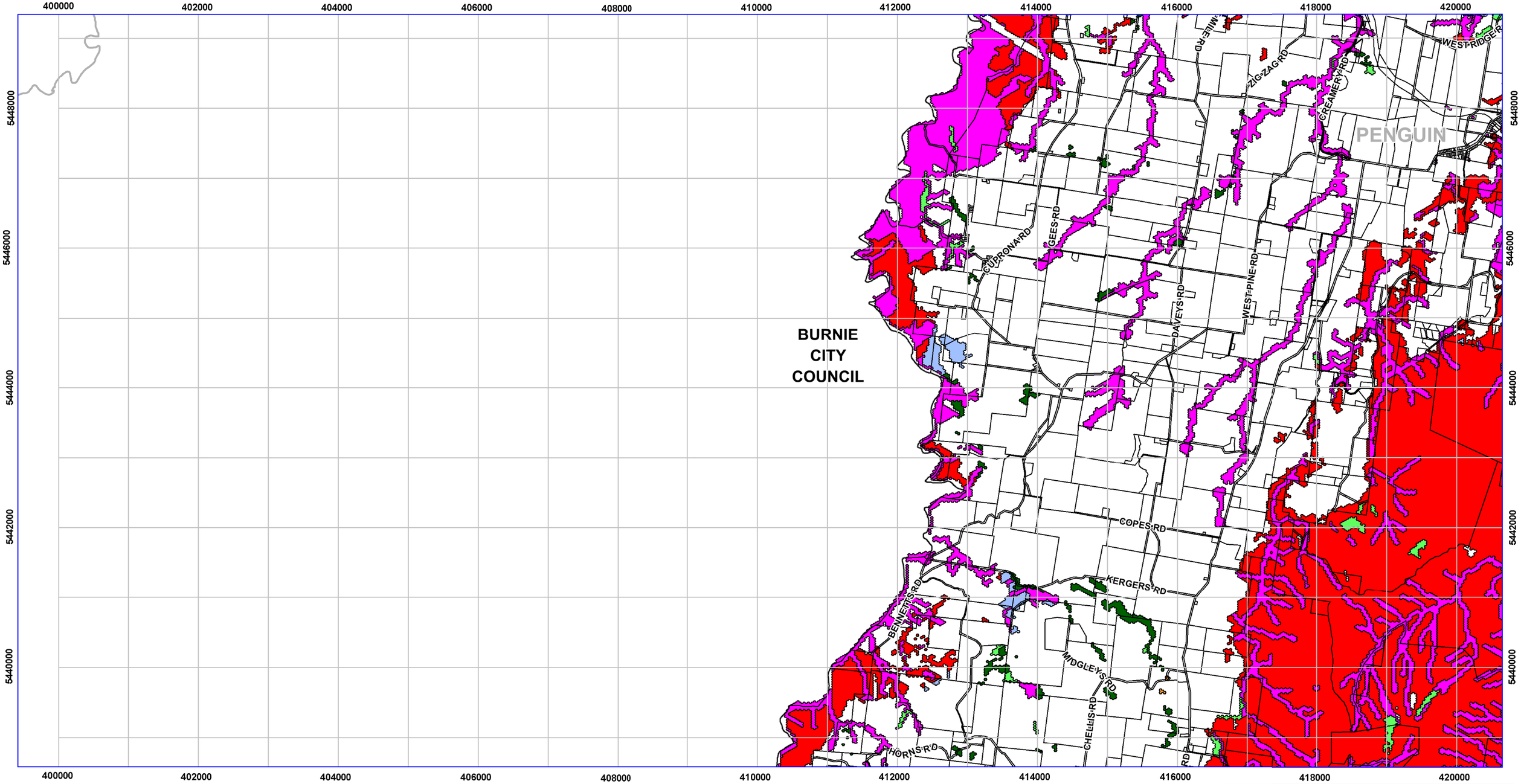


Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- VEGETATION REMNANT
- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

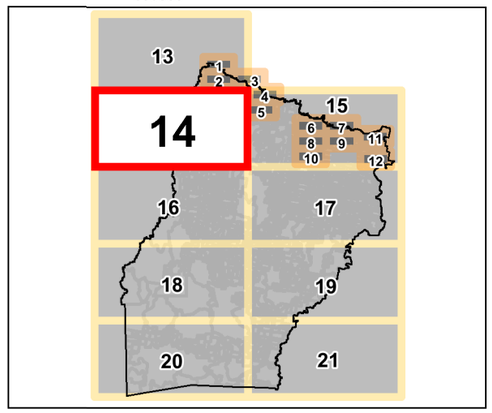
Map 14 of 21

1000 0 1000 m

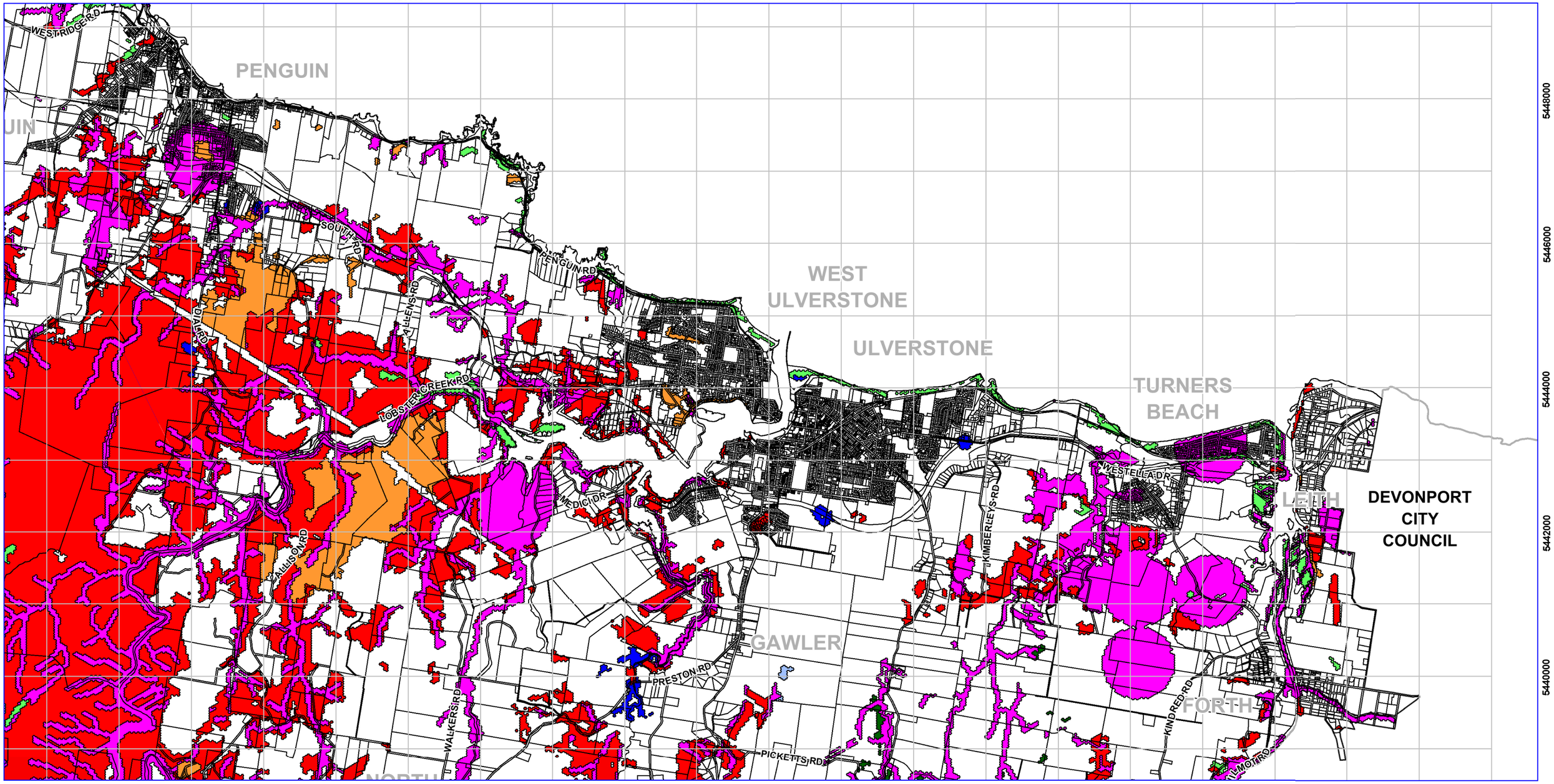
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- THREATENED FAUNA WIDESPREAD

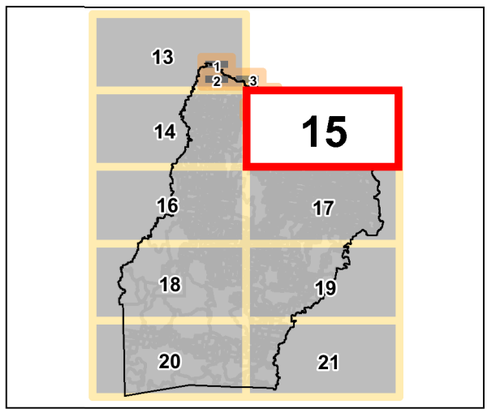
Map 15 of 21

1000 0 1000 m

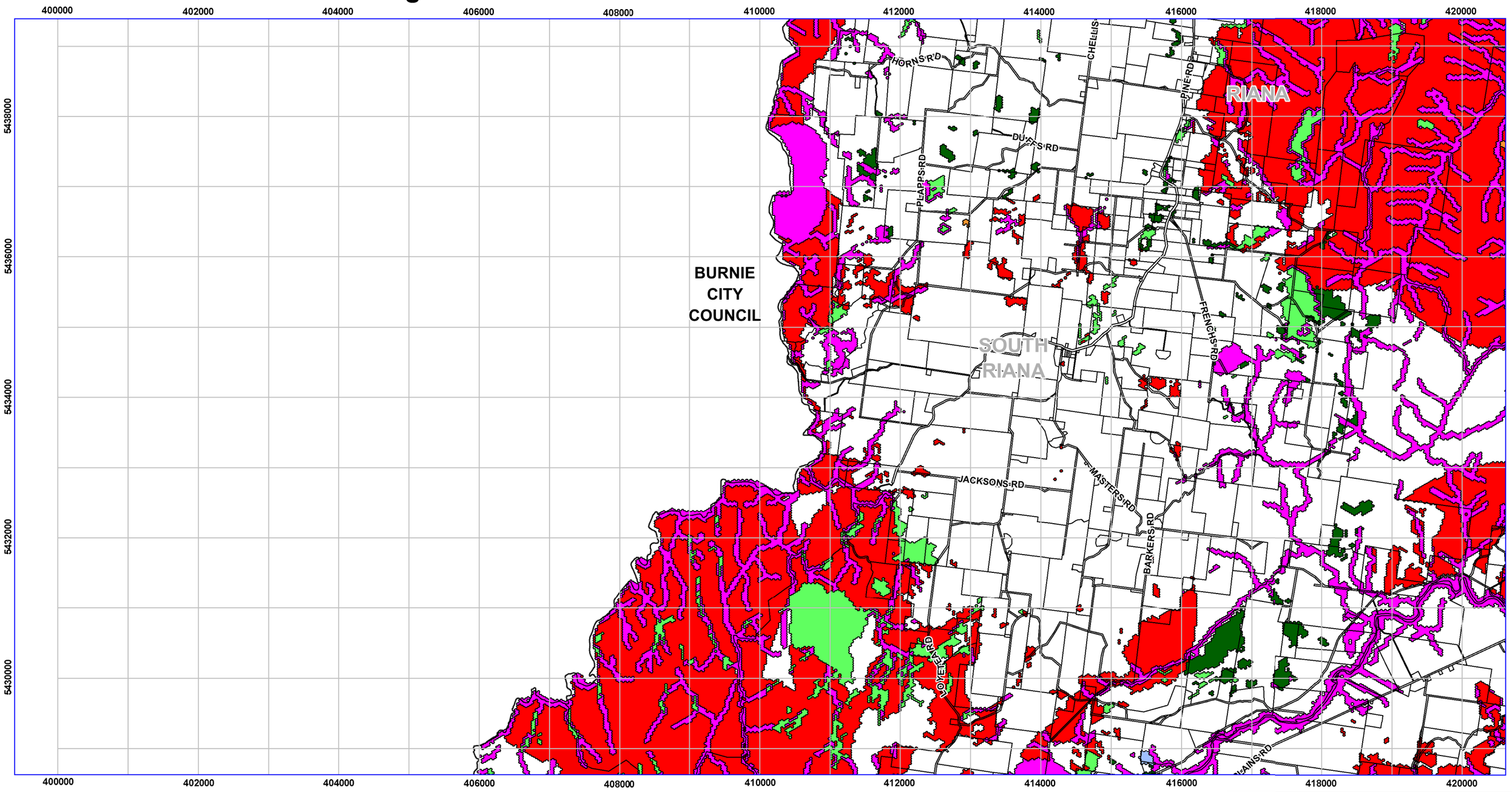
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- VEGETATION REMNANT
- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

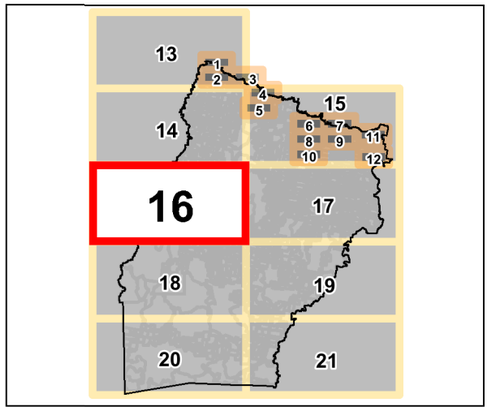
Map 16 of 21

1000 0 1000 m

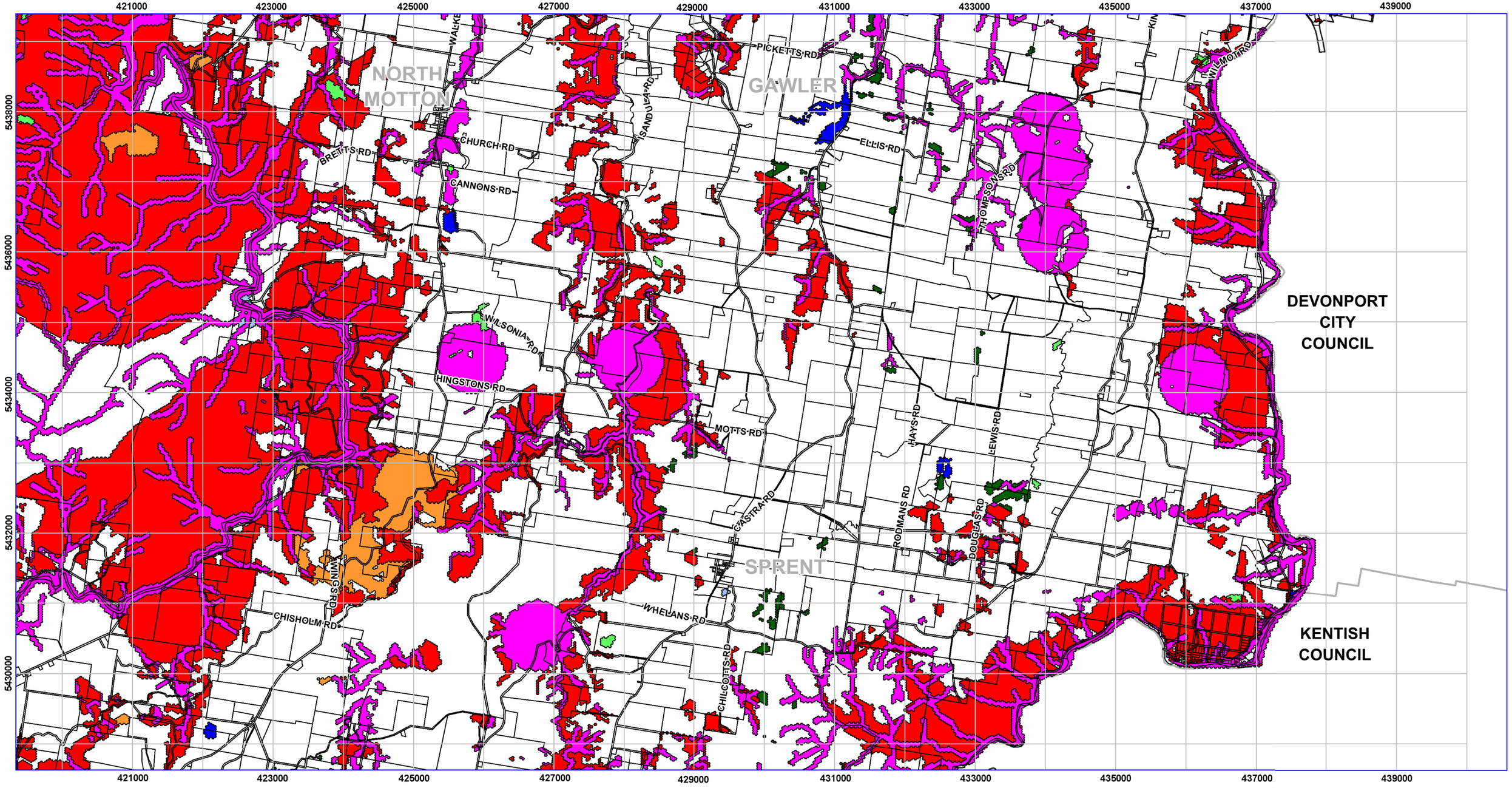
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

Map 17 of 21

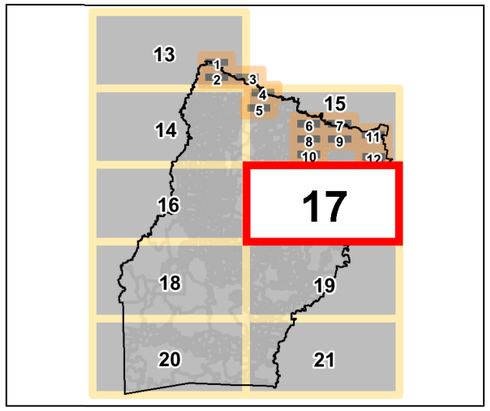
1000 0 1000 m

N W E S

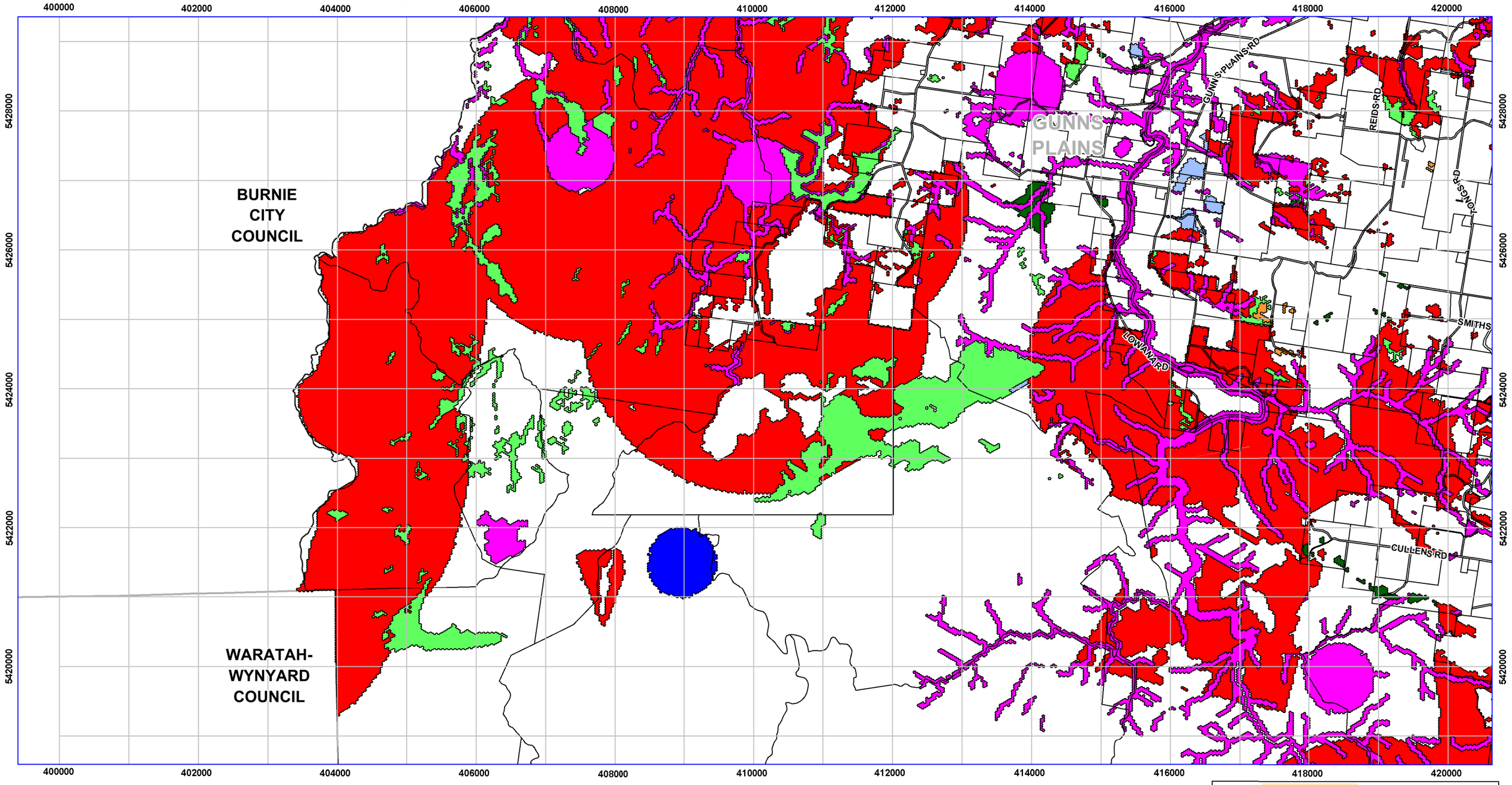
Coordinate System: GDA 94 MGA Zone 55

Natural Assets data from The LIST © State of Tasmania
Base topographic data from The LIST © State of Tasmania
Cadastre from The LIST © State of Tasmania as of 18/04/2019

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

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- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

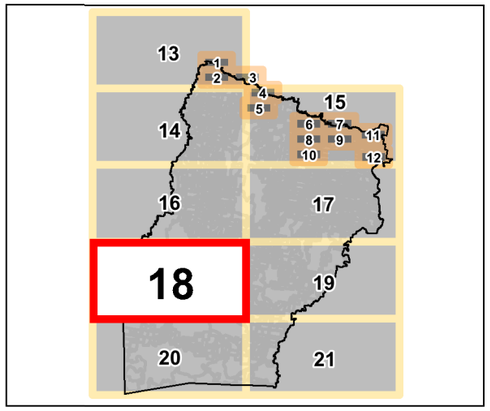
Map 18 of 21

1000 0 1000 m

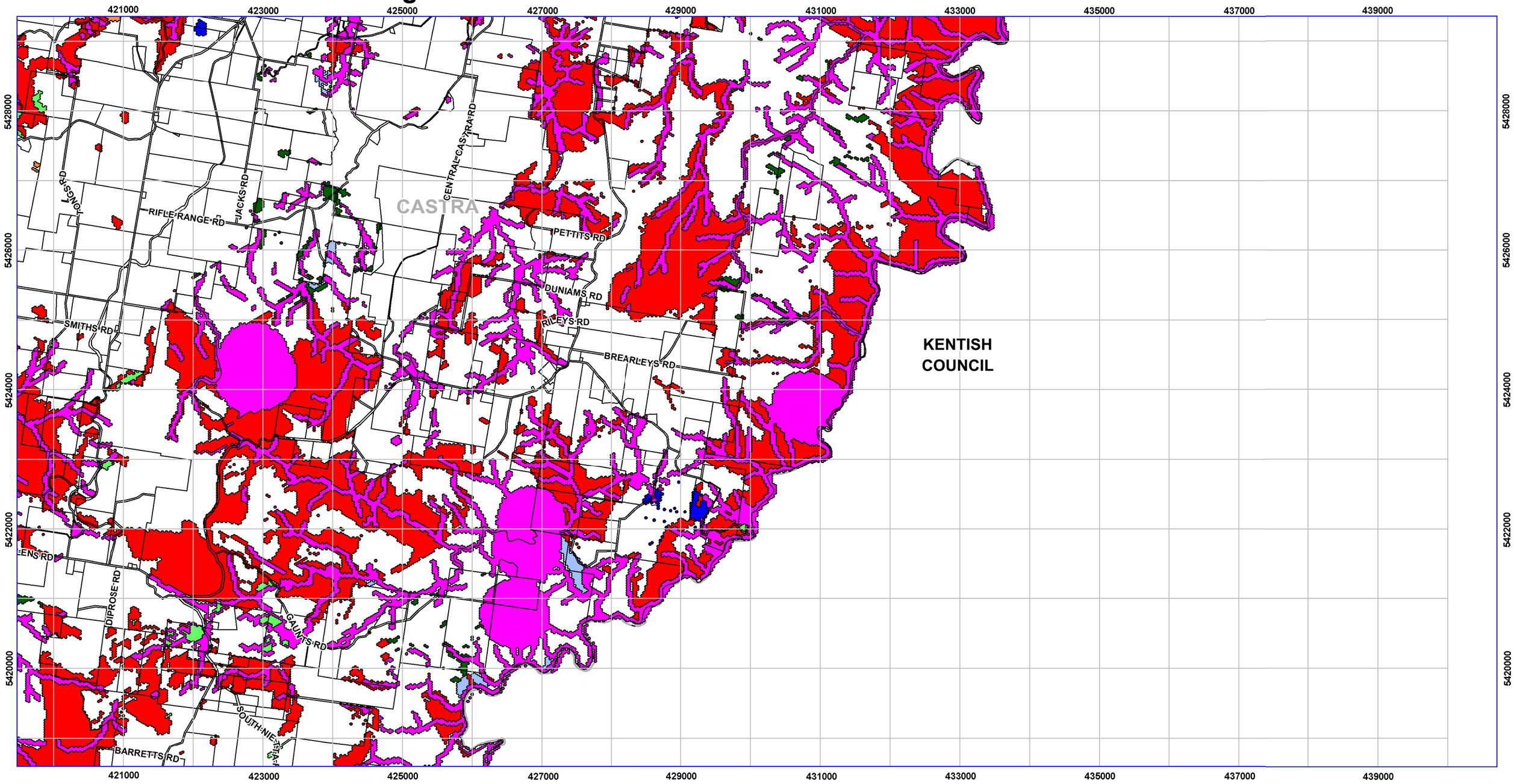
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

- THREATENED VEGETATION
- RESERVED NATIVE VEGETATION LESS THAN 30%
- NATIVE VEGETATION LESS THAN 2ha
- VEGETATION REMNANT
- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

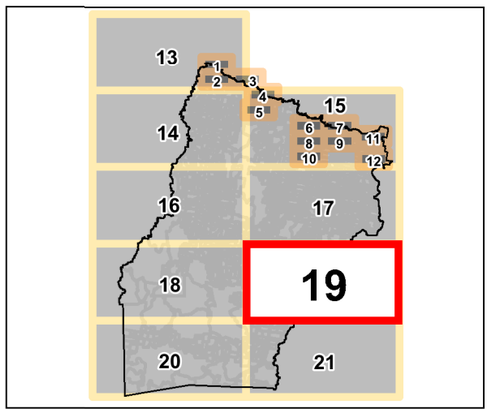
Map 19 of 21

1000 0 1000 m

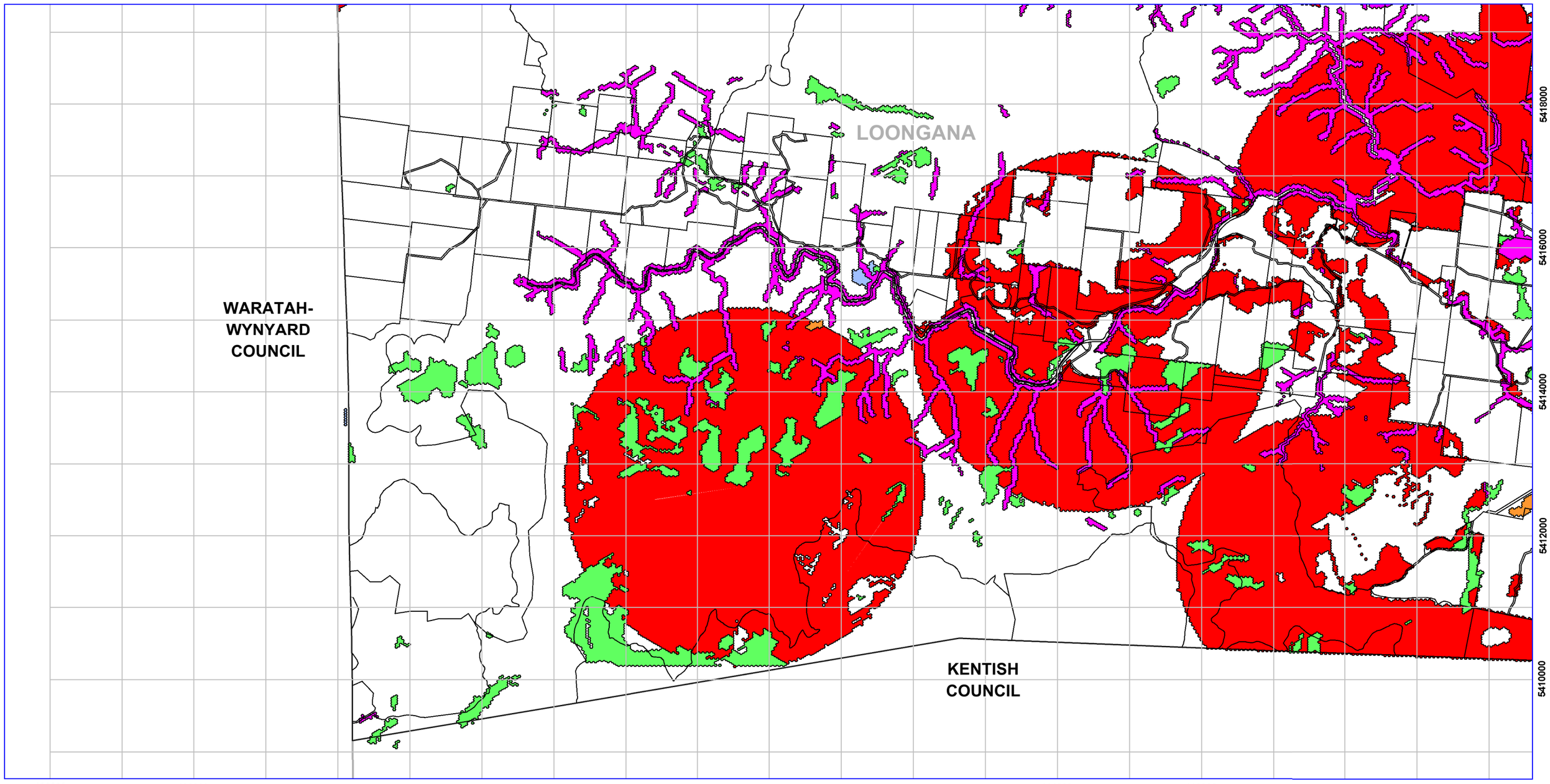
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

- THREATENED VEGETATION
- RESERVED NATIVE VEGETATION LESS THAN 30%
- NATIVE VEGETATION LESS THAN 2ha
- VEGETATION REMNANT
- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

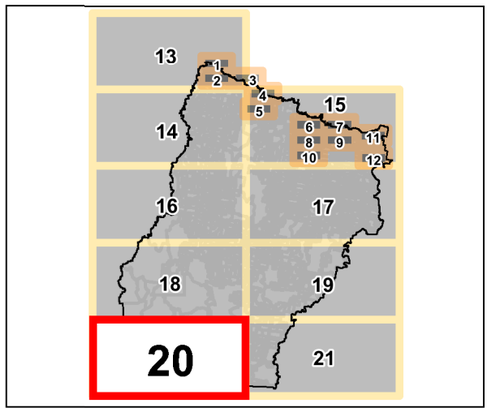
Map 20 of 21

1000 0 1000 m

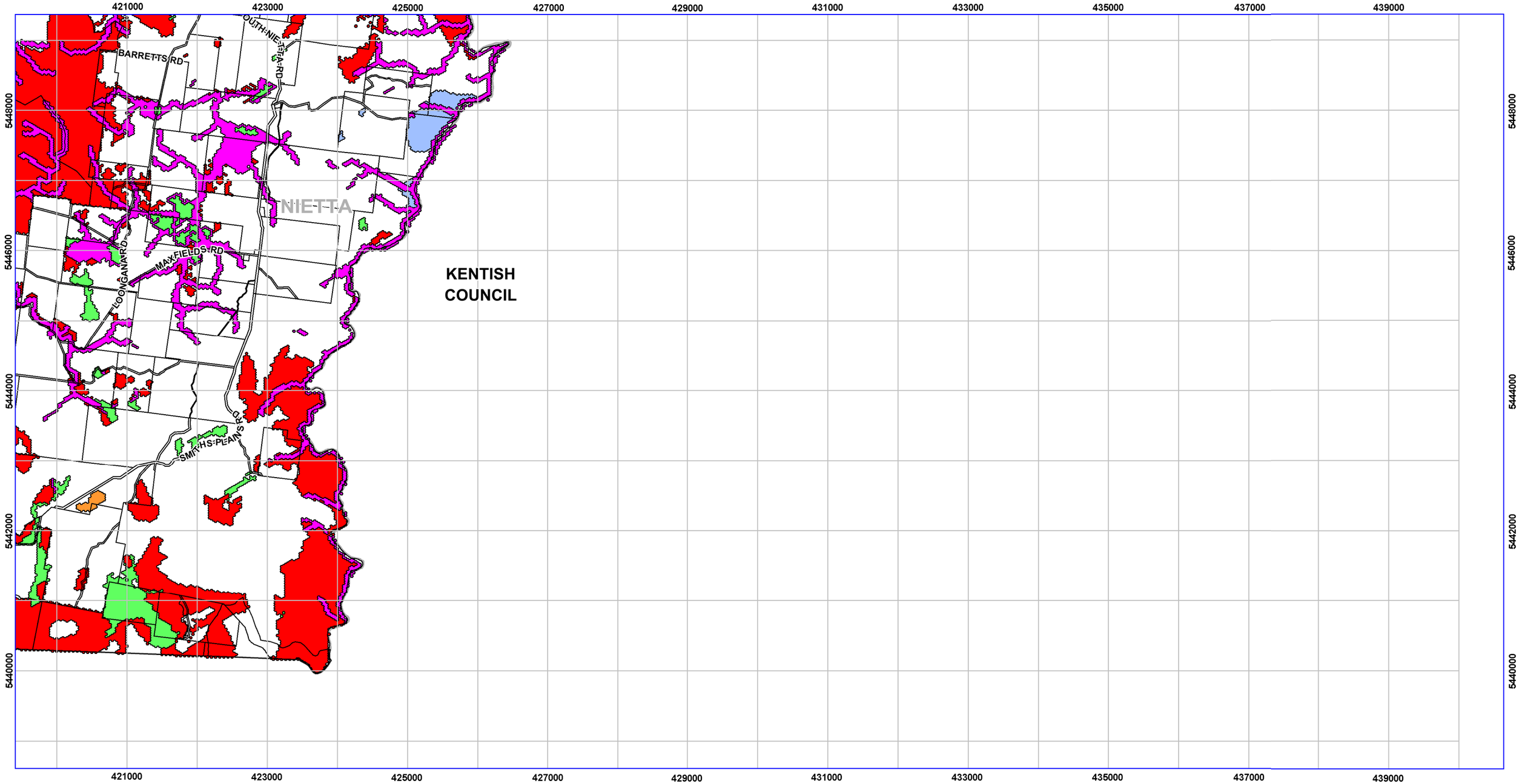
N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Tasmanian Planning Scheme - Draft Central Coast Local Provisions Schedule - Natural Assets



LEGEND

NATURAL ASSETS

- THREATENED VEGETATION
- RESERVED NATIVE VEGETATION LESS THAN 30%
- NATIVE VEGETATION LESS THAN 2ha
- VEGETATION REMNANT
- THREATENED FLORA
- THREATENED FAUNA
- THREATENED FAUNA WIDESPREAD

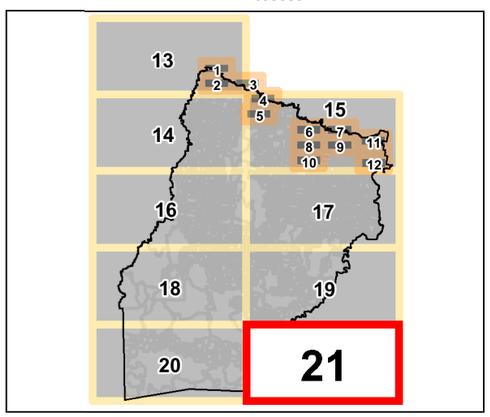
Map 21 of 21

1000 0 1000 m

N W E S

Coordinate System: GDA 94 MGA Zone 55

Print Date: 24/04/2019



Appendix 3-

Forth Flood Plan Hydraulic Modelling Report and Forth Floor Plan Hydraulic Modelling Report Addendum (under separate cover)

entura Hydro Tasmania | The power of natural thinking

Forth Flood Plan
Hydraulic Modelling Report

ENTURA-663C8
21 February 2014

Prepared by Hydro-Electric Corporation ABN48 072 377 158
t/a Entura 89 Cambridge Park Drive, Cambridge TAS 7170 Australia

Entura in Australia is certified to the latest version of ISO9001, ISO14001, and OHSAS18001.

Document information

Document title	Forth Flood Plan
	Hydraulic Modelling Report
Client organisation	Central Coast Council
Client contact	Philip Adams
ConsultDM number	ENTURA-663C8
Project Manager	Craig Ludlow
Project number	E302873/P506363

Revision history

Revision 3.0

Revision description	Final report submitted to client		
Prepared by	Craig Ludlow	C Ludlow	20/03/2015
Reviewed by	Michael Wallis	MWallis	20/3/'15
Approved by	Michael Wallis	MWallis	20/3/'15
	(name)	(signature)	(date)
Distributed to	Philip Adams (name)	Central Coast Council (organisation)	20/03/2015 (date)

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Executive summary

Introduction

Entura was commissioned by Central Coast Council (CCC) in January 2013 to carry out a flood study for the lower Forth River. The main objectives of the study were to:

- Assess the 1 in 100 annual exceedence probability (AEP) flood levels taking into consideration storm surge for current and future climate conditions and more detailed river survey data.
- Identify the impact on flood levels of the Harvest Moon levee (Levee D) and Leith Road floodstop, which were constructed after the August 2007 flood event.
- Assess the impact of the proposed Levee C which may be constructed in the future.

Background

A number of flood levees have been constructed along the lower Forth River between the Forth Road bridge and the Bass Highway to protect agricultural land and businesses from flooding, with Levee A constructed as protection from tidal influences. The design standard of the levees, in terms of flood immunity, is not known. In addition the level of the southern section of Levee D was based on the measured August 2007 flood event levels and predictions from the original modeling in the Lower Forth Flood Response and Recovery Plan (Central Coast Council, 11 March 2008).

CCC are also considering a new levee (Levee C) to link Levee A to Forth Road.

Survey

River cross sections were commissioned for this study for use in the MIKE FLOOD hydraulic model developed for the study.

Modelling scenarios

A range of modelling scenarios were carried for the study as outlined in the table below.

Scenario	Description	Rainfall	Sea Level
1	August 2007 verification flood event	Measured	Measured
2	August 2011 verification flood event	Not modelled	
3	Existing levee conditions Existing climate conditions 1 in 100 AEP rainfall	1 in 100 AEP	1 in 10 AEP storm surge.
4	Existing levee conditions Existing climate conditions 1 in 100 AEP storm surge	1 in 10 AEP	1 in 100 AEP storm surge
5	Existing levee conditions 2100 climate conditions 1 in 100 AEP rainfall	1 in 100 AEP with % increase in rainfall	1 in 10 AEP storm surge plus 0.8m sea level rise
6	Existing levee conditions	1 in 10 AEP with %	1 in 100 AEP storm surge

Scenario	Description	Rainfall	Sea Level
	2100 climate conditions 1 in 100 AEP storm surge	increase in rainfall	plus 0.8m sea level rise
7	Assessment of Harvest Moon and Leith Road Levees for worst case 1 in 100 AEP flood scenario (i.e. either rainfall or storm surge) Existing climate conditions	1 in 100 AEP or	1 in 10 AEP or
8	Assessment of Harvest Moon and Leith Road Levees for worst case 1 in 100 AEP flood scenario (i.e. either rainfall or storm surge) 2100 climate conditions	1 in 100 AEP or 1 in 10 AEP with % increase in rainfall	1 in 10 AEP or 1 in 100 storm surge plus 0.8m sea level rise
9	Assessment of Levee C for worst case 1 in 100 AEP flood scenario (i.e. either rainfall or storm surge) Existing climate conditions	1 in 100 AEP or 1 in 10 AEP	1 in 10 AEP or 1 in 100 storm surge
10	Assessment of Levee C for worst case 1 in 100 AEP flood scenario (i.e. either rainfall or storm surge) 2100 climate conditions	1 in 100 AEP or 1 in 10 AEP with % increase in rainfall	1 in 10 AEP or 1 in 100 storm surge plus 0.8m sea level rise

Hydrologic analysis

Flood hydrographs were developed for the August 2007 flood event and for the 1 in 10 AEP and 1 in 100 AEP design rainfall events for the existing climate and the 2100 future climate taking into consideration of increased rainfall due to climate change.

Climate Futures for Tasmania (2011) found that precipitation in the period 2070-2099 is anticipated to increase by 15% with an estimated increase in runoff of 65% for the 1 in 10 AEP event. For the 1 in 100 AEP event precipitation is estimated to increase by 20% with an estimated increase in runoff of 52%. This data was used to develop the 2100 climate design flood hydrographs.

The shape of the August 2007 flood hydrograph was used as the basis for the design flood hydrographs.

The peak discharges of the design flood hydrographs were has on flood frequency analysis of records on the Forth River below Paloona Dam and from catchment scaling for the catchments contributing to the lower Forth River.

The August 2007 and design flood hydrographs were used as inputs to the hydraulic model developed for the study.

Hydraulic analysis

A MIKE FLOOD hydraulic model of the lower Forth River was developed by Entura and was calibrated to the August 2007 flood event.

The MIKE FLOOD model was based on a MIKE 11 model previously developed by Entura, LiDAR survey available for the LIST, river cross section survey of the lower Forth River commissioned by CCC for this study, levee culvert details provided by CCC, as built survey of Levee D provided by CCC and design drawings of bridges and floodways sourced from DIER.

The calibrated MIKE FLOOD model was used to model the 1 in 100 AEP rainfall and storm surge events for the existing and 2100 climate conditions and to assess the impact of the existing Levee D and the proposed Levee C on flooding.

Flood extent maps were prepared for all modelled flood events.

For the existing climate 1 in 100 AEP rainfall and storm surge events, with the levees as currently in place, significant flooding is predicted to occur on the western floodplain with the impact of climate change increasing flood levels by approximately 0.7m to 1.0m.

For the existing and 2100 climate 1 in 100 AEP rainfall events and the 2100 climate 1 in 100 AEP storm surge event, with the levees as currently in place, flooding of the Harvest Moon infrastructure is predicted to occur. For the existing climate 1 in 100 AEP storm surge event the Harvest Moon infrastructure is predicted to be protected by Levee D.

In the vicinity of Turners Beach no flooding of properties is predicted to occur for the existing climate condition 1 in 100 AEP rainfall or storm surge events. For the 2100 climate approximately 35 properties along Boyes Street, Susan Street, Arcadia Avenue and Whitegum Way are predicted to be affected primarily due to the 0.8m rise in mean sea level. Properties at the end of Lethborg Avenue and Heather Court may also be affected. Provision of a small levee and one way flow device may prevent flooding of these properties in the climate change scenario.

Other areas where properties may be affected by the modelled flood events, with the levees as currently in place, include:

- Near the intersection of Turners Beach Road and the Bass Highway. For the existing climate condition the dwellings at this location are not predicted to be affected however for the 2100 climate condition 3 to 4 dwellings could potentially be inundated.
- At the bend in Forth Road near Mell Street buildings associated with the sports fields are predicted to be affected for flooding from the 1 in 100 AEP rainfall events (current and 2100 climates) and the 1 in 100 AEP 2100 climate storm surge event. Flooding of a number of residential dwellings in this area is predicted to occur for the 1 in 100 AEP 2100 climate rainfall event.
- Just upstream of the Leith Road floodstop barrier a number of properties are predicted to be affected by flooding for the 1 in 100 AEP 2100 climate rainfall event. No flooding of properties in this area is predicted for the current climate 1 in 100 AEP rainfall event.

Flooding of the low area bounded by Blackburn Drive and the Bass Highway is predicted for all modelled flood events.

Overtopping of the waste water ponds was not predicted to occur for the existing climate flood events however overtopping was predicted for the 2100 climate condition.

Flooding of the western floodplain was found to be initiated by a low section in Levee A. This low section of Levee A would be overtopped by the 1 in 10 AEP 2100 climate surge level.

Levee D was found to reduce the severity of the eastern flooding in the vicinity of the Harvest Moon infrastructure. However the levee also results in an increase in flood levels in the main channel and the western flooding. The maximum increase in flood levels in the river channel as a result of Levee D was estimated to be 0.18m for the existing 1 in 100 AEP current climate rainfall event.

It was found that Levee D has varying levels of flood immunity. The southern section adjacent to the river channel has an immunity approximately equivalent to the 1 in 100 AEP 2100 climate rainfall event while the northern section will be overtopped by a 1 in 50 AEP existing climate rainfall event.

Based on the modelling carried out for this study the Leith Road floodstop barrier is not expected to provide any benefit for the 1 in 100 AEP rainfall event (in terms of prevent flooding of the eastern floodplain) until at least 2100.

It was found that Levee C, with a top level of 2.05m AHD, could be built with minimum impact of surrounding flooding.

Overtopping of the waste water ponds is not predicted to occur for the current climate conditions. The estimated freeboard for the 1 in 100 AEP rainfall event is approximately 0.21m.

Significant overtopping of the waste water ponds is predicted to occur for the 2100 climate conditions 1 in 100 AEP rainfall or storm surge events.

Recommendations

It is recommended that a one way flow device be provided to the DN750mm diameter culvert under the Bass Highway to prevent flooding of the low lying land between Blackburn Drive and the Bass Highway.

It is recommended that a review of the Levee D design be carried out to determine whether it can be optimised to provide a consistent level of flood protection to Harvest Moon infrastructure while minimising the impacts on surrounding flooding.

It is recommended that the relevant authority review the level of freeboard required for the wastewater treatment ponds for the 1 in 100 AEP flood event to determine whether any work is required to provide the facility with the adequate level of flood protection.

It is recommended that the relevant authority put in place plans to, in the future, review the waste water ponds and level of flood protection required, once the potential consequences of climate change on rainfall and sea level rise are better understood.

Once the potential consequences of climate change on rainfall and sea level rise are better understood, it is recommended that CCC review flood mitigation measures that would be required to prevent flooding of properties in Turners Beach.

Additional work completed

On completion of the Draft Forth Flood Plan – Hydraulic Modelling Report, Entura was engaged by Council to carry out the following additional work:

- Update the Part C of the Lower Forth Flood Response and Recovery Plan including:
    - Property/Asset Tables 3 and 4 with the:
        - 1 in 2 AEP and 1 in 5 AEP columns to be deleted.
        - 1 in 10 AEP, 1 in 50 AEP and 1 in 100 AEP columns to be updated with recent modelling results.
        - 1 in 200 AEP column to be replaced with modelling results for the 1 in 100 AEP 2100 climate event.
    - Figures 1, 2 and 3 to be updated to include the latest 1 in 100 AEP existing climate and August 2007 flood event stage hydrographs. The stage hydrographs for the 1 in 1000 AEP and 1 in 2000 AEP flood events are to be retained as these events have not been re-run with the updated model.

  - Update the Forth flood 1:100 AEP flood extent map between Wilmot River and Forth.
- Assess the requirements for Levee A and D to provide a 1 in 50 AEP design flood immunity.
- Provide basic comment on the proposed upgrade work currently being completed for Levee B.

This additional work is documented in the following addendum report:

- Forth Flood Plan – Hydraulic Modelling Report Addendum, Document number: ENUTRA-76A08, 5 December 2013.

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Contents

Appendices

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1. Introduction

Entura was commissioned by Central Coast Council (CCC) in January 2013 to carry out a flood study for the lower Forth River. The main objectives of the study were to:

- Assess the 1 in 100 annual exceedence probability (AEP) flood levels taking into consideration storm surge for current and future climate conditions and more detailed river survey data.
- Identify the impact on flood levels of the Harvest Moon levee (Levee D) and Leith Road floodstop, which were constructed after the August 2007 flood event.
- Assess the impact of the proposed Levee C which may be constructed in the future.

This report summarises the findings of the investigations carried out for this study and presents flood inundation maps for the calibration and design flood events.

On completion of the Draft Forth Flood Plan – Hydraulic Modelling Report, Entura was engaged by Council to carry out the following additional work:

- Update the Part C of the Lower Forth Flood Response and Recovery Plan including:
    - Property/Asset Tables 3 and 4 with the:
        - 1 in 2 AEP and 1 in 5 AEP columns to be deleted.
        - 1 in 10 AEP, 1 in 50 AEP and 1 in 100 AEP columns to be updated with recent modelling results.
        - 1 in 200 AEP column to be replaced with modelling results for the 1 in 100 AEP 2100 climate event.
    - Figures 1, 2 and 3 to be updated to include the latest 1 in 100 AEP existing climate and August 2007 flood event stage hydrographs. The stage hydrographs for the 1 in 1000 AEP and 1 in 2000 AEP flood events are to be retained as these events have not been re-run with the updated model.
    - Update the Forth flood 1:100 AEP flood extent map between Wilmot River and Forth.
- Assess the requirements for Levee A and D to provide a 1 in 50 AEP design flood immunity.
- Provide basic comment on the proposed upgrade work currently being completed for Levee B.

This additional work is documented in the following addendum report:

- Forth Flood Plan – Hydraulic Modelling Report Addendum, Document number: ENUTRA-76A08, 5 December 2013.

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2. Background

2.1 Forth levees

A number of flood levees have been constructed along the lower Forth River between the Forth Road bridge and the Bass Highway to protect agricultural land and businesses from flooding, with Levee A constructed as protection from tidal influences. The locations of the levees are shown in Figure 2.1 and a description of each levee is provided in Table 2.1. The design standard of the levees, in terms of flood immunity, is not known. In addition, the level of the southern section of Levee D was based on the measured August 2007 flood event levels and predictions from the original modeling in the Lower Forth Flood Response and Recovery Plan (Central Coast Council, 11 March 2008).

Table 2.1: Description of Forth levees

Levee	Description
A	Protects agricultural land on the western side of the river. Built prior to 2007.
B	Protects agricultural land on the western side of the river. Built prior to 2007.
C	Not yet built. Proposed to link Levee A to Forth Road.
D	Protects Harvest Moon infrastructure on the eastern side of the river. Level raised after August 2007 flood event.

A DN 900mm diameter pipe fitted with a tide flap has been provided to drain the agricultural land protected by Levee A back to the Forth River.

A DN750mm diameter pipe, which is not fitted with a tide flap, drains a low point bounded by Blackburn Drive and the Bass Highway south to the agricultural land protected by Levee A. The Turners Beach Berry Patch is located in this low lying area.

The locations of the levee culverts are provided in Figure 2.2.

2.2 August 2007 flood event

In August 2007 a large flood occurred resulting in significant inundation of the lower Forth River and floodplains. A summary of the flooding is provided below:

- The flood discharge passed through the Forth Road bridge and the Forth Road floodway located on the western side of the river.
- The sports fields on the western side of the river downstream of the flood opening were inundated.
- The land to the west of Levee A (Refer to Figure 2.1) was inundated however the waste water ponds were not overtopped.

- A breach of Levee A occurred however it is not known whether this breach occurred before or after the peak of the flood.
- On the eastern side of the river, flow ovetopped the river channel approximately near where Leith Road rejoins the Forth River (Refer to Figure 2.1). This flow inundated Leith Road and infrastructure belonging to Harvest Moon (agribusiness specializing in fresh vegetables).
- The water treatment ponds on the western side of the river were not inundated.
- The Turners Beach Berry Patch was inundated during the flood event.

Photographs of the flood event were taken by CCC and provided to Entura. A selection of the photographs are shown in Figure 2.2.

Peak flood levels, from flood debris marks, were surveyed by CCC after the flood event. These flood levels are shown in Figure 2.1.

2.3 Harvest Moon levee

As a result of the August 2007 flood event the southern section of Levee D was constructed with the aim of protecting Harvest Moon infrastructure from future flooding. Where Levee D crosses Leith Road a floodstop barrier has been provided. When flooding is predicted to occur, the plastic flood barriers are manually installed to fill the gap in the levee. An isometric drawing of the Leith Road floodstop is shown in Figure 2.3.

2.4 Previous flood modelling

Flood modeling of the Forth River has been carried out in the past for the purpose of assessing the impact of a dambreak of the upstream Paloona Dam and to assess the impact of the upgrade of the rail bridge crossing over the river (Jokanovic, August 2012). However a flood study to assess in detail the flood levels in the lower Forth River had not been carried out prior to this study.

Figure 2.1: Forth levees and August 2007 peak flood levels (from CCC with notes by Entura)

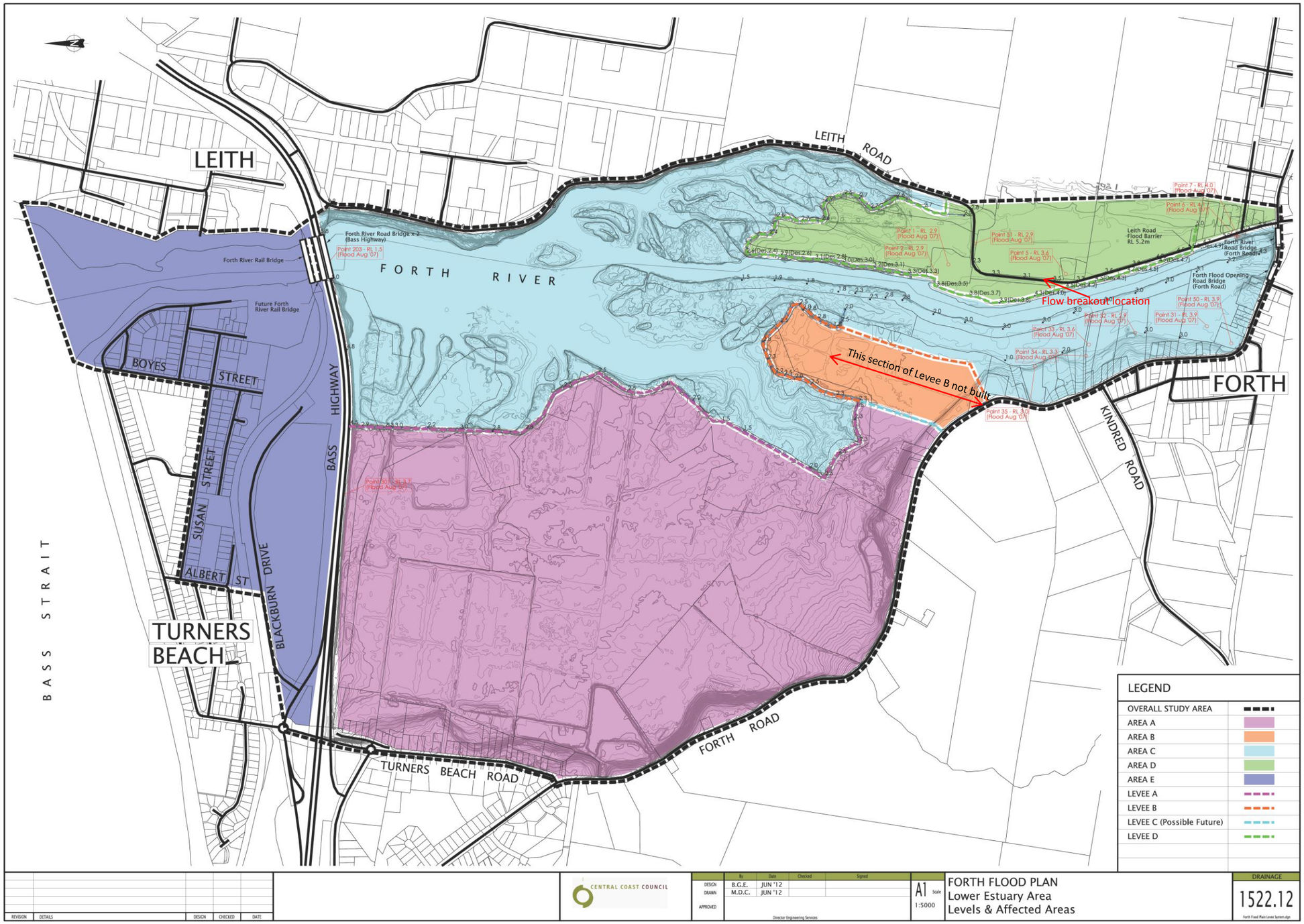


Figure 2.2: Forth levee culverts (image from Google Earth)

Table 2.2: August 2007 flood event – photographs (from CCC)

Photographs of August 2007 flood event
Aerial photograph looking south (11/08/2007) 
Forth Road bridge looking downstream (10/08/2007 approx 6:30pm) 

Playing fields looking downstream (10/08/2007 approx 6:30pm)

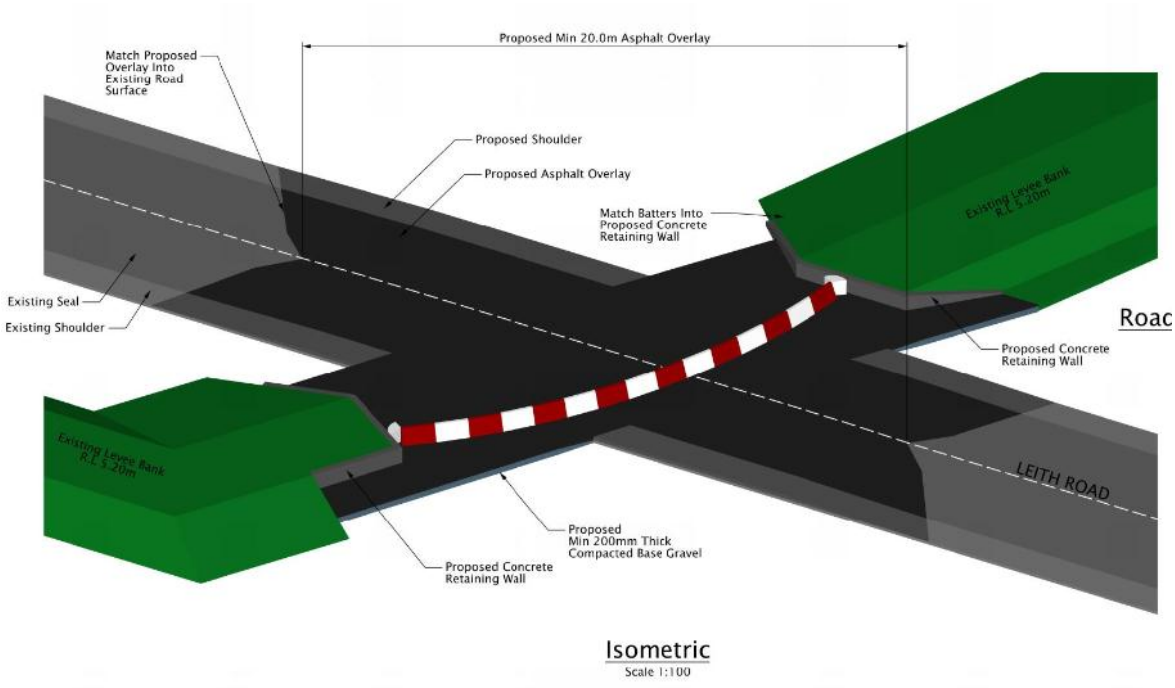
Harvest Moon Factory (11/08/2007)

Leith Road looking north to breakout point (10/08/2007 approx 1:30pm)

Leith Road behind Harvest Moon factory - looking south west (11/08/2007)

Levee A breach

Figure 2.3: Leith Road floodstop (extract from CCC drawing 1522.11)



3. Available data

3.1 Survey

The following survey information was used in the study to develop the hydraulic model:

- LiDAR survey from the Land Information System Tasmania (LIST). This LiDAR was taken post August 2007 when Levee D was partially constructed.
- Surveyed cross sections of the Forth River and detailed survey of the Forth Road bridge commissioned by CCC for the purpose of this study. Refer to Appendix A for a survey plan. Electronic files of the survey have been provided to CCC.
- Traverse survey of Levee D by G. A. Deegan. Refer to Appendix A.
- Measurements of the Forth levee culvert diameters (DN750mm and DN 900mm) by CCC.

All levels present in this study are in m AHD.

3.2 Flood data

The following data for the August 2007 flood event was provided to Entura by CCC:

- Surveyed flood levels.
- Photographs of flooding.

3.3 Hydrologic data

The following hydrologic data was utilised for the study:

- CFEV catchment delineations for the Forth and Wilmot catchments.
- Record of spill from Paloona (regulated) TSM(627.1/130.00/10) PTO(140.00,0).
- Record of water released for power station use at Paloona (regulated) TSM(235.1/156.00/1) PTO(140.00,0).
- Record of flow at the Wilmot River above the confluence with the Forth River (regulated) TSM(524.1/100.00/1) PTO(140.00,0).
- Record of flow at the Forth River below the confluence with the Wilmot River (regulated) TSM(665.1/100.00/1) PTO(140.00,0).
- Record of flow on Forth River upstream of Lemonthyme power station (natural watercourse) TSM 450.1/100.00/1 PTO(140.00,0).
- Record of flow at Clayton's Rivulet U/S Old Bass Highway (natural) DPIPWE Station No. 14237 .
- Percentage change in design rainfall for the 1:10 and 1:100 AEP event (Climate Futures for Tasmania, 2011).

3.4 Tide information

Recorded hourly tide data at Burnie during the period of August 2007 flood event was sourced from the Bureau of Meteorology (BoM) to develop the downstream boundary condition for the hydraulic model.

Storm surge levels for the design flood events were sourced using the “Canute 2” software and is discussed further in Section 6.2.7.

3.5 Design drawings

The following design drawings were sourced for this study:

- Forth River Flood Opening Bass Highway – L72.45 – General Arrangement. Drawing 253 F-1.
- Forth River Bridge Bass Highway – General Arrangement. Drawing 254 F-1.
- KPW 142.2 – Forth River Rail Bridge. Drawing No. 18912-S02
- KPW 142.2 – Forth River Rail Bridge. Drawing No. 18912-S03

3.6 Hydraulic model

The MIKE 11 model developed by Entura to assess the Forth River rail bridge duplication (Jokanovic, August 2012) was used as the basis for developing the 1D/2D integrated hydraulic model for this study. This model contains the details of the Bass Highway and rail bridges (including duplication).

4. Flood scenarios

The flood scenarios provided in Table 4.1 were adopted for the study based on discussion between CCC and Entura and form the basis of the hydrologic and hydraulic analyses carried out for this study.

Table 4.1: Modelling scenario

Scenario	Description	Rainfall	Sea Level	Purpose
Model calibration				
1	August 2007 verification flood event	Measured	Measured	For calibration of the hydraulic model.
2	January 2011 verification flood event	Measured	Measured	For verification of the hydraulic model.
Design floods				
3	Existing levee conditions Existing climate conditions 1 in 100 AEP rainfall	1 in 100 AEP	1 in 10 AEP storm surge.	To assess peak flood levels associated with a 1 in 100AEP rainfall event with co-incident storm surge. All currently constructed levees and rail bridge duplication considered.
4	Existing levee conditions Existing climate conditions 1 in 100 AEP storm surge	1 in 10 AEP	1 in 100 AEP storm surge	To assess peak flood levels associated with a 1 in 100AEP storm surge event with co-incident rainfall. All currently constructed levees and rail bridge duplication considered.
5	Existing levee conditions 2100 climate conditions 1 in 100 AEP rainfall	1 in 100 AEP with % increase in rainfall	1 in 10 AEP storm surge plus 0.8m sea level rise	To assess peak flood levels associated with a 1 in 100AEP rainfall event with co-incident storm surge. All currently constructed levees and rail bridge duplication considered.
6	Existing levee conditions 2100 climate conditions 1 in 100 AEP storm surge	1 in 10 AEP with % increase in rainfall	1 in 100 AEP storm surge plus 0.8m sea level rise	To assess peak flood levels associated with a 1 in 100AEP storm surge event with co-incident rainfall. All currently constructed levees and rail bridge duplication considered.

7	Assessment of Harvest Moon and Leith Road Levees for worst case 1 in 100 AEP flood scenario (i.e. either rainfall or storm surge) Existing climate conditions	1 in 100 AEP or	1 in 10 AEP or	To assess peak flood levels associated with a 1 in 100AEP storm surge event with co-incident rainfall prior to construction of Levee D. Peak flood levels to be compared with Scenario 4 to assess impact of Levee D on flooding. Levees and bridges as per 2007.
8	Assessment of Harvest Moon and Leith Road Levees for worst case 1 in 100 AEP flood scenario (i.e. either rainfall or storm surge) 2100 climate conditions	1 in 100 AEP or 1 in 10 AEP with % increase in rainfall	1 in 10 AEP or 1 in 100 AEP storm surge plus 0.8m sea level rise	To assess peak flood levels associated with a 1 in 100AEP storm surge event with co-incident rainfall prior to construction of Levee D. Peak flood levels to be compared with Scenario 4 to assess impact of Levee D on flooding. Levees and bridges as per 2007.
9	Assessment of Levee C for worst case 1 in 100 AEP flood scenario (i.e. either rainfall or storm surge) Existing climate conditions	1 in 100 AEP or 1 in 10 AEP	1 in 10 AEP or 1 in 100 AEP storm surge	To assess the impact of the prosed Levee C on flooding.
10	Assessment of Levee C for worst case 1 in 100 AEP flood scenario (i.e. either rainfall or storm surge) 2100 climate conditions	1 in 100 AEP or 1 in 10 AEP with % increase in rainfall	1 in 10 AEP or 1 in 100 AEP storm surge plus 0.8m sea level rise	To assess the impact of the prosed Levee C on flooding.

5. Hydrology

5.1 Introduction

A hydrologic analysis was carried out for this study to:

- Develop flood hydrographs for the August 2007 flood event.
- Develop flood hydrographs for the 1 in 10 AEP and 1 in 100 AEP design floods for the existing climate and the 2100 future climate.

5.2 August 2007 flood event

Flood hydrographs were derived for the August 2007 flood event from available flow records and catchment scaling. These hydrographs were used as inputs for the hydraulic modelling calibration.

Recorded flows in the Forth and Wilmot Rivers upstream and downstream of the confluence were used as the basis for the August 2007 flood event hydrographs for input to the top end of the hydraulic model. The flood hydrograph downstream of the confluence is shown in Figure 5.3.

As there are no flow gauging stations on the lower Forth River, catchment scaling was required to estimate the runoff from the catchments downstream of the Wilmot River confluence. The method adopted for the catchment scaling as outlined in Section 5.3.2.

5.3 Design flood events

Flood hydrographs were developed for the 1 in 10 AEP and 1 in 100 AEP design flood events for the current climate and for the 2100 future climate for use as inputs to the hydraulic model of the Forth River.

The development of the design flood hydrographs was based on the following process:

- Flood frequency analysis of recorded flows just downstream of the confluence of the Forth and Wilmot Rivers to determine peak flood discharges at this location for the required flood events. Refer to Section 5.3.1 for details.
- Splitting the peak design flood discharges (from just downstream of the Forth and Wilmot confluence) into the respective contributions from:
    - Outflow from Paloona Power Station.
    - Spill from Paloona Dam.
    - Contribution from Wilmot River.
- Catchment scaling to derive the contribution from the catchment below the Forth and Wilmot confluence. Refer to Section 5.3.2 for details.
- Development of a shape for the design flood hydrographs. The shape of the design flood hydrographs was based on the August 2007 flood hydrograph. The recorded hydrograph was

scaled to match the peak flows estimated by the flood frequency analysis for the 1 in 10 AEP and 1 in 100 AEP design flood events. Refer to Section 5.3.3.

- Assessment of the impact of climate change on the design flood discharges based on outcomes from the Climate Futures for Tasmania (CFT) project.

The design hydrographs for existing climate and future climate conditions for the August 2007 flood event and the 1 in 10 AEP and 1 in 100 AEP design flood events are provided in Appendix B.

5.3.1 Flood frequency analysis – Forth River below Wilmot confluence

The flood frequency analysis carried out to estimate peak flows downstream of the confluence between the Forth and Wilmot Rivers was based on the generalised extreme value (GEV) distribution which provided the best fit to the recorded data. The GEV distribution fit is shown in Figure 5.1.

The results of the flood frequency analysis are provided in the Table 5.1 and show the peak flood discharges (at Forth River below Wilmot) that have been adopted for this study under the existing climate.

Figure 5.1: GEV distribution fitted to annual maxima from downstream of the confluence between the Forth and Wilmot Rivers.

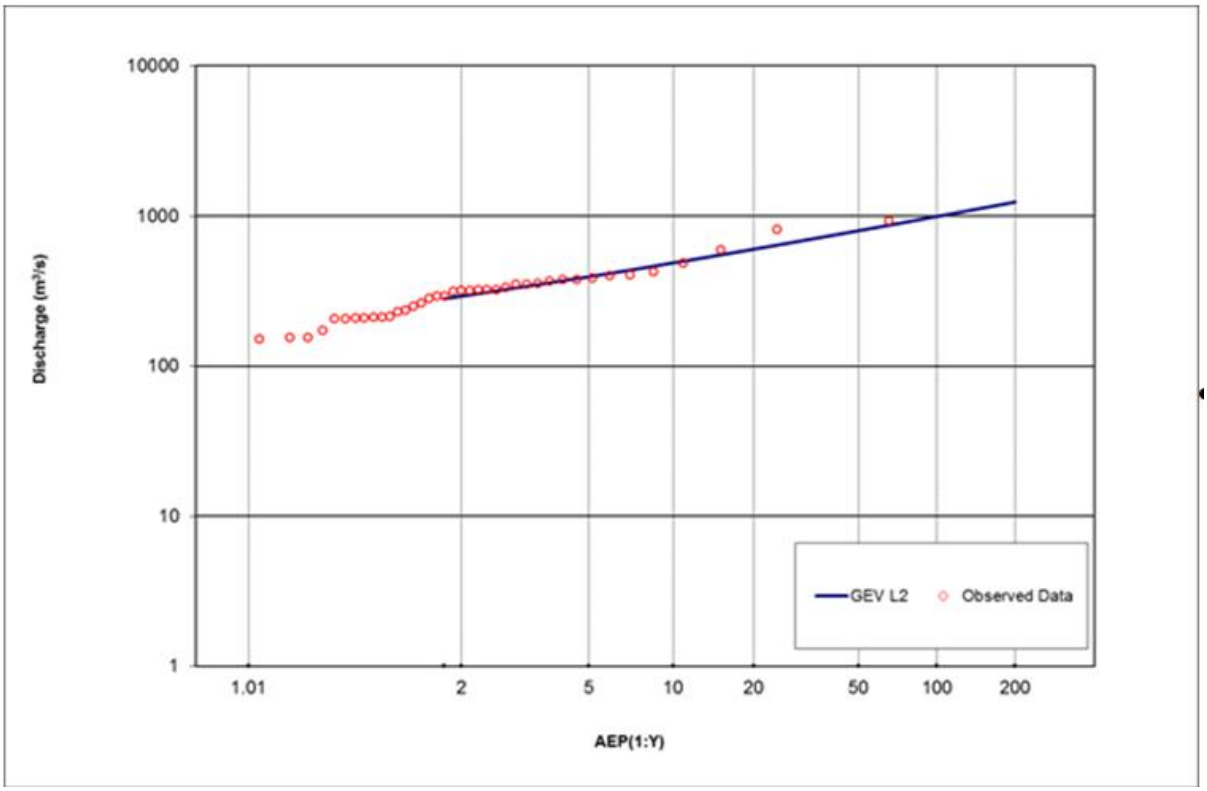


Table 5.1: Results of flood frequency analysis downstream of the confluence of the Forth and Wilmot Rivers – existing climate

AEP	Peak Discharge (m^3/s)
1.8	281
2	292
5	394
10	487
20	601
50	798
100	993
200	1239

5.3.2 Estimation of pickup between the confluence of the Wilmot and Forth Rivers and the Bass Highway

Downstream pickup between the confluence of the Forth and Wilmot Rivers and the Bass Highway Bridge needed to be estimated to account for additional flood discharge resulting from rainfall in the lower portion of the catchment for both the August 2007 calibration event and the 1 in 10 AEP and 1 in 100 AEP design rainfall events.

No gauging stations exist on the Forth River below the confluence with the Wilmot River so other gauging stations within the catchment were investigated for use in estimating downstream pickup. Two gauging stations were identified that would be suitable for estimating natural pickup at the Bass Highway bridge site. These two sites were located at Claytons Rivulet and the Forth River upstream of Lemonthyme power station.

It was found that the gauging station at Claytons Rivulet could not be used as the period of record does not extend back as far as 2007 and the Forth River gauge site above Lemonthyme power station was used in the analysis.

A factor was derived so that the recorded August 2007 flood hydrograph at the Forth River above Lemonthyme power station could be scaled to represent the contribution of flow downstream of the Forth River and Wilmot River confluence. The scaling factor was determined based on the areas and mean annual rainfalls of the two catchment using Equation 1. The areas and mean annual rainfalls for the two catchment are shown in Table 5.2.

$$Factor = \left(\frac{Area_{pickup}}{Area_{lemonthyme}}\right)^{0.8} \times \frac{Mean\ annual\ rainfall_{pickup}}{Mean\ annual\ rainfall_{lemonthyme}} \qquad \text{Equation 1}$$

A scaling factor of 0.21 was derived and was used to scale the recorded Lemonthyme flood hydrograph to represent the pickup downstream of the Forth and Wilmot confluence for the August 2007 flood event.

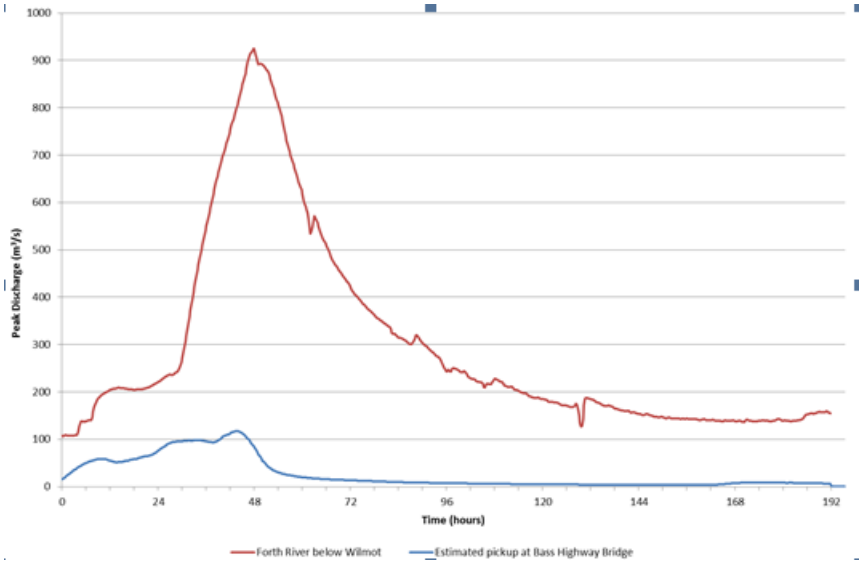
For the 1 in 10 AEP an 1 in 100 AEP flood events, the August 2007 pickup flood hydrograph was scaled again based on the ratio of the design flood discharges estimated from the flood frequency

analysis and the peak discharge of the 2007 August flood event to develop the pickup flood hydrographs for the respective design flood events.

Table 5.2: Scaling factors used for estimating downstream pickup

Area	Area (km^2)	Mean annual rainfall (mm)
Southern Forth River	108	1062
Lemonthyme	310.9	2147

Figure 5.2: Estimated hydrograph shape for pickup at the Bass Highway Bridge



5.3.3 Flood hydrograph shape

In order to identify a representative period of flow record at the sites of interest it is important to identify when changes occurred within the catchment. The Forth and Wilmot Rivers have significant hydropower infrastructure constructed across them and as such are heavily regulated. A review of completion dates of hydropower dams in the catchment are shown in Table 5.3. In this case the flow record has only been considered representative from 1974 onwards.

Table 5.3: History of construction of significant hydropower infrastructure along the Forth and Wilmot Rivers

Dam constructed	Year filled	Source
Cethana	1971	HT Dam Summary Information
Devils Gate	1970	HT Dam Summary Information
Mackenzie	1972	HT Dam Summary Information
Paloona	1973	HT Dam Summary Information

Parangana	1969	HT Dam Summary Information
Rowallan	1967	HT Dam Summary Information
Wilmot	1970	HT Dam Summary Information

The four largest flood events that have been recorded at the gauging station located downstream of the confluence between the Forth and Wilmot Rivers have been analysed, details of each of these peak events is summarised in Table 5.4. The hydrographs for these events are shown on Figure 5.3.

Table 5.4: Event selection for the confluence between the Forth and Wilmot Rivers

Year	Peak discharge (m^3/s)	Start date	Finish date	Approximate AEP
1975	594	18-May	20-May	15
1994	481	26-May	31-May	11
2007	927	09-Aug	14-Aug	65
2011	810	11-Jan	20-Jan	25

The shape of the hydrograph for the August 2007 event has been adopted for this study as it is the largest event on record. It also received significant inflows from both the Wilmot and Forth Rivers.

The hydrograph shape extracted from the 2007 flood event was split to reflect the respective contributions from the Wilmot River and discharges from Paloona Dam (spill and power station water). These inputs were cross-checked against those derived from the gauging station downstream of the confluence between the Forth and Wilmot Rivers.

Spill from Paloona Dam and flows from the Wilmot River were scaled until their sum plus the power station water provided an equivalent peak flow to that calculated using flood frequency analysis for the 1:10 and 1:100 AEP events. Power station water was capped at the flows recorded in the 2007 event flood.

In terms of emergency management it should be noted that shorter duration floods with a similar peak flood discharge have the potential to occur such as the January 2011 flood event. This event was almost entirely driven by rainfall in the lower catchment causing a very fast response time.

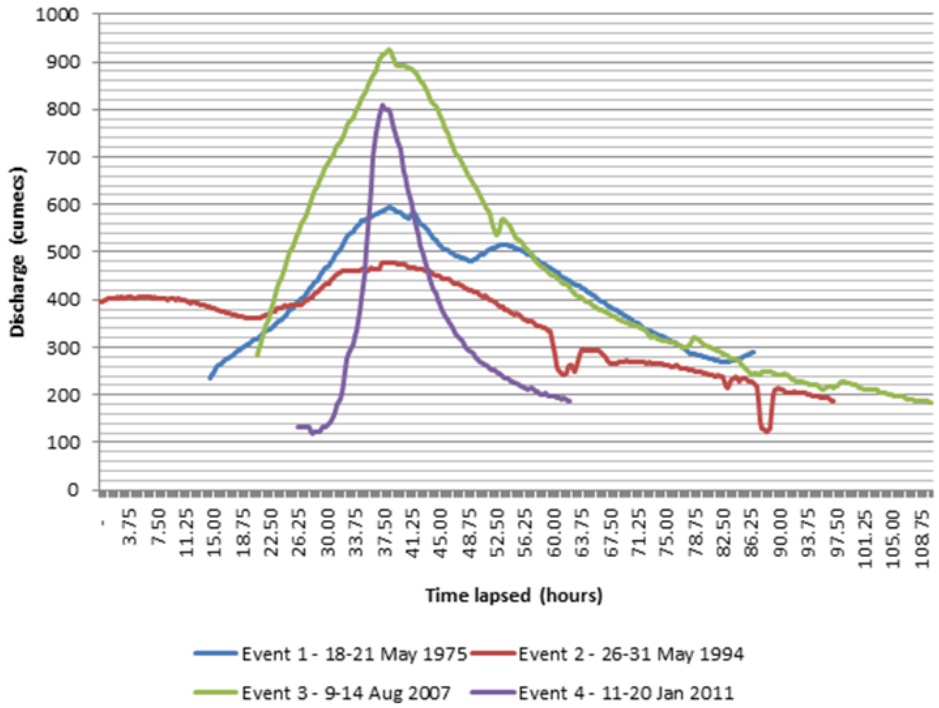
5.3.4 Climate change impact on flood discharge

The impact of climate change on peak flood discharge was estimated using a process developed by CFT (Climate Futures for Tasmania, 2011). Design rainfalls were obtained from Australian Rainfall and Runoff (Climate Futures for Tasmania, 2011). Climate Futures for Tasmania gridded rainfall has been used to derive percentage change in design rainfall depth for the 1 in 10 and 1 in 100 AEP storm event for the critical duration event. Climate change impacts on runoff were derived from linear interpolation between the rainfall intensities at the end of the 21st century (2070-2099) and the baseline period (1961-1990). A relationship was derived between percentage change in rainfall in the Mersey and Forth catchments and percentage change in runoff for the 1 in 10 AEP and the 1 in 100 AEP flood event. This relationship was used to scale the hydrographs to account for climate change impacts at the end of the 21st Century.

Climate Futures for Tasmania (2011) found that precipitation in the period 2070-2099 is anticipated to increase by 15% with an estimated increase in runoff of 65% for the 1 in 10 AEP event. For the 1 in 100 AEP event precipitation is estimated to increase by 20% with an estimated increase in runoff of 52%.

The estimate percentage increases of 65% and 52% were used respectively to factor the flood frequency peak discharges for the 1 in 10 AEP and 1 in 100 AEP design flood events.

Figure 5.3: Hydrographs assessed at the confluence between the Forth and Wilmot Rivers.



5.4 Design flood discharges

The peak discharges for the 1 in 10 and 1 in 100 AEP events adopted for this study are shown in Table 5.5. The design hydrographs for existing climate and future climate conditions for the August 2007 flood event and the 1 in 10 AEP and 1 in 100 AEP design flood events are provided in Appendix B.

Table 5.5: Results of hydrological analysis of peak discharges at key locations along the Forth and Wilmot Rivers for the existing and 2100 future climate 2100

AEP (1 in X)	Peak Discharge at Forth River above Wilmot (m^3/s)	Peak Discharge at Wilmot River above Forth (m^3/s)	Downstream Pickup at Bass Highway Bridge (m^3/s)
10 (existing climate)	354	139	62
10 (2100 future climate)	557	257	103
100 (existing climate)	679	328	127
100 (2100 future climate)	1011	521	193

6. Hydraulic study

6.1 Introduction

An integrated 1D/2D unsteady MIKE FLOOD (developed by DHI) model was developed for the hydraulic study of the lower Forth River. Details of the software can be found at http://www.dhigroup.com.au.

The hydraulic model was initially calibrated to the August 2007 flood event and was then used to assess the flood scenarios outlined in Section 4.

The model set-up, calibration and results from the design flood events are discussed below.

6.2 Model set-up

6.2.1 Model extent

A single MIKE FLOOD model was set-up to represent the study area as shown in Figure 6.1. MIKE FLOOD links a 1 dimensional model (MIKE 11), used to model the river channel, and a 2 dimensional model (MIKE 21) representing the floodplain into a single combined hydraulic model.

The original MIKE 11 model of the Forth River previously developed by Entura (Jokanovic, August 2012) extends from the Paloona Dam to Bass Strait. This original model was used at the basis for the MIKE FLOOD model developed for this study. The full extent of the original MIKE 11 model was retained however the river channel from approximately 1km upstream of the Forth Road bridge to Bass Strait was modified to suit the inclusion of the MIKE 21 model and the new survey of the river channel.

The MIKE 21 model representing the floodplain was set to cover the likely extent of flooding of the agricultural land downstream of the Forth Road bridge. The upstream extent of the MIKE 21 model was set to capture floodplain flow conditions upstream of and through the Forth Road floodway.

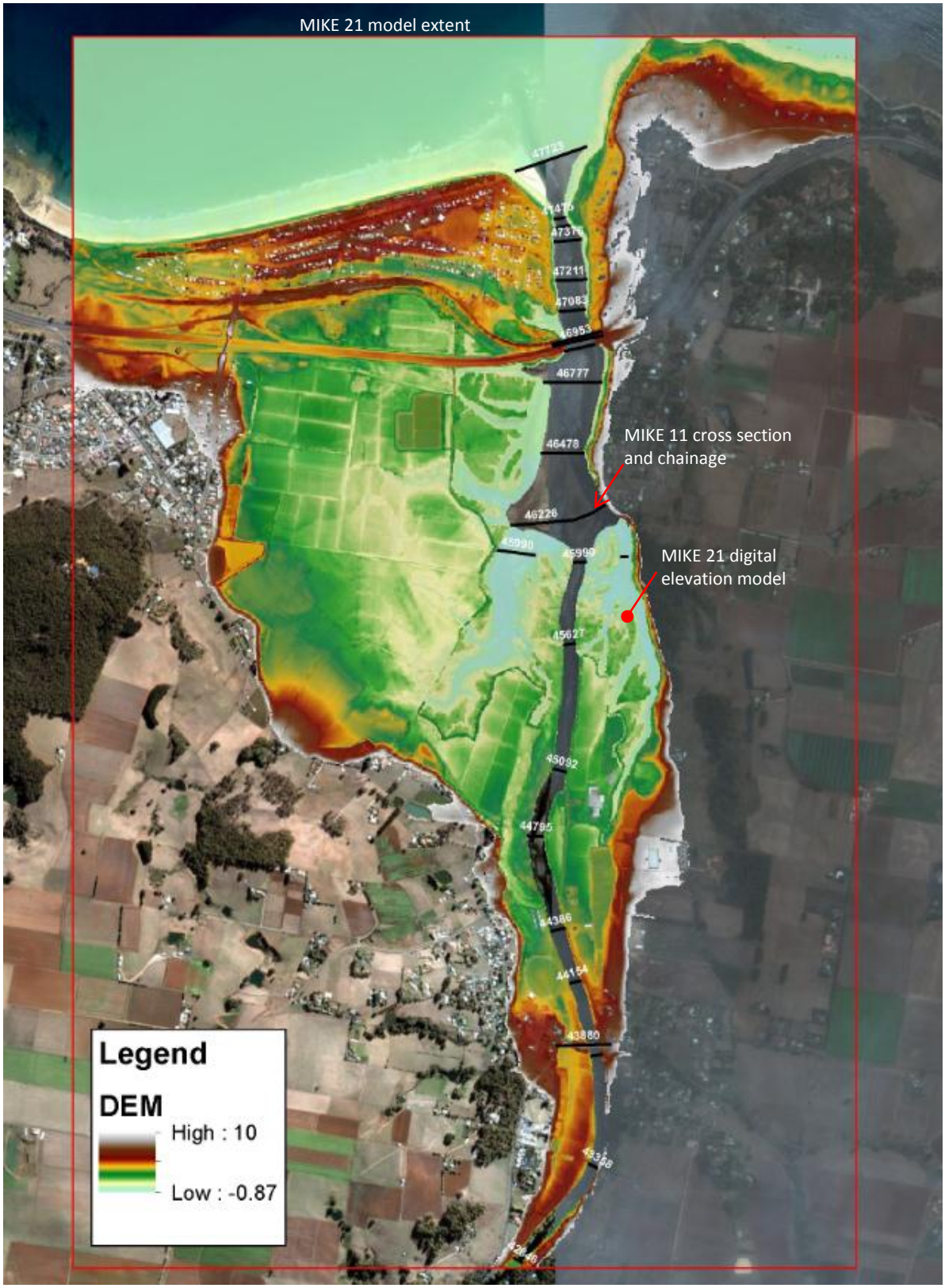
6.2.2 River cross sections and floodplain bathymetry

The river cross sections in the updated section of the MIKE 11 model were based on the bathymetric survey obtained by CCC for this study. Where required the surveyed sections were extended using the LiDAR survey. The locations of the river cross sections are provided in Figure 6.1.

Two gridded digital terrain models were developed for the floodplain areas modelled in MIKE 21 based on the available LiDAR survey from the LIST. A grid cell size of 5m was adopted as this size provided a good balance between the accuracy required for this study and the run times required for the hydraulic model. Based on a 5m grid size the hydraulic model run time was approximately 24 hours.

The first terrain model represented the floodplain pre-construction of Levee D for use in the model calibration scenario. The available LiDAR survey, which was taken after construction of Levee D had

Figure 6.1: MIKE FLOOD model extent for the lower Forth River



commenced, was adjusted (adjacent to the main river channel only) to remove the levee by interpolating between levels either of the levee.

The second terrain model represented the floodplain post-construction of Levee D. The traverse survey of Levee D (refer to Appendix A) was used to set the levels along the top of the levee.

For both terrain models the top levels of Levees A and B were based on the LiDAR survey and were captured in the 5m grid along with key barriers to floodplain flow including roads and the water treatment pond bunds.

6.2.3 Bridges and culverts

The following bridges, weir and culverts were included in the MIKE 11 hydraulic model:

- Paloona Bridge (deck level = 25.44m, soffit level = 23.60m)
- Forth River weir near pumping station
- Forth Bridge at Forth (deck level = 7.35m, soffit level = 6.12m)
- Flood Bypass Bridge (deck level = 6.15m, soffit level = 5.53m)
- Bass Highway Bridges (deck level = 5.40m, soffit level = 3.31m)
- Railway Bridge (deck level = 6.31m, soffit level = 4.02m)
- Pipe culvert across Bass Highway, DN 750mm.
- Pipe culvert across flood protection levee, DN 900mm.

6.2.4 Coupling 1 and 2 dimensional models

The MIKE 11 and MIKE 21 models were coupled together using MIKE FLOOD. Lateral links along the banks of the blocked out river cells were assigned to allow flow from the river channel to the floodplain i.e., transfer of flow between the MIKE 11 cross sections and the MIKE 21 models.

The parameters and values used for the lateral links are summarised in Table 6.1 below.

Table 6.1: Lateral Link Structure Details (Common for all links)

Parameter	Value	Comment
Method	Cell to cell	
Type	Weir 1	$Q = W \cdot C \cdot (H_{US} - H_W)^k \cdot \left[1 - \left(\frac{H_{dS} - H_W}{H_{US} - H_W}\right)^k\right]^{0.385}$ Refer to MIKE 11 reference manual for details.
Source	M21	HGH adopted for model stability.
Depth Tolerance	0.1m	For model stability.
Weir C	1.838	Default discharge coefficient.
Manning's n	0.05	Adopted value.

Standard links were established at the inlet and outlet of the structures on the floodplain. The standard links are at the upstream and downstream side of the following structures:

- Flood Bypass Bridge at Forth
- Levee culvert
- Bass Highway culvert.

6.2.5 Hydraulic roughness

Three different hydraulic roughness values, Manning's n values, were assigned to the river cross sections in the MIKE 11 model based on site observations. For the upper 12km stretch of river (between Paloona Dam and pump station) a Manning's n of 0.035 was adopted as per the original MIKE 11 model.

Downstream of the pump station for approximately 3km a Manning's n of 0.033 was adopted. For the final 2km stretch of river a Manning's n of 0.030 was applied.

The hydraulic roughness values for the floodplain were based on field observations and photographic comparison. The roughness values were set to the same 5m grid as the floodplain DEM. The adopted roughness values in the modelling are shown in Table 6.2.

Table 6.2: Adopted roughness values in the MIKE 21 model

Topography type	Roughness (Manning's "n")
River	0.03
Road	0.017
Rural area, private and public open spaces	0.036
Low density residential	0.1
Closed residential	0.167

6.2.6 Inflow locations

Flow in the Forth River is primarily from the outflow from Paloona Dam and power station and from Wilmot Dam. Inflow in the model is modelled as a point source at the location of Paloona Dam and Wilmot River confluence.

The local pickup between the confluence of Wilmot-Forth downstream of Paloona Dam and Forth River at Bass Highway was modelled as a point source just downstream of the Forth Weir near the pumping station.

6.2.7 Ocean water levels

Bass Strait was adopted as the downstream boundary of the MIKE FLOOD model.

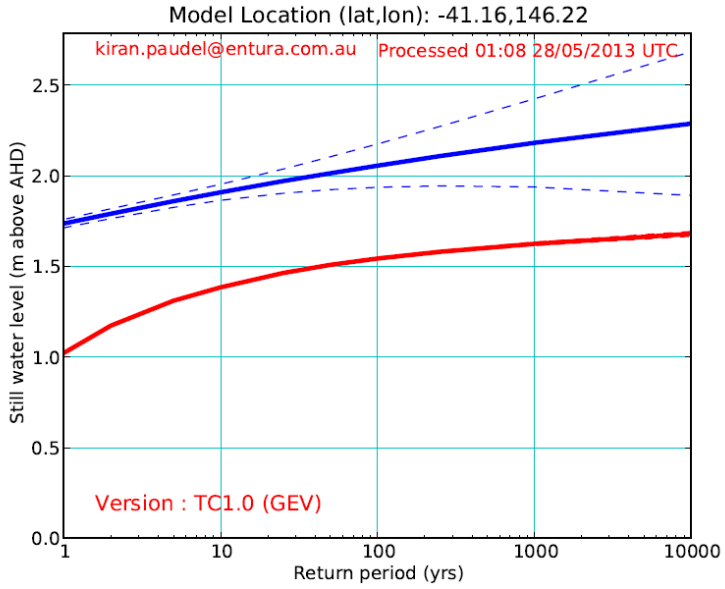
For the August 2007 calibration flood event recorded timeseries of 1 hourly tide levels at Burnie were adopted due to lack of available data at the mouth of the Forth River.

For the design flood events estimates of coincident storm surge were adopted as per the modelling scenarios outlined in Table 4.1.

The storm surge in the Bass Strait at the mouth of Forth River was calculated using a web based software called “Canute”. Developed by Antarctic Climate and Ecosystems Cooperative Research Centre, Canute provides estimates of the likelihood of flooding from the sea during this century, taking into account sea-level rise and the effects of tides and storm surges. More information on Canute can be found at http://canute2.sealevelrise.info/

At the mouth of Forth River, Figure 6.2 shows the storm level plot for extra tropical storm-surge + tide (blue trace) and tropical cyclone storm-surge + tide (red trace). For the worst case scenario, the storm surge levels for the 1 in 10 AEP and 1 in 100 AEP was considered as 1.91 AHD m and 2.06m AHD respectively as indicated by the blue trace.

Figure 6.2: Storm surge level calculation using Canute2.



The required 2100 sea level rise planning allowance for Tasmania is 0.8m (Tasmanian Climate Change Office, August 2012) and was adopted for the climate change scenarios carried out for this study.

The adopted tide levels for the study are summarised in

Table 6.3: Design flood storm surge levels

Storm surge event	Adopted level (m AHD)
1 in 10 AEP existing climate	1.91
1 in 100 AEP existing climate	2.06
1 in 10 AEP 2100 future climate	2.71
1 in 100 AEP 2100 future climate	2.86

6.2.8 Modelling assumptions

The following modelling assumptions were made during the set-up of the hydraulic model:

- The invert levels of the DN 750mm and DN 900 mm flood levee culverts were not surveyed. The invert levels were based on the available LiDAR survey at the inlet and outlet of the culverts.
- As per the original MIKE 11 hydraulic model the dual Bass Highway and rail bridges have each been combined into single hydraulic structures.
- The Leith Road floodstop barrier has been assumed to be in place for all design flood events.

6.3 Model calibration (Scenario 1 and 2)

The August 2007 flood event was used to calibrate the Forth River MIKE FLOOD model.

The flood hydrographs from Paloona Dam and from Wilmot River for the period between 9 August 2007 and 17 August 2007 were obtained from Hydro Tasmania's data record system and were applied to the top end of the MIKE 11 model near Paloona Dam.

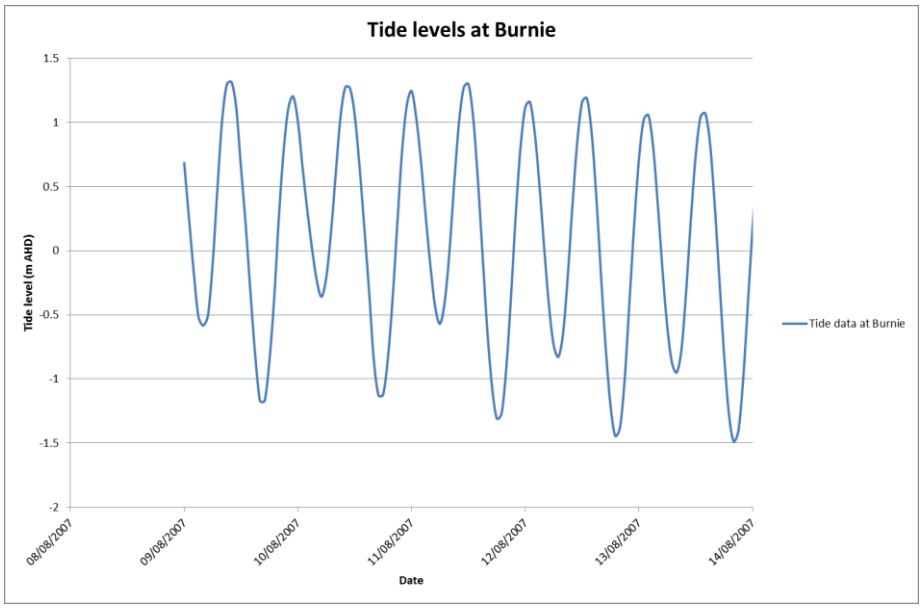
Local pickup between Paloona Dam and the bass Highway was based on catchment scaling as outlined in Section 5.3.2.

As no recorded tide information was available for the Forth River for the August 2007 flood event, the time series of recorded hourly tide levels at Burnie were applied as the downstream boundary condition for the model. The plot of tide level is provided in Figure 6.3.

Levee D, protecting Harvest Moon infrastructure, and the recent rail bridge duplication were not included in the hydraulic model.

The breach that occurred in Levee A was not considered in the calibration of the hydraulic model.

Figure 6.3: Recorded tide levels at Burnie



The hydraulic modelling results for the August 2007 flood event were compared against aerial photographs (Figure 6.4) to check flood extent and the peak surveyed flood levels provided by CCC.

The modelled and observed flood event extents are shown in Figure 6.4. It should be noted that the flood in the lower Forth River peaked at approximately 12am on the 11 August 2007 and the aerial photograph was taken later the same morning. There is a good visual match between the flood extents.

The modelled and surveyed flood levels are shown in Table 6.4, with Figure 6.5 to be used as a reference for the locations of the surveyed flood levels. The peak flood levels predicted by the model are typically within 0.2m of the surveyed flood levels which is considered to be acceptable.

The largest discrepancy between the surveyed and modelled flood levels is at the Bass Highway bridge where the modelled water level is approximately 0.5m above the surveyed level. The highest tide level from the Burnie data is approximately 1.3m AHD. Given the high discharge of the August 2007 flood it is considered unlikely that the water surface would only increase by 0.2m between the ocean and the Bass Highway. This suggests that the surveyed flood level could be too low at this location, which could be due to a local draw down in water level due to high flow velocities in the bridge not picked up by the hydraulic model. Alternatively the difference between absolute tide levels, and timing of the tidal peaks between Burnie and the Forth River could be the cause of the difference between the modelled and surveyed flood level. Due to the uncertainty of the available data, and the reasonable calibration with flood levels near Harvest Moon and the sports fields, Entura did not force the hydraulic model to produce lower water levels at the Bass Highway bridge.

Based on the above analysis the MIKE FLOOD hydraulic model calibration was considered to be acceptable for the design flood modelling.

Due to lack of available data for the 2011 flood event a verification model run was not carried out.

A review of the flood behaviour of the August 2007 flood event was carried out. Plots showing the progress of flooding are provided in Figure 6.6 and show:

- Flooding of the agricultural land on the western side of the river initiated through a low point in Levee A. Flooding of this land progressed via the low point in Levee A until flooding bypassed the southern end of Levee A and B.
- The area protected by Levee B was initially flooded by flow that had broken out of the river just downstream of the sports ovals.
- The breakout of flow on the eastern side of the river upstream of Harvest Moon matched the anecdotal descriptions and flood photographs of the flooding that occurred in this location.
- The model predicted the inundation on the northern side of the Bass Highway which occurred due to high water levels behind Levee A backing up the DN 750mm diameter pipe under the highway.

The calibrated MIKE FLOOD model was adopted for the design flood scenarios.

Figure 6.4: Comparison between observed and modelled flood extents – August 2007

Aerial photograph taken after flood peak had subsided

Modelled peak flood extent (Google Earth image)

Table 6.4: Comparison between observed and modelled flood levels – August 2007

Survey point	Surveyed flood level (m AHD)	Modelled flood level (m AHD)	Difference (m)	Comment
1	2.9	3.04	+0.14	Good match
2	2.9	2.80	-0.1	Good match
5	3.6	3.20	-0.4	Model result low
6	4.1	4.33	+0.23	Reasonable match
7	4.0	4.33	+0.33	Model result slightly high
31	3.9	4.13	+0.3	Reasonable match
32	2.9	N/A	N/A	Surveyed point just outside modelled flood extent
34	3.3	N/A	N/A	Surveyed point just outside modelled flood extent
35	3.0	3.14	+0.14	Good match
50	3.9	4.13	+0.23	Reasonable match
51	2.9	3.06	+0.16	Reasonable match
203	1.5	1.98	+0.48	Model result significantly higher than recorded
301	3.7	N/A	N/A	Surveyed point outside modelled flood extent

Figure 6.5: Locations of surveyed flood levels – calibration flood extent

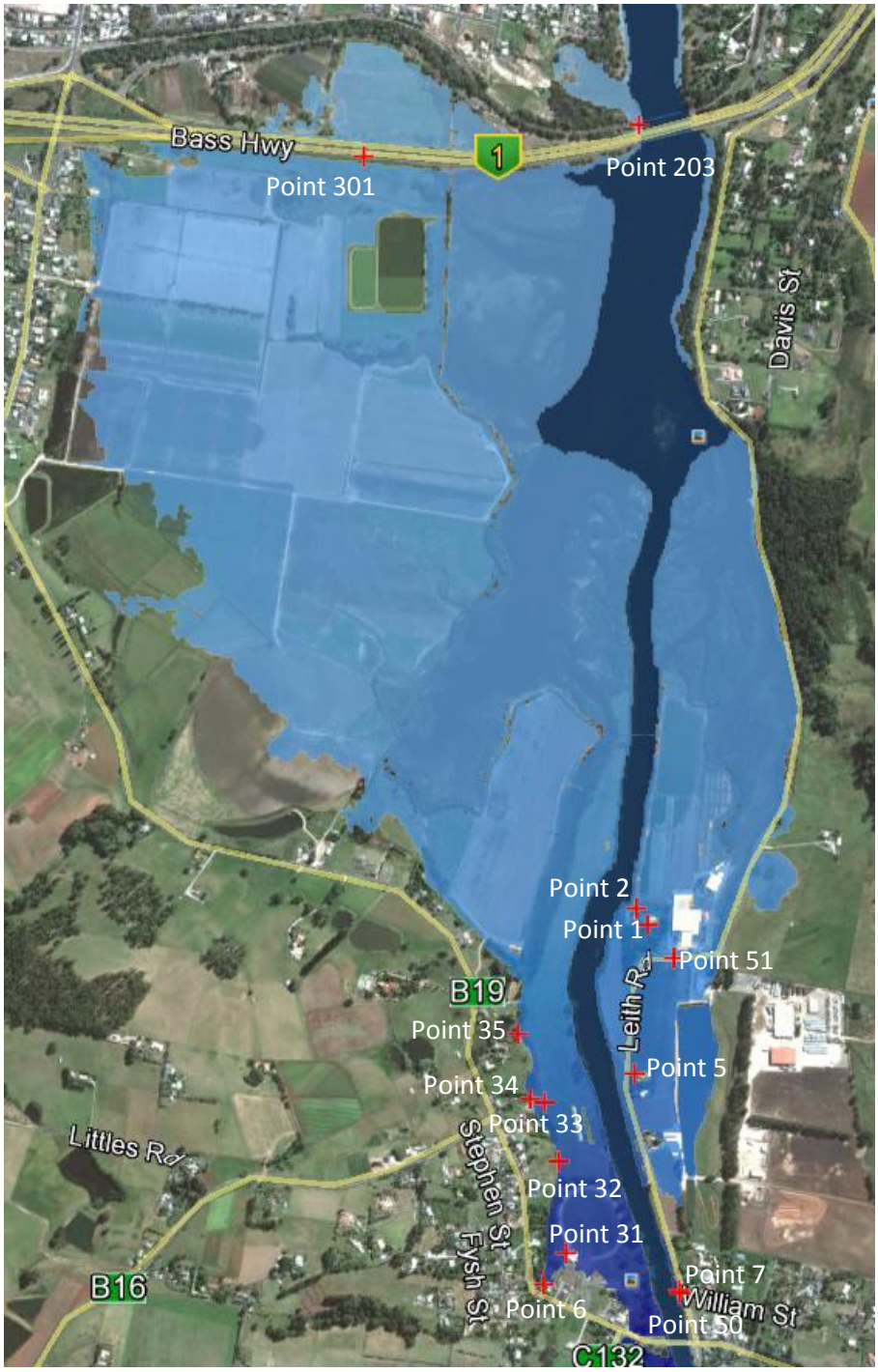
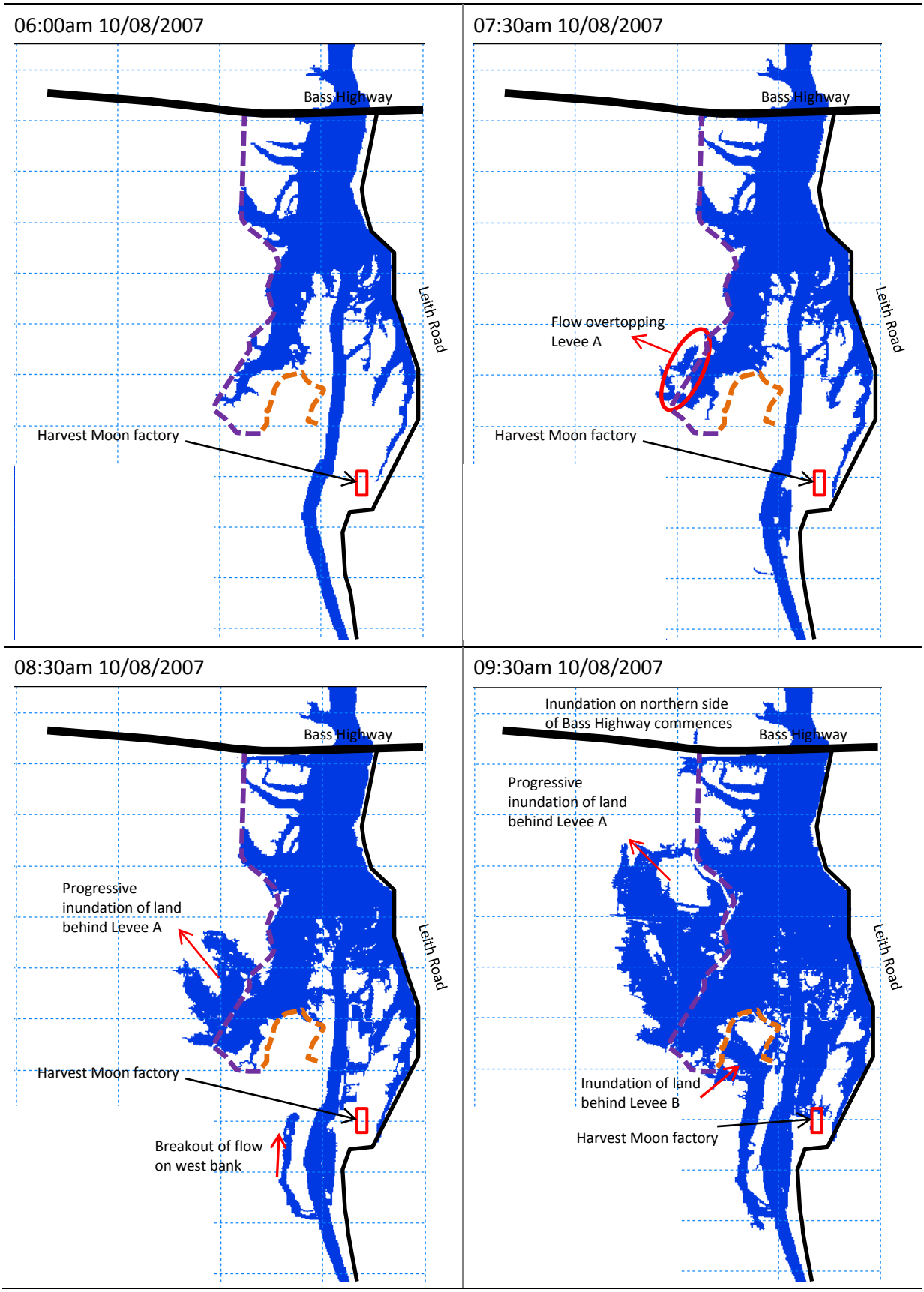


Figure 6.6: August 2007 flood event – modelled flood progress from MIKE 21



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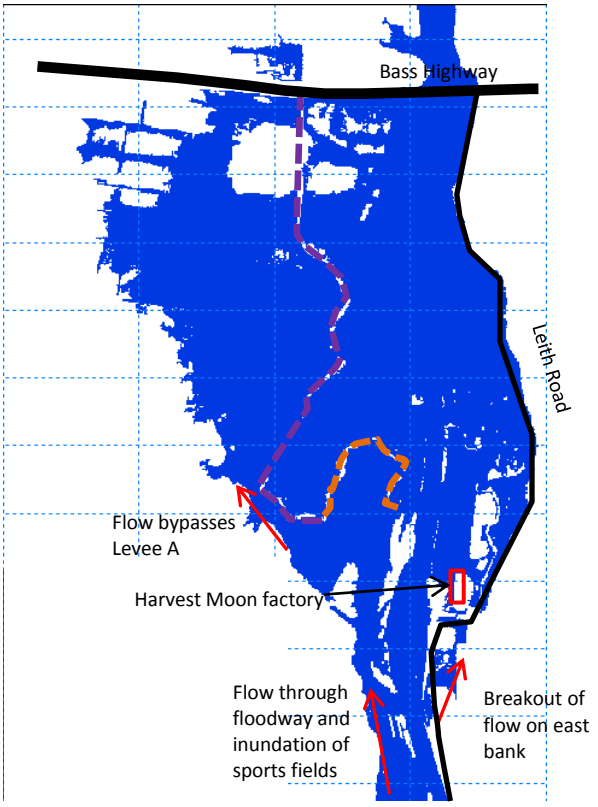

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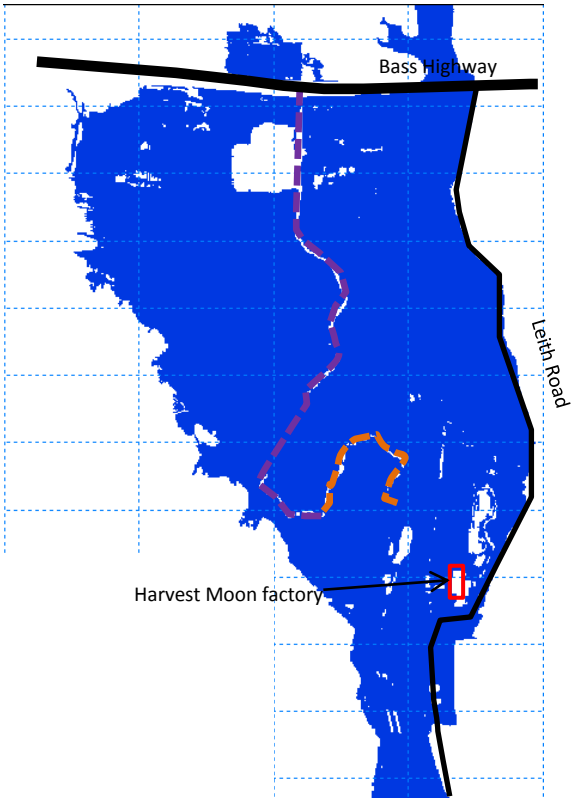

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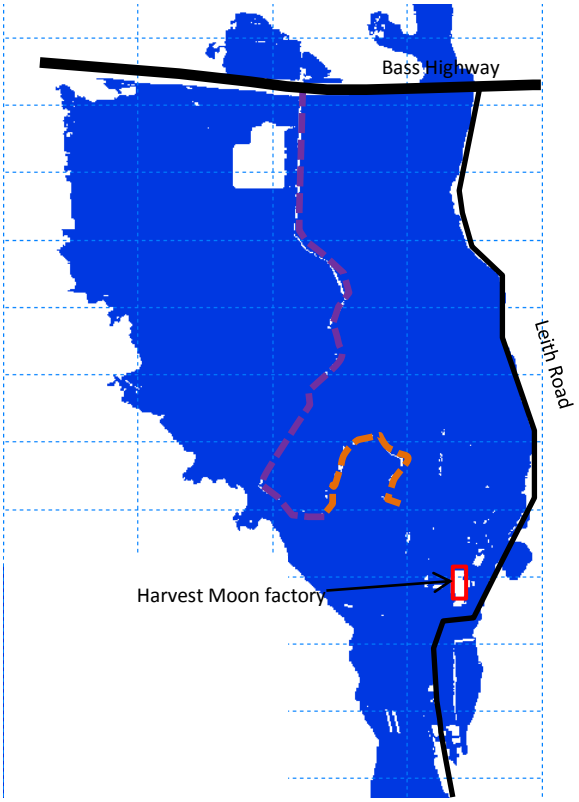

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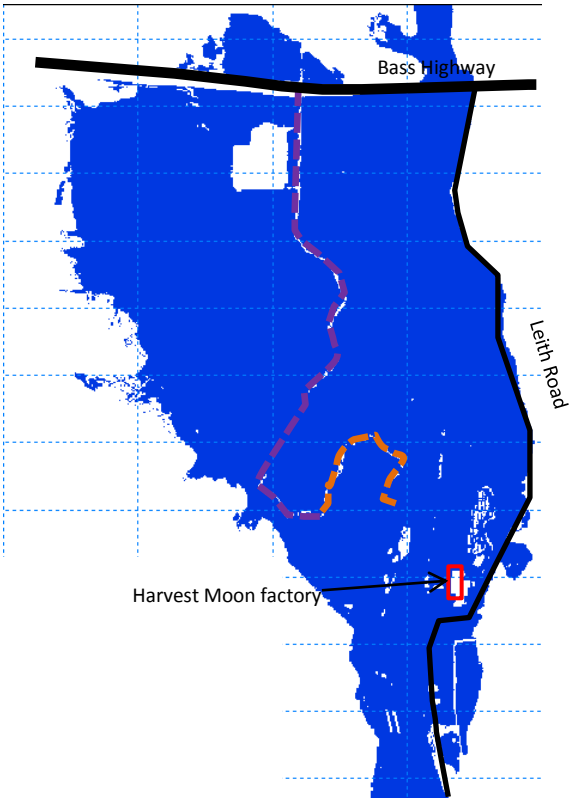


6.4 Design flood events (Scenarios 3 to 10)

6.4.1 General

A summary the design flood scenarios assessed for the study are provided in Table 6.5. The focus of the design flood events was to assess flooding from the 1 in 100 AEP rainfall and storm surge events.

Scenarios 3 to 6 were run to assess the peak flood levels of the existing catchment conditions for the existing and 2100 future climate conditions.

Scenarios 7 and 8 were run with Levee D removed from the model with the aim of comparing the results against those from Scenarios 3 and 5 to determine the likely impact of the levee on surrounding flooding.

Scenarios 9 and 10 were run to assess the impact of constructing Levee C (for pedestrian access) on flooding. A level of 2.05m AHD was assumed for the top of Levee C to match the top level of Levee A.

The estimated peak flood levels along the main river channel for the existing and 2100 future climates are provided in Table 6.6.

The difference in flood levels between Scenarios 3 and 7 (existing climate 1 in 100 AEP flood event with and without Levee D) and between Scenarios 3 and 9 (existing climate 1 in 100 AEP flood event with and without Levee C) are provided in Table 6.7.

The difference in flood levels between Scenarios 5 and 8 (2100 future climate 1 in 100 AEP flood event with and without Levee D) and between Scenarios 5 and 10 (2100 future climate 1 in 100 AEP flood event with and without Levee C) are provided in Table 6.8.

Flood extent and level difference maps for the design flood events are provided in Appendix C.

Table 6.5: Summary of modelled scenarios

Scenario No.	Description						Mapping remarks
	Climate	Levees		Rainfall AEP	Storm Surge AEP	Storm Surge Level (m AHD)	
		HM & LR*	Levee C				
3	Current	Yes	No	1:100	1:10	1.91	Flood extent plot
4	Current	Yes	No	1:10	1:100	2.06	Flood extent plot
5	2100	Yes	No	1:100	1:10	2.71	Flood extent plot
6	2100	Yes	No	1:10	1:100	2.86	Flood extent plot
7	Current	No	No	1:100	1:10	1.91	Flood extent and level difference with Scenario No. 3
8	2100	No	No	1:100	1:10	2.71	Flood extent and level difference with Scenario No. 5
9	Current	Yes	Yes	1:100	1:10	1.91	Flood extent and level difference with Scenario No. 3
10	2100	Yes	Yes	1:100	1:10	2.71	Flood extent and level difference with Scenario No. 5

* HM & LR: Harvest Moon and Leith Road Levees

Table 6.6: Peak flood levels at different locations along Forth River

Chainage	Description	Peak flood level (m AHD) for Scenario No.							
		3	4	5	6	7	8	9	10
42846	~800m d/s of pump station	7.20	5.83	8.22	6.77	7.19	8.19	7.20	8.22
43358		5.92	4.83	6.73	5.59	5.91	6.66	5.92	6.73
43834		4.90	3.51	5.77	4.44	4.84	5.50	4.90	5.76
43844	Upstream of Forth Bridge	4.98	3.57	5.84	4.53	4.92	5.59	4.98	5.84
43914		4.39	3.24	5.30	4.08	4.30	5.24	4.39	5.30
44154	Near the oval	4.19	3.13	5.07	3.95	4.07	4.79	4.19	5.08
44387		3.80	2.93	4.62	3.68	3.62	4.31	3.80	4.62
44795		3.23	2.67	3.94	3.36	3.06	3.82	3.23	3.94
45092		2.97	2.53	3.72	3.25	2.93	3.79	2.97	3.72
45627		2.71	2.34	3.69	3.18	2.69	3.68	2.71	3.68
45979		2.52	2.24	3.52	3.08	2.54	3.56	2.52	3.52
46226	Widened river section	2.61	2.27	3.61	3.13	2.60	3.62	2.60	3.61
46478		2.53	2.24	3.53	3.09	2.53	3.55	2.53	3.53
46777		2.51	2.23	3.50	3.08	2.51	3.50	2.51	3.49
46922	Upstream of Bass Hwy Bridge	2.45	2.22	3.39	3.05	2.45	3.39	2.45	3.38
46963	Upstream of Railway Bridge	2.37	2.19	3.24	3.02	2.37	3.24	2.38	3.25
47083		2.25	2.14	3.08	2.96	2.25	3.08	2.25	3.07
47211		2.20	2.12	3.03	2.94	2.20	3.03	2.20	3.02
47378		2.14	2.11	2.94	2.92	2.14	2.94	2.14	2.94
47475	Narrowed river section	1.81	2.00	2.67	2.76	1.81	2.67	1.81	2.67
47723	Mouth of the river	1.91	2.06	2.71	2.86	1.91	2.71	1.91	2.71

Note: Peak flood levels and flood level differences will vary on the floodplain.

Table 6.7: Peak flood levels along the Forth River channel and flood level differences for the 1 in 100 AEP rainfall event – existing climate

Chainage	Peak flood level 1 in 100 AEP rainfall with Levee D Scenario 3 (m AHD)	Peak flood level 1 in 100 AEP rainfall without Levee D Scenario 7 (m AHD)	Difference in peak flood level between Scenario 3 and 7 representing impact of Levee D (m)	Peak flood level 1 in 100 AEP rainfall with Levee D and C Scenario 9 (m AHD)	Difference in peak flood level between Scenario 3 and 9 representing impact of Levee C (m)
42846	7.2	7.19	0.01	7.2	0
43358	5.92	5.91	0.01	5.92	0
43834	4.9	4.84	0.06	4.9	0
43844	4.98	4.92	0.06	4.98	0
43914	4.39	4.3	0.09	4.39	0
44154	4.19	4.07	0.12	4.19	0
44387	3.8	3.62	0.18	3.8	0
44795	3.23	3.06	0.17	3.23	0
45092	2.97	2.93	0.04	2.97	0
45627	2.71	2.69	0.02	2.71	0
45979	2.52	2.54	-0.02	2.52	0
46226	2.61	2.6	0.01	2.6	-0.01
46478	2.53	2.53	0	2.53	0
46777	2.51	2.51	0	2.51	0
46922	2.45	2.45	0	2.45	0
46963	2.37	2.37	0	2.38	0.01
47083	2.25	2.25	0	2.25	0
47211	2.2	2.2	0	2.2	0
47378	2.14	2.14	0	2.14	0
47475	1.81	1.81	0	1.81	0
47723	1.91	1.91	0	1.91	0

Note: Peak flood levels and flood level differences will vary on the floodplain.

Table 6.8: Peak flood levels along the Forth River channel and flood level differences for the 1 in 100 AEP rainfall event – 2100 future climate

Chainage	Peak flood level 1 in 100 AEP rainfall with Levee D Scenario 5 (m AHD)	Peak flood level 1 in 100 AEP rainfall without Levee D Scenario 8 (m AHD)	Difference in peak flood level between Scenario 5 and 8 representing impact of Levee D (m)	Peak flood level 1 in 100 AEP rainfall with Levee D and C Scenario 10 (m AHD)	Difference in peak flood level between Scenario 5 and 10 representing impact of Levee C (m)
42846	8.22	8.19	0.03	8.22	0
43358	6.73	6.66	0.07	6.73	0
43834	5.77	5.5	0.27	5.76	-0.01
43844	5.84	5.59	0.25	5.84	0
43914	5.3	5.24	0.06	5.3	0
44154	5.07	4.79	0.28	5.08	0.01
44387	4.62	4.31	0.31	4.62	0
44795	3.94	3.82	0.12	3.94	0
45092	3.72	3.79	-0.07	3.72	0
45627	3.69	3.68	0.01	3.68	-0.01
45979	3.52	3.56	-0.04	3.52	0
46226	3.61	3.62	-0.01	3.61	0
46478	3.53	3.55	-0.02	3.53	0
46777	3.5	3.5	0	3.49	-0.01
46922	3.39	3.39	0	3.38	-0.01
46963	3.24	3.24	0	3.25	0.01
47083	3.08	3.08	0	3.07	-0.01
47211	3.03	3.03	0	3.02	-0.01
47378	2.94	2.94	0	2.94	0
47475	2.67	2.67	0	2.67	0
47723	2.71	2.71	0	2.71	0

Note: Peak flood levels and flood level differences will vary on the floodplain.

Table 6.9: Predicted change in flood levels along the Forth River channel due to climate change – Levee D constructed

Chainage	Difference in peak flood level between Scenario 3 and 5 1 in 100 AEP rainfall event (m)	Difference in peak flood level between Scenario 4 and 6 1 in 100 AEP storm surge event (m)
42846	1.02	0.94
43358	0.81	0.76
43834	0.87	0.93
43844	0.86	0.96
43914	0.91	0.84
44154	0.88	0.82
44387	0.82	0.75
44795	0.71	0.69
45092	0.75	0.72
45627	0.98	0.84
45979	1.00	0.84
46226	1.00	0.86
46478	1.00	0.85
46777	0.99	0.85
46922	0.94	0.83
46963	0.87	0.83
47083	0.83	0.82
47211	0.83	0.82
47378	0.80	0.81
47475	0.86	0.76
47723	0.80	0.80

Note: Peak flood levels and flood level differences will vary on the floodplain.

6.4.2 Assessment of results

A summary of the key outcomes from the hydraulic modelling are provided below. The summary has been structured with comments on the following topics:

- Summary of flooding for existing levee conditions.
- Assessment of existing as built levees.
- Assessment of the potential impact associated with the construction of Levee D.
- Assessment of the impact of Levee C which is currently proposed to be constructed to provide a pedestrian link between Forth and Turners Beach.
- Flood immunity of the waste water treatment ponds.

6.4.2.1 Summary of flooding for existing levee conditions

The 1 in 100 AEP rainfall flood event resulted in higher flood levels upstream of the Bass Highway compared with a 1 in 100 AEP storm surge event. As a result the 1 in 100 AEP rainfall event was used to assess the impact of Levee D and Levee C.

For the existing climate 1 in 100 AEP rainfall and storm surge events, with the levees as currently in place, significant flooding is predicted to occur on the western floodplain with the impact of climate change increasing flood levels by approximately 0.7m to 1.0m as shown in Table 6.9.

For the existing and 2100 climate 1 in 100 AEP rainfall events and the 2100 climate 1 in 100 AEP storm surge event, with the levees as currently in place, flooding of the Harvest Moon infrastructure is predicted to occur. For the existing climate 1 in 100 AEP storm surge event the Harvest Moon infrastructure is predicted to be protected by Levee D.

In the vicinity of Turners Beach no flooding of properties is predicted to occur for the existing climate condition 1 in 100 AEP rainfall of storm surge events. For the 2100 climate approximately 35 properties along Boyce Street, Susan Street, Arcadia Avenue and Whitegum Way are predicted to be affected primarily due to the 0.8m rise in mean sea level. Properties at the end of Lethborg Avenue and Heather Court may also be affected. Provision of a small levee and once way flow device may prevent flooding of these properties in the climate change scenario.

Other areas where properties may be affected by the modelled flood events, with the levees as currently in place, include:

- Near the intersection of Turners Beach Road and the Bass Highway. For the existing climate condition the dwellings at this location are not predicted to be affected however for the 2100 climate condition 3 to 4 dwellings could potentially be inundated.
- At the bend in Forth Road near Mell Street buildings associated with the sports fields are predicted to be affected for flooding from the 1 in 100 AEP rainfall events (current and 2100 climates) and the 1 in 100 AEP 2100 climate storm surge event. Flooding of a number of residential dwellings in this area is predicted to occur for the 1 in 100 AEP 2100 climate rainfall event.
- Just upstream of the Leith Road floodstop barrier a number of properties are predicted to be affected by flooding for the 1 in 100 AEP 2100 climate rainfall event. No flooding of properties in this area is predicted for the current climate 1 in 100 AEP rainfall event.

Flooding of the low area bounded by Blackburn Drive and the Bass Highway is predicted for all modelled flood events.

Overtopping of the waste water ponds is not predicted to occur for the current climate conditions 1 in 100 AEP rainfall or storm surge events.

Overtopping of the waste water ponds is predicted to occur for the 2100 climate conditions 1 in 100 AEP rainfall or storm surge events.

Overtopping of the Bass Highway or the rail bridges is not predicted for the modelled flood events.

Overtopping of Forth Road and Wilmot Road is predicted to occur for the 2100 climate condition 1 in 100 AEP rainfall event.

6.4.2.2 Assessment of existing levees

Levee A

The low point in Levee A, as per the August 2007 calibration flood event, initiates flooding of the agricultural land on the western side of Levee A for the design flood events. Refer to Figure 6.7. It should be noted the low point in the levee would be breached by the 1 in 10 AEP existing climate storm surge level without any flow in the Forth River from a rainfall event.

Levee D

It is considered that Levee D could be optimally designed to minimise the impact on surrounding flooding for the 1 in 100 AEP existing and 2100 climate rainfall events.

For all the modelled flood events in this study where Levee D is in place, flooding of the Harvest Moon infrastructure has been initiated by overtopping of the northern section of the levee as shown in Figure 6.7. It is estimated that northern section of Levee D has a flood immunity approximately equal to a 1 in 50 AEP existing climate flood event.

A plot along the Forth River channel is shown in Figure 6.8 and shows the river invert, the peak flood levels predicted for the August 2007 event and Scenario 3 to 6 and the top levels of Levee D adjacent to the river. It can be seen that the section of Levee D adjacent to the river will only just be overtopped for the 1 in 100 AEP 2100 climate rainfall event. This section of levee has a much higher flood immunity than the northern section.

When the impact of Levee D on flooding is assessed (ie comparing the flood predicted flood levels with and without Levee D), it is observed that the levee will slightly increase surrounding flood levels in the Forth River and on the western floodplain from upstream of the Forth Road bridge to approximately the northern extent of the levee. The levee does however reduce the severity of flooding on the eastern floodplain as intended.

For the 1 in 100 AEP current climate rainfall event:

- The maximum predicted increase in flood levels in the river channel is approximately 0.18m. Refer to Table 6.7.
- Based on the flood difference map provided in Appendix C, the increase in flood levels on the western floodplain may not impact on dwellings located on the eastern side of Forth Road, however infrastructure located on the properties may experience a worsening of flooding.

For the 1 in 100 AEP 2100 future climate rainfall event:

- The maximum predicted increase in flood levels in the river channel is approximately 0.31m. Refer to Table 6.7.
- Based on the flood extent and flood level difference maps provided in Appendix C the increase in flood levels due to Levee D is predicted to result in overtopping of Wilmot Road and Forth Road with a small number of dwellings and buildings in the flow path being affected.

  The increase in flood levels may also slightly worsen flooding for a small number of properties located on the eastern side of the river just upstream of the floodstop barrier.

It is recommended that CCC review the design of the existing Levee D. The review should consider the flood immunity required for the Harvest Moon infrastructure and the varying flood immunity of

the various sections of Levee D. It may be possible to redesign Levee D so that it can provide the appropriate level of flood protection for the Harvest Moon infrastructure while minimising the impact of flooding for existing and future climate conditions. The re-design of Levee D could potentially involve a lowering of the levee where it runs adjacent to the river channel and a raising of the northern section.

The lowering of Levee D to the appropriate flood protection level may also allay community concerns in respect to the perceived flood height in the river relative to the Level of Levee D.

Leith Road floodstop barrier

Based on the modelling carried out for this study the Leith Road floodstop barrier is not expected to provide any benefit for the 1 in 100 AEP rainfall event (in terms of prevent flooding of the eastern floodplain) until at least 2100.

6.4.2.3 Impact of constructing Levee C

Construction of Levee C at a level of 2.05m AHD is not predicted to significantly impact flood levels for the 1 in 100 AEP existing or 2100 future climate condition rainfall events. This is based on the current levels of Levee A and B. Should Levees A and B be raised from their current levels then implementing Levee C could have a more significant impact on flood levels.

6.4.2.4 Flood immunity of waste water ponds

The lowest level of the waste water pond bunds is approximately 2.82m AHD. It should be noted that this level is not from design drawings or survey and has been extracted from the LiDAR survey.

The peak flood levels for Scenarios 3 to 6 and the freeboard to the lowest point along the pond bunds is shown in Table 6.10.

It is recommended that the relevant authority review whether the freeboard for the existing climate condition is acceptable.

For the 2100 future climate it is predicted that the ponds will be inundated. If the climate change predictions do eventuate the relevant authority will need to be prepared to raise the pond bunds to provide a 1 in 100 AEP flood immunity for future climate conditions.

It should be noted that the 2040 climate condition has not been assessed for this study. There is potential that work to the pond bunds may be required to provide a 1 in 100 AEP flood immunity for this future climate.

Table 6.10: Assessment of waste water ponds

Scenario	Description	Peak flood level (m AHD)	Freeboard to lowest point on bund (m)
3	1 in 100 AEP rainfall and 1 in 10 AEP storm surge – existing climate	2.63	+0.21
4	1 in 10 AEP rainfall and 1 in 100 AEP storm surge – existing climate	2.28	+0.55
5	1 in 100 AEP rainfall and 1 in 10 AEP storm surge – 2100 climate	3.6	-0.83
6	1 in 10 AEP rainfall and 1 in 100 AEP storm surge – 2100 climate	3.14	-0.31

Figure 6.7: Assessment of levees – reference figure

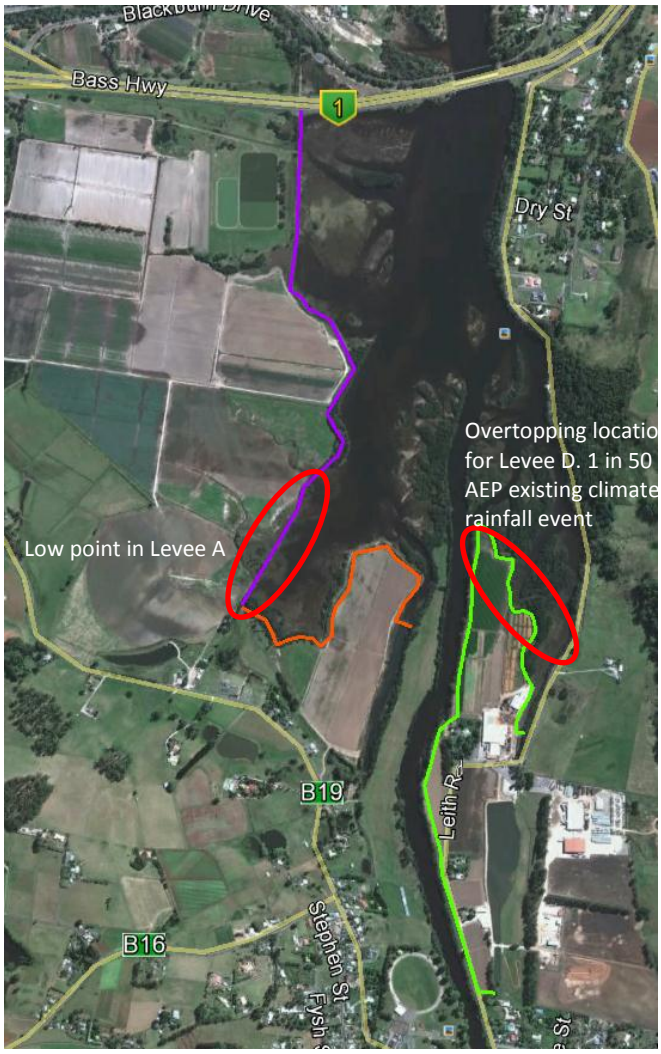
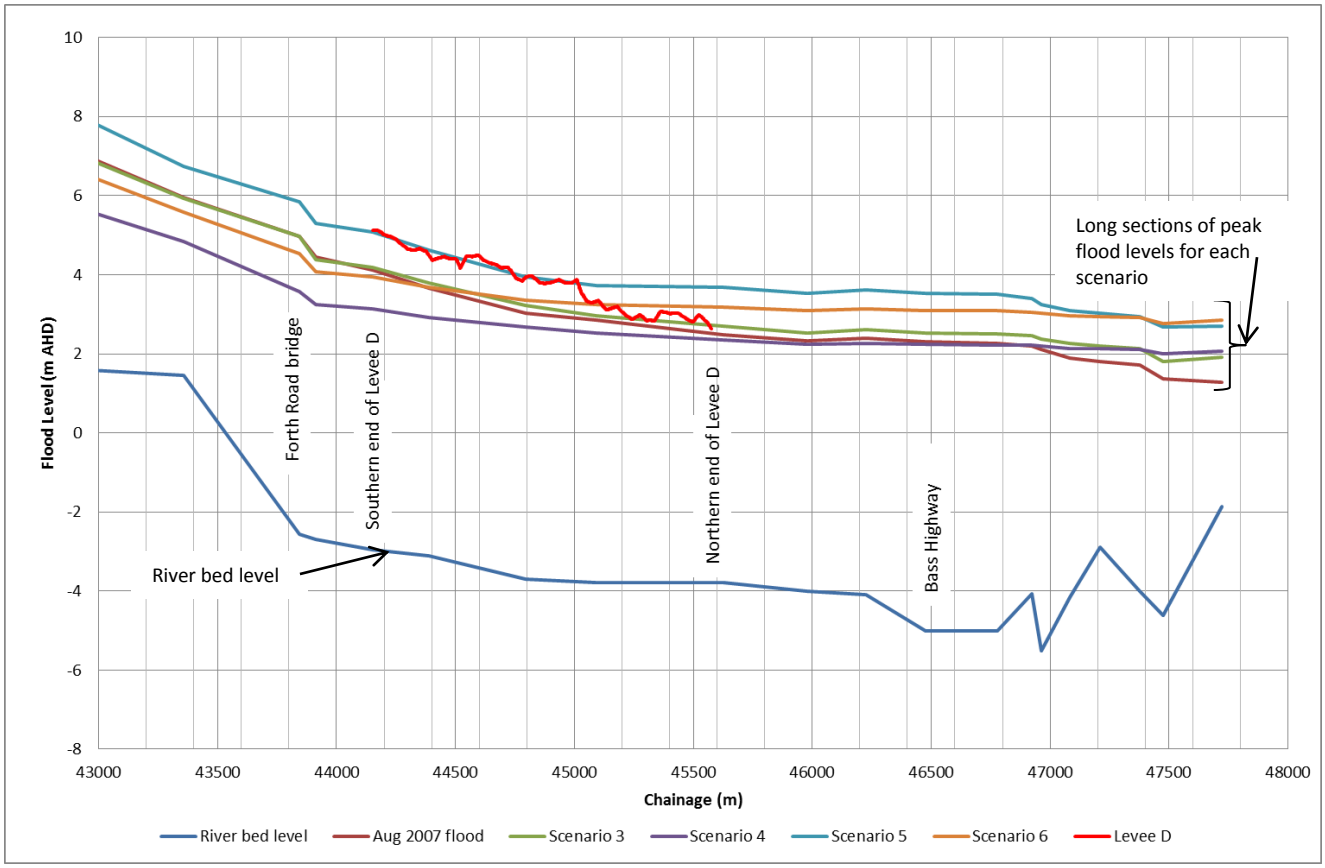


Figure 6.8: Forth River long section



6.4.2.5 Flooding between Blackburn Drive and Bass Highway

Flooding of the low area between Blackburn Drive and the Bass Highway due to water backing up the DN750mm diameter pipe under the Bass Highway could potentially be eliminated through the provision of a one way flow device (such as a tide flap) on the pipe. It is recommended that CCC give consideration to providing such a device on the pipe.

6.5 Mapping

Flood inundation and flood difference maps were prepared for the study and are provided in Appendix C.

It should be noted that the flood difference maps for the 1 in 100 AEP 2100 climate rainfall event assessing the impact of Levee C and D highlight some numerical instabilities in the modelling results near Levee D for these scenarios. However these instabilities do not affect the conclusions and outcomes and recommendations for the study.

7. Conclusions and recommendations

7.1 Conclusions

Flood hydrographs were developed for the August 2007 flood event and for the 1 in 10 AEP and 1 in 100 AEP design rainfall events for the existing climate and the 2100 future climate taking into consideration of increased rainfall due to climate change.

Climate Futures for Tasmania (2011) found that precipitation in the period 2070-2099 is anticipated to increase by 15% with an estimated increase in runoff of 65% for the 1 in 10 AEP event. For the 1 in 100 AEP event precipitation is estimated to increase by 20% with an estimated increase in runoff of 52%. This data was used to develop the 2100 climate design flood hydrographs.

The shape of the August 2007 flood hydrograph was used as the basis for all design flood hydrographs used in this study.

The peak discharges of the design flood hydrographs were based on flood frequency analysis of records on the Forth River below Paloona Dam and from catchment scaling for the catchments contributing to the lower Forth River.

The August 2007 and design flood hydrographs were used as inputs to the hydraulic model developed for the study.

A MIKE FLOOD hydraulic model of the lower Forth River was developed by Entura and was calibrated to the August 2007 flood event.

The MIKE FLOOD model was based on a MIKE 11 model previously developed by Entura, LiDAR survey available for the LIST, river cross section survey of the lower Forth River commissioned by CCC for this study, levee culvert details provided by CCC, as built survey of Levee D provided by CCC and design drawings of bridges and floodways sourced from DIER.

The calibrated MIKE FLOOD model was used to model the 1 in 100 AEP rainfall event with 1 in 10 AEP storm surge and the 1 in 100 AEP and storm surge with 1 in 10 AEP rainfall events for the existing and 2100 climate conditions and to assess the impact of the existing Levee D and the proposed Levee C on flooding.

Flood extent maps were prepared for all modelled flood events.

For the existing climate 1 in 100 AEP rainfall and storm surge events, with the levees as currently in place, significant flooding is predicted to occur on the western floodplain with the impact of climate change increasing flood levels by approximately 0.7m to 1.0m.

For the existing and 2100 climate 1 in 100 AEP rainfall events and the 2100 climate 1 in 100 AEP storm surge event, with the levees as currently in place, flooding of the Harvest Moon infrastructure is predicted to occur. For the existing climate 1 in 100 AEP storm surge event the Harvest Moon infrastructure is predicted to be protected by Levee D.

In the vicinity of Turners Beach no flooding of properties is predicted to occur for the existing climate condition 1 in 100 AEP rainfall or storm surge events. For the 2100 climate approximately 35 properties along Boyes Street, Susan Street, Arcadia Avenue and Whitegum Way are predicted to be affected primarily due to the 0.8m rise in mean sea level. Properties at the end of Lethborg Avenue and Heather Court may also be affected. Provision of a small levee and one way flow device may prevent flooding of these properties in the climate change scenario.

Other areas where properties may be affected by the modelled flood events, with the levees as currently in place, include:

- Near the intersection of Turners Beach Road and the Bass Highway. For the existing climate condition the dwellings at this location are not predicted to be affected however the for the 2100 climate condition 3 to 4 dwellings could potentially be inundated.
- At the bend in Forth Road near Mell Street buildings associated with the sports fields are predicted to be affected for flooding from the 1 in 100 AEP rainfall events (current and 2100 climates) and the 1 in 100 AEP 2100 climate storm surge event. Flooding of a number of residential dwellings in this area is predicted to occur for the 1 in 100 AEP 2100 climate rainfall event.
- Just upstream of the Leith Road floodstop barrier a number of properties are predicted to be affected by flooding for the 1 in 100 AEP 2100 climate rainfall event. No flooding of properties in this area is predicted for the current climate 1 in 100 AEP rainfall event.

Flooding of the low area bounded by Blackburn Drive and the Bass Highway is predicted for all modelled flood events.

Overtopping of the waste water ponds was not predicted to occur for the existing climate flood events however overtopping was predicted for the 2100 climate condition.

Flooding of the western floodplain was found to be initiated by a low section in Levee A. This low section of Levee A would be overtopped by the 1 in 10 AEP 2100 climate surge level.

Levee D was found to reduce the severity of the eastern flooding in the vicinity of the Harvest Moon infrastructure. However the levee also results in an increase in flood levels in the main channel and the western floodplain. The maximum increase in flood levels in the river channel as a result of Levee D was estimated to be 0.18m for the 1 in 100 AEP current climate rainfall event.

It was found that Levee D has varying levels of flood immunity. The southern section adjacent to the river channel has an immunity approximately equivalent to the 1 in 100 AEP 2100 climate rainfall event while the northern section will be overtopped by a 1 in 50 AEP existing climate rainfall event.

Based on the modelling carried out for this study the Leith Road floodstop barrier is not expected to provide any benefit for the 1 in 100 AEP rainfall event (in terms of prevent flooding of the eastern floodplain) until at least 2100.

It was found that Levee C, with a top level of 2.05m AHD, could be built with minimum impact on surrounding flooding.

Overtopping of the waste water ponds is not predicted to occur for the current climate conditions. The estimated freeboard for the 1 in 100 AEP rainfall event is approximately 0.21m.

Significant overtopping of the waste water ponds is predicted to occur for the 2100 climate conditions 1 in 100 AEP rainfall or storm surge events.

7.2 Recommendations

It is recommended that a one way flow device be provided to the DN750mm diameter culvert under the Bass Highway to prevent flood of the low lying land between Blackburn Drive and the Bass Highway.

It is recommended that a review of the Levee D design be carried out to determine whether it can be optimised to provide a consistent level of flood protection to Harvest Moon infrastructure while minimising the impacts on surrounding flooding.

It is recommended that the relevant authority review the level of freeboard required for the wastewater treatment ponds for the 1 in 100 AEP flood event to determine whether any work is required to provide the facility with the adequate level of flood protection.

It is recommended that the relevant authority put in place plans to, in the future, review the waste water ponds and level of flood protection required, once the potential consequences of climate change on rainfall and sea level rise are better understood.

Once the potential consequences of climate change on rainfall and sea level rise are better understood, it is recommended that CCC review flood mitigation measures that would be required to prevent flooding of properties in Turners Beach.

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8. References

Central Coast Council. (11 March 2008). *Lower Forth Flood Response and Recovery Plan.* Ulverstone: Central Coast Council.

Climate Futures for Tasmania. (2011). *Flood Inundation Mapping.* Hobart: Antarctic Climate and Ecosystems CRC.

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Tasmanian Climate Change Office. (August 2012). *Derivation of the Tasmania Sea Level Rise Planning Allowances Technical Paper.* Hobart.

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Appendices

A – Survey

B – Flood hydrographs

C – Flood maps

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Survey

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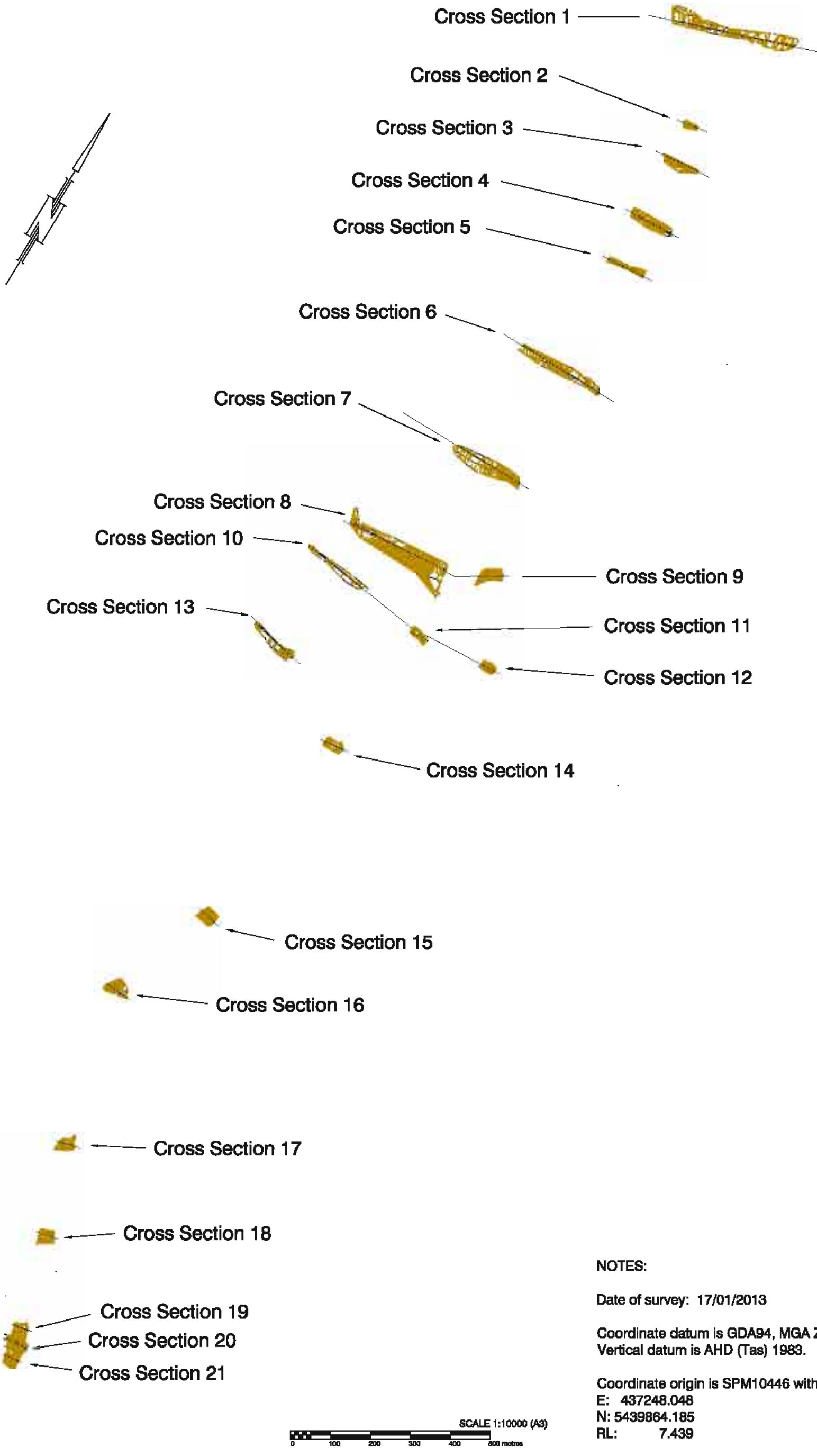

NOTES:

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Vertical datum is AHD (Tas) 1983.

Coordinate origin is SPM10446 with reputed coordinates:
E: 437248.048
N: 5439864.185
RL: 7.439

SURVEYOR	GEODIVIL
J.M.	15544
DRAWN	CHECKED
N.A.W.	A.J.H.
DATE	
04MAR13	

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FORTH RIVER
FORTH
BATHYMETRIC DATA SURVEY

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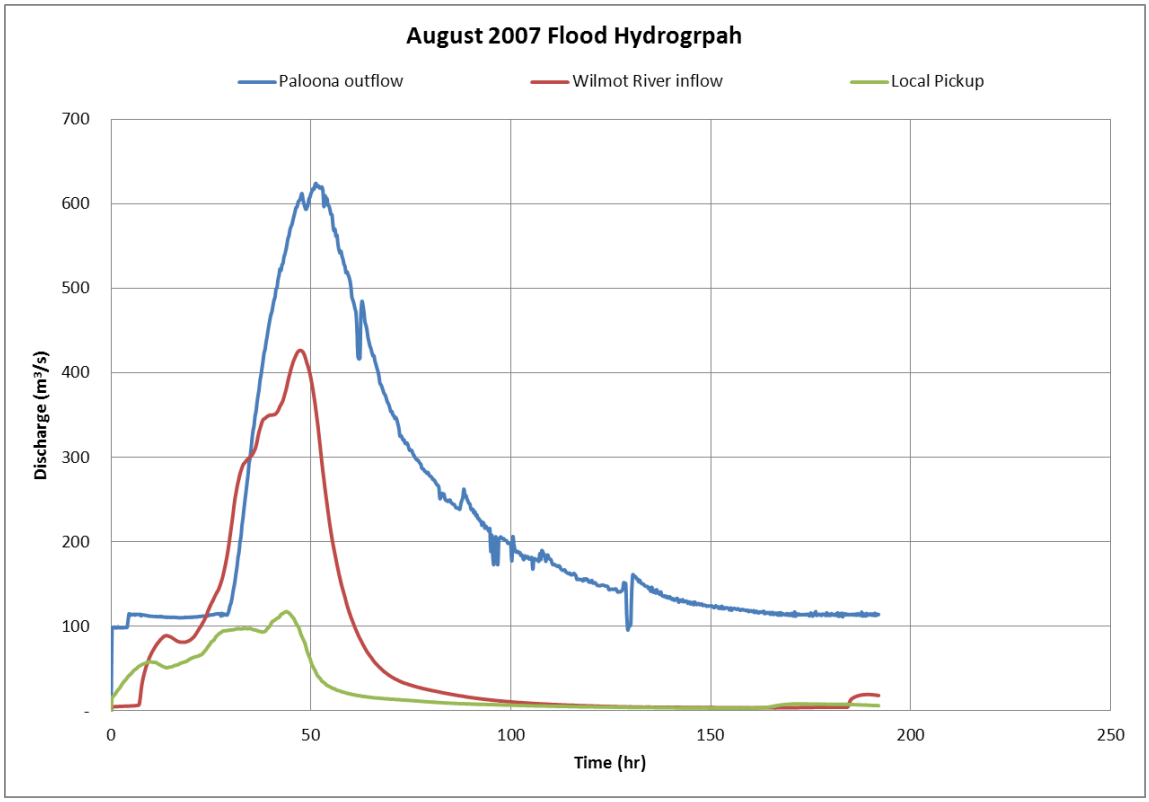
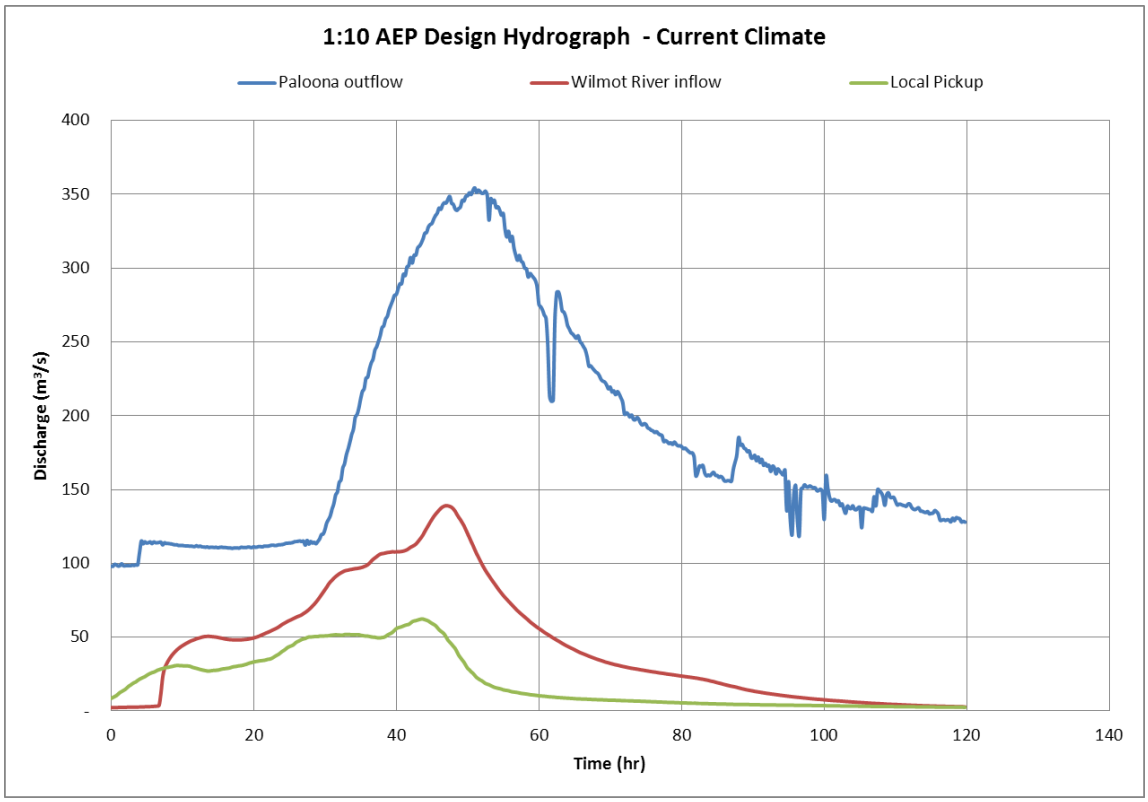
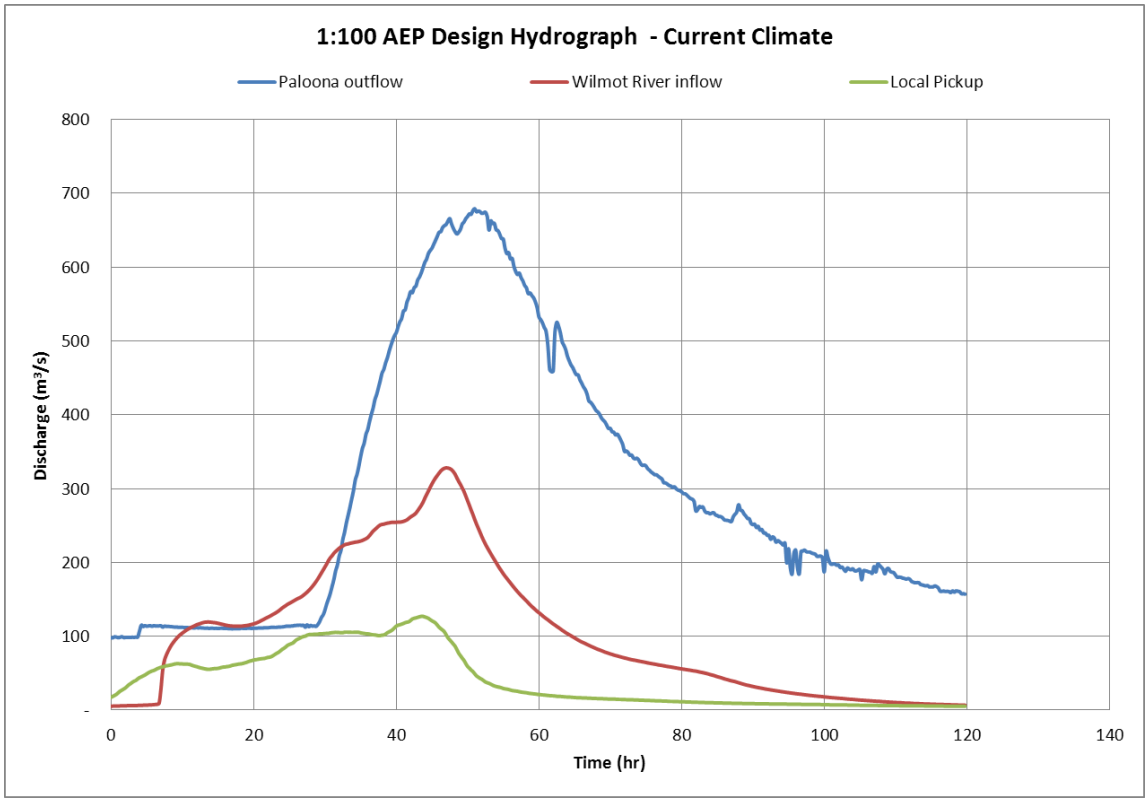
Flood hydrographs






1:100 AEP Design Hydrograph - Current Climate
Paloona outflow
Wilmot River inflow
Local Pickup
Discharge (m³/s)
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600
500
400
300
200
100
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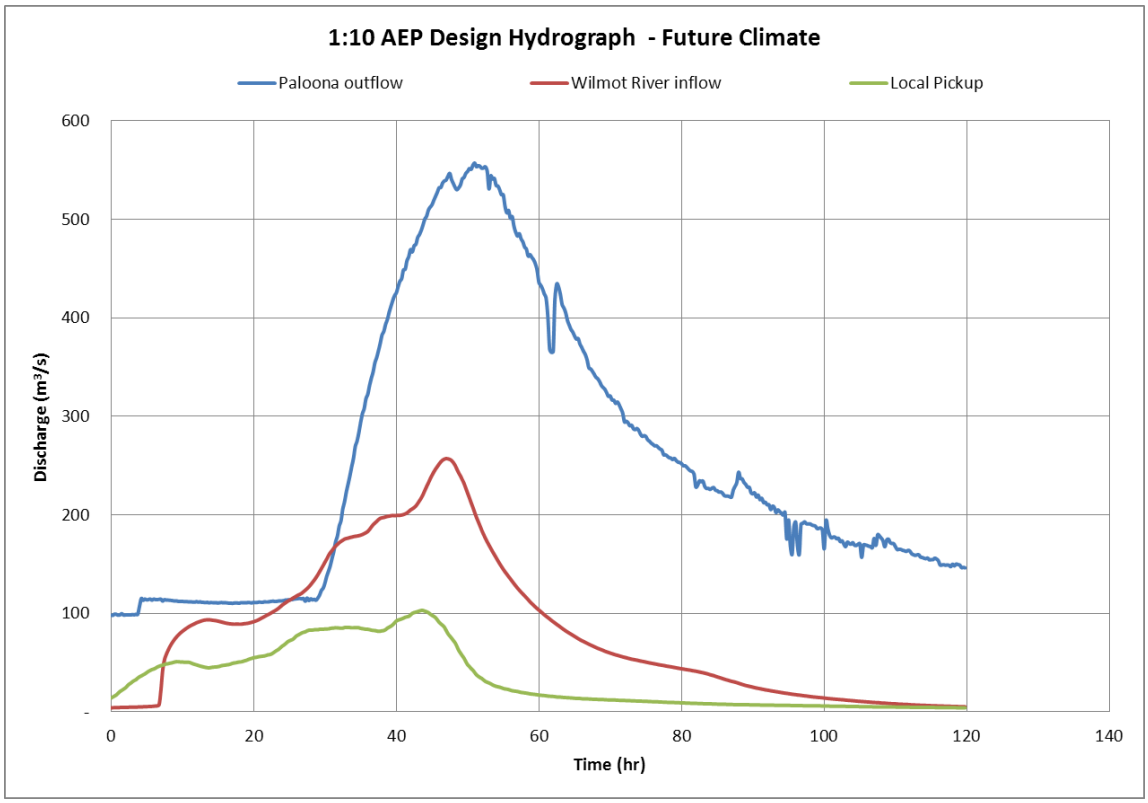
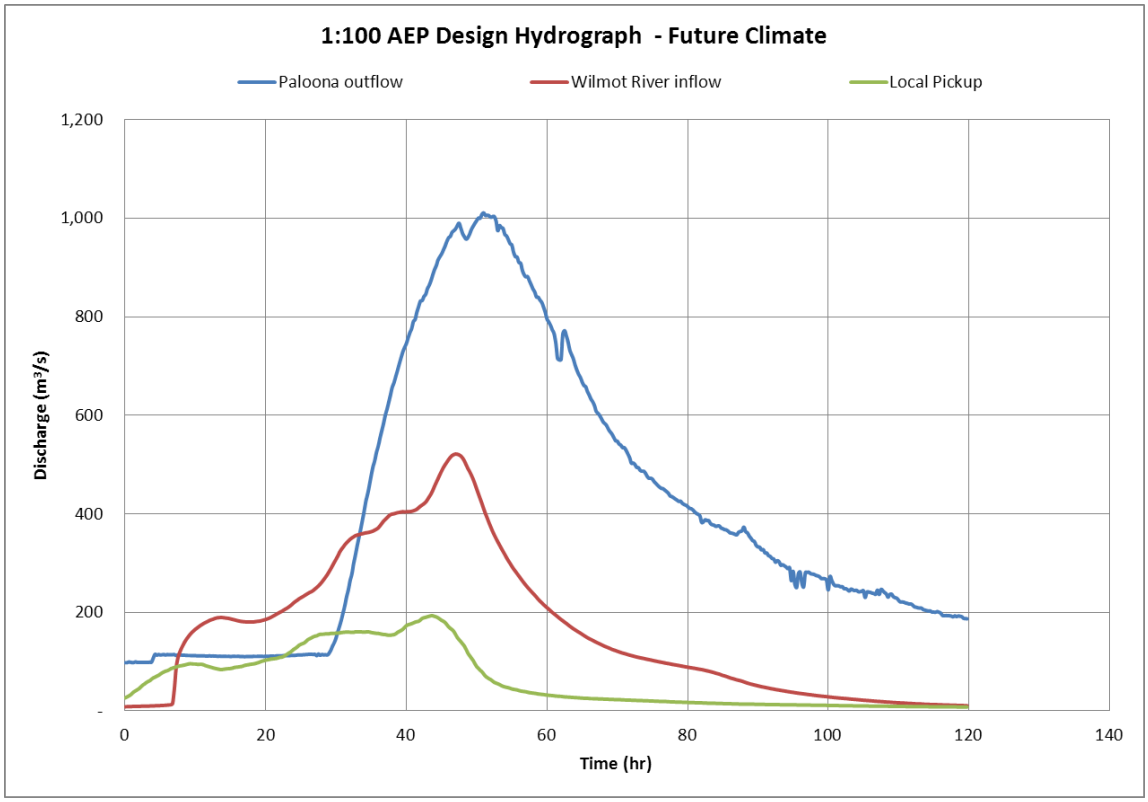
0
20
40
60
80
100
120
140
Time (hr)


1:10 AEP Design Hydrograph - Future Climate
Paloona outflow
Wilmot River inflow
Local Pickup
Discharge (m³/s)
600
500
400
300
200
100
-
0
20
40
60
80
100
120
140
Time (hr)


1:100 AEP Design Hydrograph - Future Climate
Paloona outflow
Wilmot River inflow
Local Pickup
Discharge (m³/s)
1,200
1,000
800
600
400
200
-
0
20
40
60
80
100
120
140
Time (hr)

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Flood maps

Flood extent maps

Scenario 1: Flood extent map for August 2007 flood event.

Scenario 3: Flood extent map for existing levee and current climate condition with 1:100 AEP flow and 1:10 AEP storm surge.

Scenario 4: Flood extent map for existing levee and current climate condition with 1:10 AEP flow and 1:100 AEP storm surge.

Scenario 5: Flood extent map for existing levee and future climate condition (2100) with 1:100 AEP flow and 1:10 AEP storm surge.

Scenario 6: Flood extent map for existing levee and current climate condition with 1:10 AEP flow and 1:100 AEP storm surge.

Scenario 7: Flood extent map, Levee D removed, for current climate condition with 1:100 AEP flow and 1:10 AEP storm surge.

Scenario 8: Flood extent map, Levee D removed, for future climate condition (2100) with 1:100 AEP flow and 1:10 AEP storm surge.

Scenario 9: Flood extent map, Levee C in place, for current climate condition with 1:100 AEP flow and 1:10 AEP storm surge.

Scenario 10: Flood extent map, Levee C in place, for future climate condition (2100) with 1:100 AEP flow and 1:10 AEP storm surge.

Level differences maps

Scenario 7 - 3: Level difference and extent map with and without Harvest Moon Levee and Leith Road Levee for current climate condition with1:100 AEP flow and 1:10 AEP storm surge.

Scenario 8 - 5: Level difference and extent map with and without Harvest Moon Levee and Leith Road Levee for future climate condition (2100) with1:100 AEP flow and 1:10 AEP storm surge.

Scenario 9 - 3: Level difference and extent map with and without Levee C for existing levee and climate condition with 1:100 AEP flow and 1:10 AEP storm surge.

Scenario 10 - 5: Level difference and extent map with and without Levee C for existing levee and future climate condition (2100) with 1:100 AEP flow and 1:10 AEP storm surge.

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Forth Flood Plan

Hydraulic Modelling Report Addendum

ENTURA-76A08
25 February 2015

Prepared by Hydro-Electric Corporation ABN48 072 377 158
t/a Entura 89 Cambridge Park Drive, Cambridge TAS 7170 Australia

Entura in Australia is certified to the latest version of ISO9001, ISO14001, and OHSAS18001.

Document information

Title	Forth Flood Plan
	Hydraulic Modelling Report Addendum
Client organisation	Central Coast Council
Client contact	Philip Adams
Document number	ENTURA-76A08
Project manager	Craig Ludlow
Project reference	E302873 - P506363

Revision history

Revision 3.0

Revision description	Final Addendum submitted to central Coast Council		
Prepared by	Craig Ludlow	C. Ludlow	25/02/2015
Reviewed by	Michael Wallis	M Wallis	25/02/2015
Approved by	Craig Ludlow	C. Ludlow	25/02/2015
	(name)	(signature)	(date)
Distributed to	Philip Adams (name)	Central Coast Council (organisation)	3/03/2015 (date)

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Contents

Appendices

List of figures

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1. Introduction

Entura was commissioned by Central Coast Council (CCC) in January 2013 to carry out a flood study for the lower Forth River (Ludlow, 5 December 2013). The main objectives of the study were to:

- Assess the 1 in 100 annual exceedence probability (AEP) flood levels taking into consideration storm surge for current and future climate conditions and more detailed river survey data.
- Identify the impact on flood levels of the Harvest Moon levee (Levee D) and Leith Road floodstop, which were constructed after the August 2007 flood event.
- Assess the impact of the proposed Levee C which may be constructed in the future.

This report summarises the findings of the investigations carried out for this study and presents flood inundation maps for the calibration and design flood events.

On completion of the Draft Forth Flood Plan – Hydraulic Modelling Report, Entura was engaged by Council to carry out the following additional work:

- Update the Part C of the Lower Forth Flood Response and Recovery Plan including:
    - Property/Asset Tables 3 and 4 with the:
        - 1 in 2 AEP and 1 in 5 AEP columns to be deleted.
        - 1 in 10 AEP, 1 in 50 AEP and 1 in 100 AEP columns to be updated with recent modelling results.
        - 1 in 200 AEP column to be replaced with modelling results for the 1 in 100 AEP 2100 climate event.
    - Figures 1, 2 and 3 to be updated to include the latest 1 in 100 AEP existing climate and August 2007 flood event stage hydrographs. The stage hydrographs for the 1 in 1000 AEP and 1 in 2000 AEP flood events are to be retained as these events have not been re-run with the updated model.
    - Update the Forth flood 1:100 AEP flood extent map between Wilmot River and Forth.
- Assess the requirements for Levee A and D to provide a 1 in 50 AEP design flood immunity.
- Provide basic comment on the filling activity currently being undertaken on Levee B.

This additional work is documented this addendum report.

2. Lower Forth Flood Response and Recovery Plan – Part C Update

2.1 Introduction

The updated property/asset Tables 3 and 4 and Figures 1, 2 and 3 are discussed below. In order to update the tables and figures the Forth hydraulic model was re-run for the following events:

- 1 in 10 AEP existing climate rainfall and 1 in 10 AEP storm surge.
- 1 in 50 AEP existing climate rainfall and 1 in 10 AEP storm surge.

The updated Tables 3 and 4, Figures 1, 2 and 3 and the 1 in 100 AEP flood extent map provided below should replace the existing information in Part C of the Lower Forth Flood Response and Recovery Plan.

It should be noted that there is a significant reduction in flood levels and number of properties inundated in the updated tables and figures. This is due to:

- Updated hydrologic analysis which has resulted in a significant reduction in the peak discharge for the 1 in 100 AEP flood event.
- Updated hydraulic model. The previous hydraulic model used very conservative estimates of the Manning's n and did not include the floodway at the Forth Road Bridge. It should be noted that the current model is only calibrated downstream of the Forth Road Bridge. The model has not been calibrated upstream of this location.

2.2 Property/asset Tables 3 and 4

The updated property/asset Tables 3 and 4 are provided in Appendix A. These tables were also provided in electronic format.

2.3 Figures 1, 2 and 3

The updated Figures 1, 2 and 3 are provided in Appendix B. These figures were also provided in electronic format.

2.4 1 in 100 AEP flood extent map

The updated 1 in 100 AEP flood extent map is provided in Appendix C. The map was also provided in ArcGIS format.

3. Assessment of Levee A and D

3.1 Introduction

An assessment was carried to:

- Identify the levels required for Levee A in order to provide 1 in 50 AEP flood immunity for the protected agricultural land.
- Identify the impact on flooding should Levee A be upgraded to provide a 1 in 50 AEP flood immunity.
- Confirm the flood immunity provided by Levee D to the Harvest Moon infrastructure on the eastern side of the river.

3.2 Levee A

The Forth River MIKE Flood hydraulic model was run for the 1 in 50 AEP rainfall and 1 in 10 AEP storm surge event with Levee A levels increased to a height that would prevent it from being overtopped.

In order to provide 1 in 50 AEP immunity to the land protected by Levee A:

- The gap between Levee A and the Forth Road (refer to Figure 3.1) would need to be closed through an extension of Levee A or provision of Levee C. If Levee A is raised without closing this gap, for a large flood event it is likely that flood levels behind Levee A could be higher than the existing case flood levels. This is due to:
    - The water levels behind the levee being controlled by a higher upstream water level at the location of the gap.
    - The raised levee preventing the water levels behind the levee being balanced with lower flood levels in the Forth River (when compared with the flood level in the river adjacent to the gap) between Levee B and the Bass Highway.
- Levee A would need to be raised above the 1 in 50 AEP flood levels. A relief spillway would also need to be required to pass the 1in 100 AEP (or higher) flood event. The desired design flood discharge for the spillway, spillway length and required freeboard above the maximum flood level would dictate the level to which the levee crest would need to be raised. Levee crest levels based on allowing a 0.6m freeboard above the 1 in 50 AEP flood level are shown on Figure 3.1. The 0.6m freeboard is based on:
    - The assumption that a relief spillway would be provided with the crest level at the 1 in 50 AEP flood level.
    - The spillway would be sized to pass the design flow for 0.3m head over the spillway crest.
    - A freeboard of 0.3m is adopted above the spillway design discharge level.

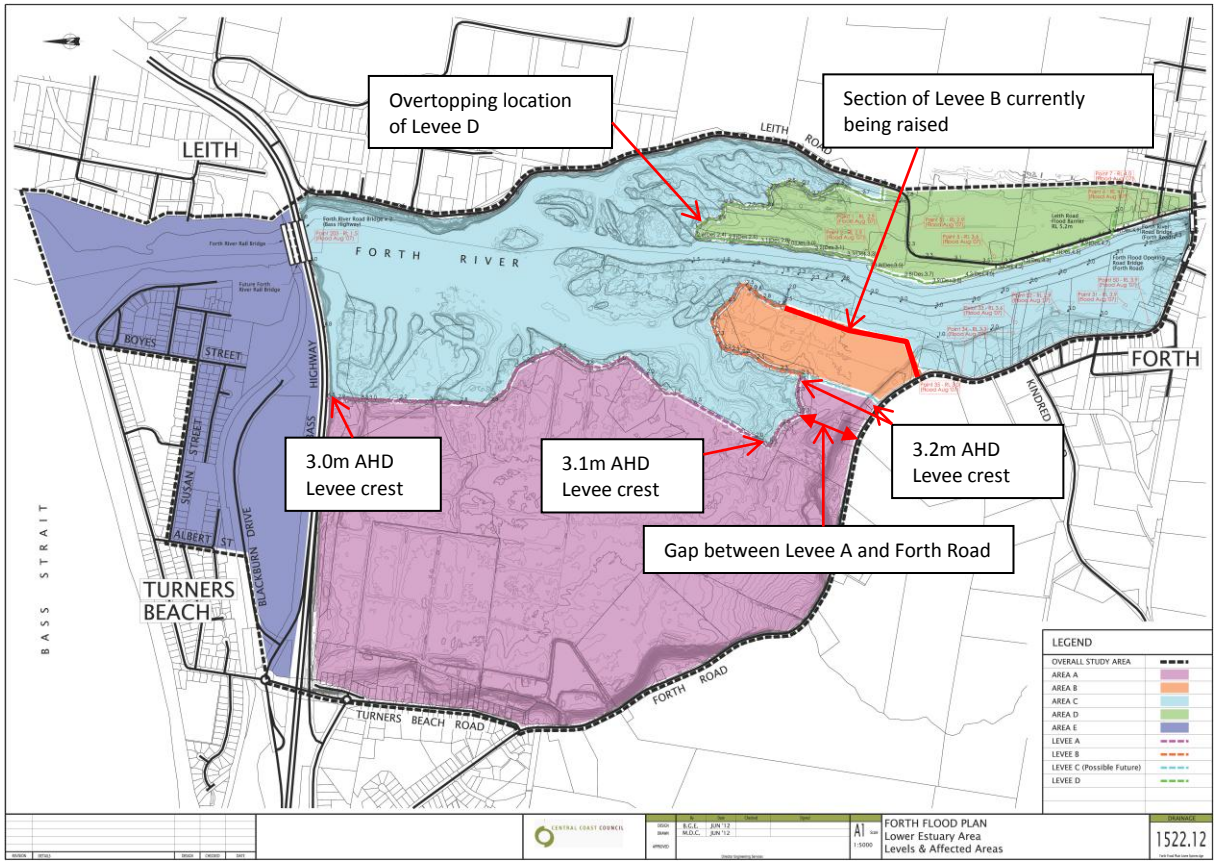
The peak 1 in 50 AEP flood levels for Levee A in its current arrangement were compared against the flood levels for Levee A raised and Levee A raised with the gap blocked off. The predicted increases in flood levels for both cases were similar with the following outcomes:

- In the vicinity of the gap, peak flood levels were raised by 0.1m to 0.2m.

- On the opposite side of the river to the gap flood levels were raised by approximately 0.03m to 0.05m.
- Upstream of the southern end of Levee B flood levels were increased by approximately 0.02m decreasing to approximately 0m at the Forth Road bridge.

It should be noted however that raising Levee A to provide a 1 in 50 AEP flood immunity should be carefully considered. Levee A is unlikely to have been designed to reliably hold flood water without it failing. It is noted that Levee A breached during the August 2007 flood event when differential pressure across the levee would have been low. Should Levee A be raised it is recommended that a thorough geotechnical investigation and design review of the existing levee be carried out to confirm the viability of raising the levee. As an alternative the existing levee could be demolished and replaced with a new levee to the desired height.

Figure 3.1: Levee A, B and D assessment



3.3 Levee D

For the 1 in 50 AEP rainfall and 1 in 10 AEP storm surge event it was found the Levee D was just overtopped by approximately 0.1m at the location shown in Figure 3.1

The immunity of the northern end of Levee D could be increased to 1 in 50 AEP rainfall and 1 in 10 AEP storm surge with some raising of the low section of the levee without impacting flood levels.

4. Assessment of Levee B

It is understood that work is proposed to raise the section of Levee B adjacent to the river and shown on Figure 3.1.

The raising of this levee could result in a localised raising of flood levels. Should this levee be raised it is recommended that:

- A hydraulic assessment be carried out to ensure it does not adversely impact surrounding flooding.
- It is correctly designed to ensure safe operation of the levee during a flood event.

5. References

Ludlow, C. (5 December 2013). *Forth Flood Plan - Hydraulic Modelling Report, Doc Number: ENTURA-663C8.* Hobart: Entura.

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Appendices

Appendix A – Updated property/asset Tables 3 and 4.

Appendix B – Updated Figures 1, 2 and 3.

Appendix C – Updated 1 in 100 AEP flood extent

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A Updated property/asset Tables 3 and 4

A.1 Table 3

Address	Floor level (m)	Annual Exceedence Probability			
		1 in 10	1 in 50	1 in 100	1 in 100 Climate change
		BOM Flood Gauge River Height Prediction			
		5.2 m	6.4 m	7.0 m	8.1 m
		Predicted Flood Height in m (level above(+)/below(-) floor level)			
4 Wilmot Road	5.6	3.4 (-2.2) No action	4.2 (-1.4) No action	4.7 (-0.9) No action	5.7 (0.1) Sandbag
182 Wilmot Road	9.7	6.0 (-3.7) No action	7.3 (-2.4) No action	7.8 (-1.9) No action	8.9 (-0.8) No action
184 Wilmot Road	11.3	6.2 (-5.1) No action *	7.3 (-4.0) No action *	7.8 (-3.5) No action *	9 (-2.3) No action *
483 Wilmot Road	12.5	9.4 (-3.1) No action	10.7 (-1.8) No action	11.3 (-1.2) No action	12.6 (0.1) Sandbag
520 Wilmot Road	18.3	10.1 (-8.2) No action *	11.4 (-6.9) No action *	12 (-6.3) No action *	13.2 (-5.1) No action *
655 Wilmot Road	20.9	12.1 (-8.8) No action *	13.3 (-7.6) No action *	14 (-7) No action *	15.2 (-5.7) No action *
538 Paloona Road	26.2	21 (-5.2) No action *	22.1 (-4.1) No action *	22.6 (-3.6) No action *	23.8 (-2.4) No action *
643 Forth Road	8.3	3.4 (-4.9) No action *	4.3 (-4.0) No action *	4.8 (-3.5) No action *	5.7 (-2.6) No action *
120 Pumping Station Road	7.0	5.9 (-1.1) No action	6.9 (-0.1) Sandbag	7.3 (0.3) Sandbag + Evacuate	8.4 (1.4) Sandbag + Evacuate

Address	Floor level (m)	Annual Exceedence Probability			
		1 in 10	1 in 50	1 in 100	1 in 100 Climate change
		BOM Flood Gauge River Height Prediction			
		5.2 m	6.4 m	7.0 m	8.1 m
		Predicted Flood Height in m (level above(+)/below(-) floor level)			
136 Pumping Station Road	8.3	6.1 (-2.2) No action	7.1 (-1.2) No action	7.6 (-0.7) No action	8.7 (0.4) Sandbag + Evacuate
137 Pumping Station Road	14.8	6.1 (-8.7) No action	7.1 (-7.7) No action	7.6 (-7.2) Monitor*	8.7 (-6.1) Monitor*
269 Pumping Station Road	15.1	6.4 (-8.7) No action *	7.6 (-7.5) No action *	8.1 (-7.0) No action *	9.3 (-5.8) No action *
Taswater Pumping Station	9.0	6.2 (-2.8) No action	7.3 (-1.7) No action	7.8 (-1.2) No action	8.9 (-0.1) Sandbag
393 Leith Road (Bridge Hotel)	8.3	3.4 (-5) No action	4.3 (-4.0) No action	4.8 (-3.5) No action	5.7 (-2.6) No action
381 Leith Road	5.7	3.2 (-2.5) No action	3.9 (-1.8) No action	4.3 (-1.4) No action	5.2 (-0.5) No action
341 Leith Road	4.0	2.9 (-1.1) No action	3.5 (-0.5) No action	3.8 (-0.2) Monitor + Sandbag	4.6 (0.6) Sandbag + Evacuate
329 Leith Road	3.6	2.8 (-0.8) No action	3.3 (-0.3) Monitor + Sandbag	3.6 (0.0) Sandbag	4.4 (0.8) Sandbag + Evacuate
325 Leith Road	3.8	2.8 (-1.0) No action	3.3 (-0.5) No action	3.6 (-0.2) Monitor + Sandbag	4.3 (0.5) Sandbag + Evacuate
294 Leith Road	3.9	2.6 (-1.3) No action	3 (-0.9) No action	3.2 (-0.7) No action	3.9 (0.0) Sandbag
288 Leith Road (Forth Farm Processing Plant)	2.2	2.6 (0.4) Sandbag + Evacuate	2.9 (0.7) Sandbag + Evacuate	3.2 (1.0) Sandbag + Evacuate	3.9 (1.7) Sandbag + Evacuate
643 Forth Road	8.3	3.4 (-4.9) No action *	4.3 (-4.0) No action *	4.8 (-3.5) No action *	5.7 (-2.6) No action *

Address	Floor level (m)	Annual Exceedence Probability			
		1 in 10	1 in 50	1 in 100	1 in 100 Climate change
		BOM Flood Gauge River Height Prediction			
		5.2 m	6.4 m	7.0 m	8.1 m
		Predicted Flood Height in m (level above(+)/below(-) floor level)			
667 Forth Road	5.8	3.4 (-2.4) No action	4.2 (-1.6) No action	4.7 (-1.1) No action	5.7 (-0.1) Sandbag
668 Forth Road - General Store	5.5	3.2 (-2.3) No action	4 (-1.5) No action	4.4 (-1.1) No action	5.3 (-0.2) Monitor + Sandbag
673 Forth Road	5.5	3.2 (-2.3) No action	4 (-1.5) No action	4.4 (-1.1) No action	5.3 (-0.2) Monitor + Sandbag
8 Mell Street	3.8	3.1 (-0.7) No action	3.8 (0) Sandbag	4.2 (0.4) Sandbag + Evacuate	5.1 (1.3) Sandbag + Evacuate
Football Clubrooms - Forth Road	4.0	3.1 (-0.9) No action	3.8 (-0.2) Monitor + Sandbag	4.2 (0.2) Sandbag	5.1 (1.1) Sandbag + Evacuate
678 Forth Road - Automotive Garage	5.1	3.2 (-1.9) No action	3.9 (-1.2) No action	4.3 (-0.8) No action	5.2 (0.1) Sandbag
680 Forth Road - Community Hall	5.2	3.2 (-2) No action	3.9 (-1.3) No action	4.3 (-0.9) No action	5.2 (0.0) Sandbag
684 Forth Road	5.0	3.2 (-1.8) No action	3.9 (-1.1) No action	4.3 (-0.7) No action	5.2 (0.2) Sandbag
33 Turners Beach Road	3.4	2.1 (-1.3) No action	2.3 (-1.1) No action	2.5 (-0.9) No action	3.4 (0.0) Sandbag
35 Turners Beach Road	3.7	2.1 (-1.6) No action	2.3 (-1.4) No action	2.5 (-1.2) No action	3.4 (-0.3) Monitor + Sandbag
Shorehaven Drive	3.0	2.0 (-1.0) No action	2.1 (-0.9) No action	2.2 (-0.8) No action	3 (0.0) Sandbag
2 Heather Court	3.1	2 (-1.1) No action	2.1 (-1.0) No action	2.2 (-0.9) No action	3 (-0.1) Monitor + Sandbag

Address	Floor level (m)	Annual Exceedence Probability			
		1 in 10	1 in 50	1 in 100	1 in 100 Climate change
		BOM Flood Gauge River Height Prediction			
		5.2 m	6.4 m	7.0 m	8.1 m
		Predicted Flood Height in m (level above(+)/below(-) floor level)			
3 Heather Court	3.4	2.0 (-1.4) No action	2.1 (-1.3) No action	2.2 (-1.2) No action	3.0 (-0.4) No action
4 Heather Court	3.1	2.0 (-1.1) No action	2.1 (-1) No action	2.2 (-0.9) No action	3.0 (-0.1) Monitor + Sandbag
5 Heather Court	3.4	2.0 (-1.4) No action	2.1 (-1.3) No action	2.2 (-1.2) No action	3.0 (-0.4) No action
24 Lethborg Avenue	3.5	2.0 (-1.5) No action	2.1 (-1.4) No action	2.2 (-1.3) No action	3.0 (-0.5) No action
30 Lethborg Avenue	2.9	2.0 (-0.9) No action	2.1 (-0.8) No action	2.2 (-0.7) No action	3.0 (0.1) Sandbag
31 Lethborg Avenue	3.3	2.0 (-1.3) No action	2.1 (-1.2) No action	2.2 (-1.1) No action	3.0 (-0.3) Monitor + Sandbag
33 Lethborg Avenue	3.4	2.0 (-1.4) No action	2.1 (-1.3) No action	2.2 (-1.2) No action	3.0 (-0.4) Monitor
34 Lethborg Avenue	3.5	2.0 (-1.5) No action	2.1 (-1.4) No action	2.2 (-1.3) No action	3.0 (-0.5) No action
52 Lethborg Avenue - Units	3.2	2.0 (-1.2) No action	2.1 (-1.1) No action	2.2 (-1.0) No action	3.0 (-0.2) Monitor + Sandbag
10 Lukin Street	3.5	2.0 (-1.5) No action	2.1 (-1.4) No action	2.2 (-1.3) No action	3.0 (-0.5) No action
33-35 Boyes Street	3.1	2.0 (-1.1) No action	2.1 (-1.0) No action	2.2 (-0.9) No action	3.0 (-0.1) Sandbag

Address	Floor level (m)	Annual Exceedence Probability			
		1 in 10	1 in 50	1 in 100	1 in 100 Climate change
		BOM Flood Gauge River Height Prediction			
		5.2 m	6.4 m	7.0 m	8.1 m
		Predicted Flood Height in m (level above(+)/below(-) floor level)			
124-126 The Esplanade	4.20	2.0 (-2.2) No action *	2.1 (-2.1) No action *	2.2 (-2.0) No action *	3.0 (-1.2) No action *

* Indicates properties near flooded area that were identified in previous SES plan, but are not inundated based on the latest flood modelling.

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A.2 Table 4

Road/Bridge and Locations	AHD level (m)	Distance (kms from Forth by road)	Annual Exceedence Probability			
			1 in 10	1 in 50	1 in 100	1 in 100 Climate change
			BOM Flood Gauge River Height Prediction			
			5.2 m	6.4 m	7.0 m	8.1 m
			Predicted Flood Height in m (level above(+)/below(-) floor level)			
Alma Bridge*	34.7	12.2			25.7 (-9)	27.4 (-7.3)
Paloona Bridge	25.4	10	21.2 (-4.2)	22.3 (-3.1)	22.9 (-2.5)	24 (-1.4)
Forth Bridge	7.3	0	3.4 (-3.9)	4.3 (-3.0)	4.8 (-2.5)	5.7 (-1.6)
Forth River overflow (deck)	6.3	0	3.4 (-2.9)	4.3 (-2.0)	4.8 (-1.5)	5.7 (-0.6)
Forth River overflow (underside)	6.0	0	3.4 (-2.6)	4.3 (-1.7)	4.8 (-1.2)	5.7 (-0.3)
Bass Highway Bridge (D/S deck)	5.2	3.0	2.1 (-3.1)	2.3 (-2.9)	2.4 (-2.8)	3.4 (-1.8)
Bass Highway Bridge (D/S - underside beam)	3.3	3.0	2.1 (-1.2)	2.3 (-1.0)	2.4 (-0.9)	3.4 (0.1)
Railway Bridge at Turners Beach (rails)*	6.3	3.0	2.1 (-4.2)	2.3 (-4.0)	2.4 (-3.9)	3.4 (-2.9)
Railway Bridge at Turners Beach (underside)*	4.0	3.0	2.1 (-1.9)	2.3 (-1.7)	2.4 (-1.6)	3.4 (-0.6)
Jamiesons Road*	32.3	13			25.7 (-6.6)	27.4 (-4.9)
Paloona Power Station Road	30.3	12.0	28 (-2.3)	28.4 (-1.9)	28.7 (-1.6)	29.4 (-0.9)
Wilmot Road*	30.5	10.2				25 (-5.5)
Wilmot Road (North of Kindred Creek)*	22.5	8.8				18.7 (-3.8)
Wilmot Road (low point - approximate)	7.8	1.8	6.2 (-1.6)	7.3 (-0.5)	7.8 (0.0)	9 (1.2)
Pumping Station Road (low point - approximate)	5.4	1.0	5.8 (0.4)	6.7 (1.3)	7.2 (1.8)	8.2 (2.8)
Wilmot Road at Forth Road (low point - approximate)*	7.5	0.0			4.6 (-2.9)	5.6 (-1.9)
Leith Road, (1km north of bridge)	2.0	1.0	3.0 (1.0)	3.7 (1.7)	4.1 (2.1)	5 (3)
Bass Highway (low point)	3.7	4.5	2.1 (-1.6)	2.3 (-1.4)	2.5 (-1.2)	3.4 (-0.3)

Road/Bridge and Locations	AHD level (m)	Distance (kms from Forth by road)	Annual Exceedence Probability			
			1 in 10	1 in 50	1 in 100	1 in 100 Climate change
			BOM Flood Gauge River Height Prediction			
			5.2 m	6.4 m	7.0 m	8.1 m
			Predicted Flood Height in m (level above(+)/below(-) floor level)			
Leith Road (low point - approximate)	2.0	1.5	2.4 (0.4)	2.7 (0.7)	2.9 (0.9)	3.7 (1.7)
Leith Road	2.0	2.3	2.2 (0.2)	2.4 (0.4)	2.6 (0.6)	3.6 (1.6)
Turners Beach Road*	9.7	3.5				3.5 (-6.2)

* Indicates bridges near flooded area that were identified in previous SES plan, but are not inundated based on the latest flood modelling.

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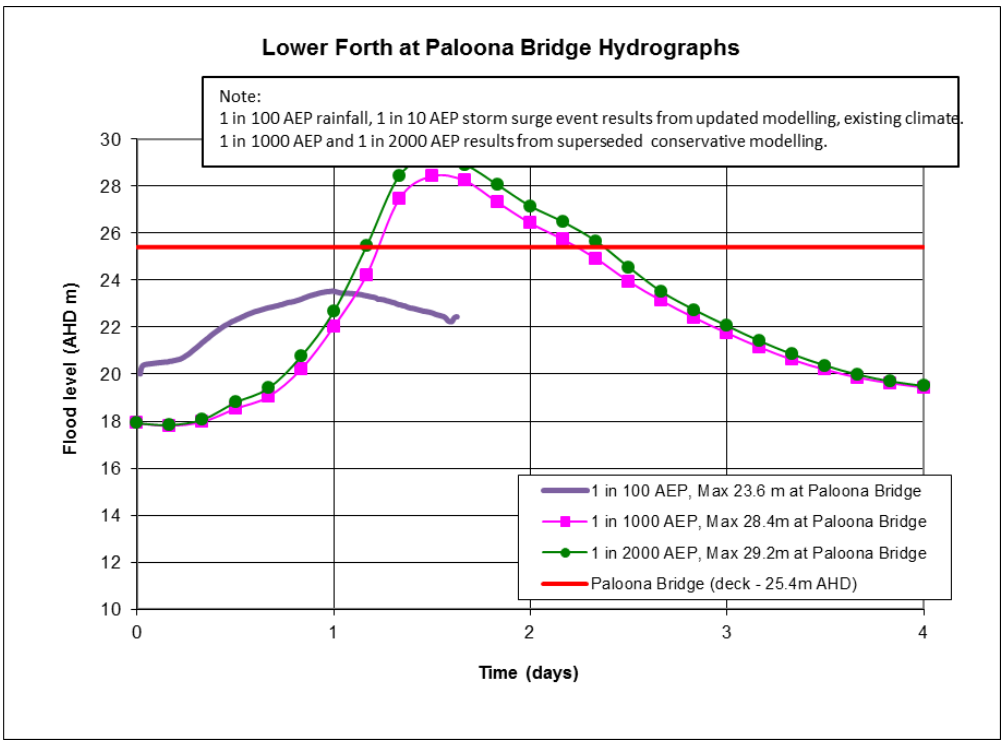
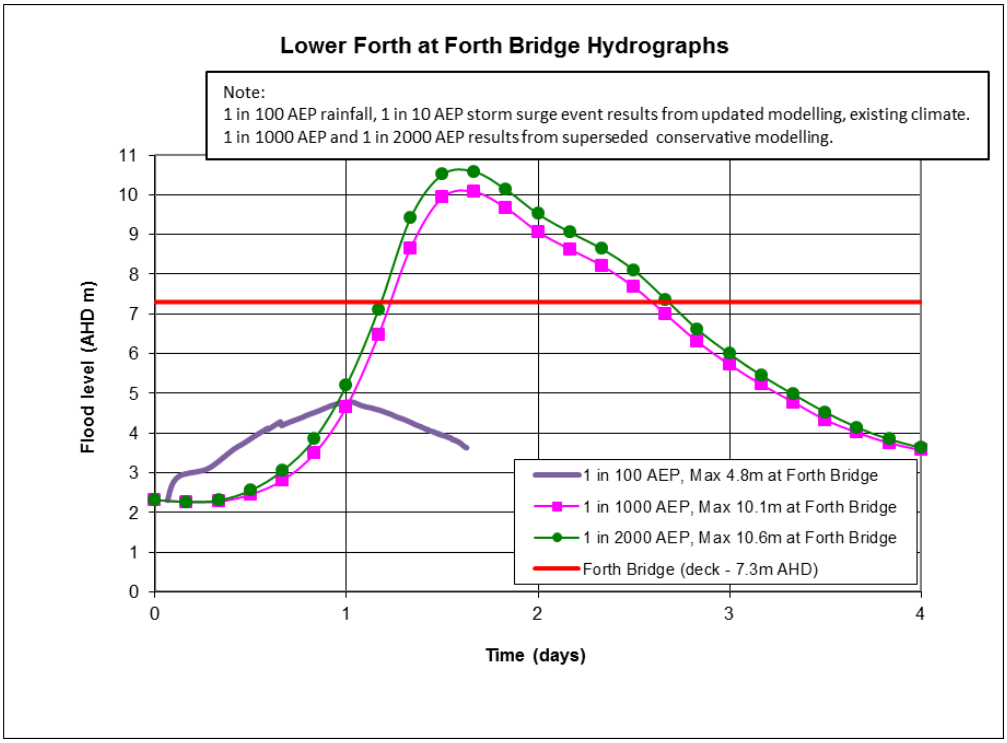
B Updated Figures 1, 2 and 3

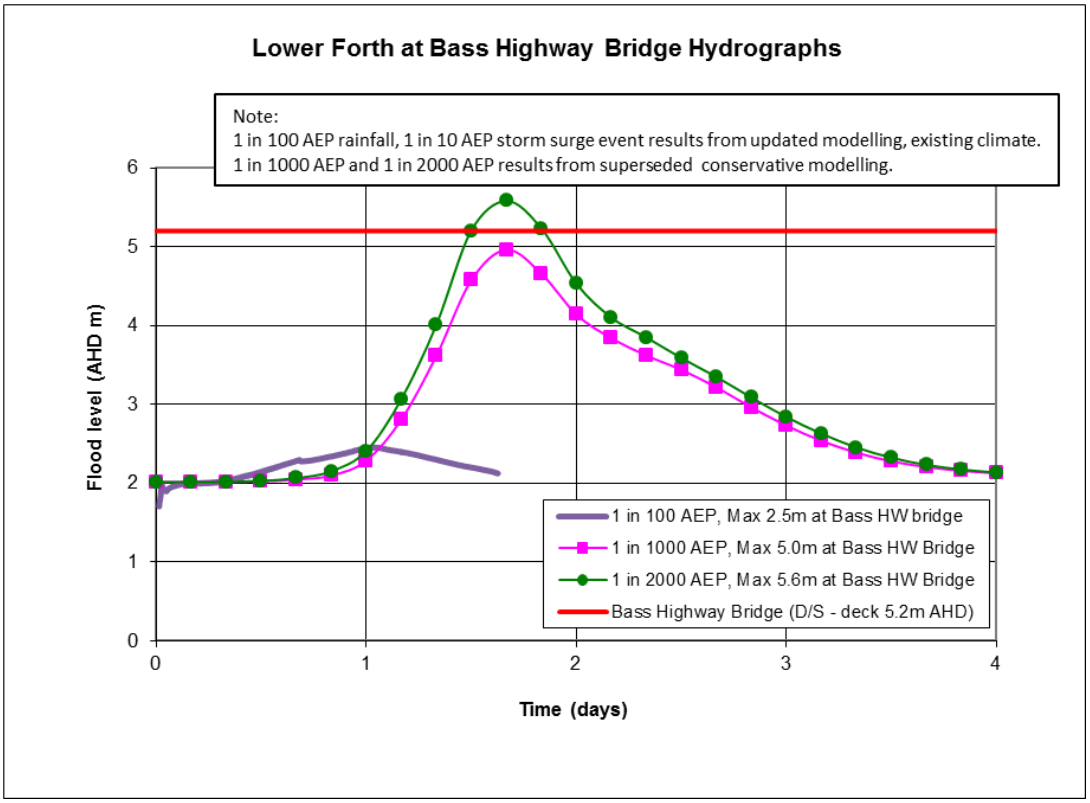
B.1 Figure 1



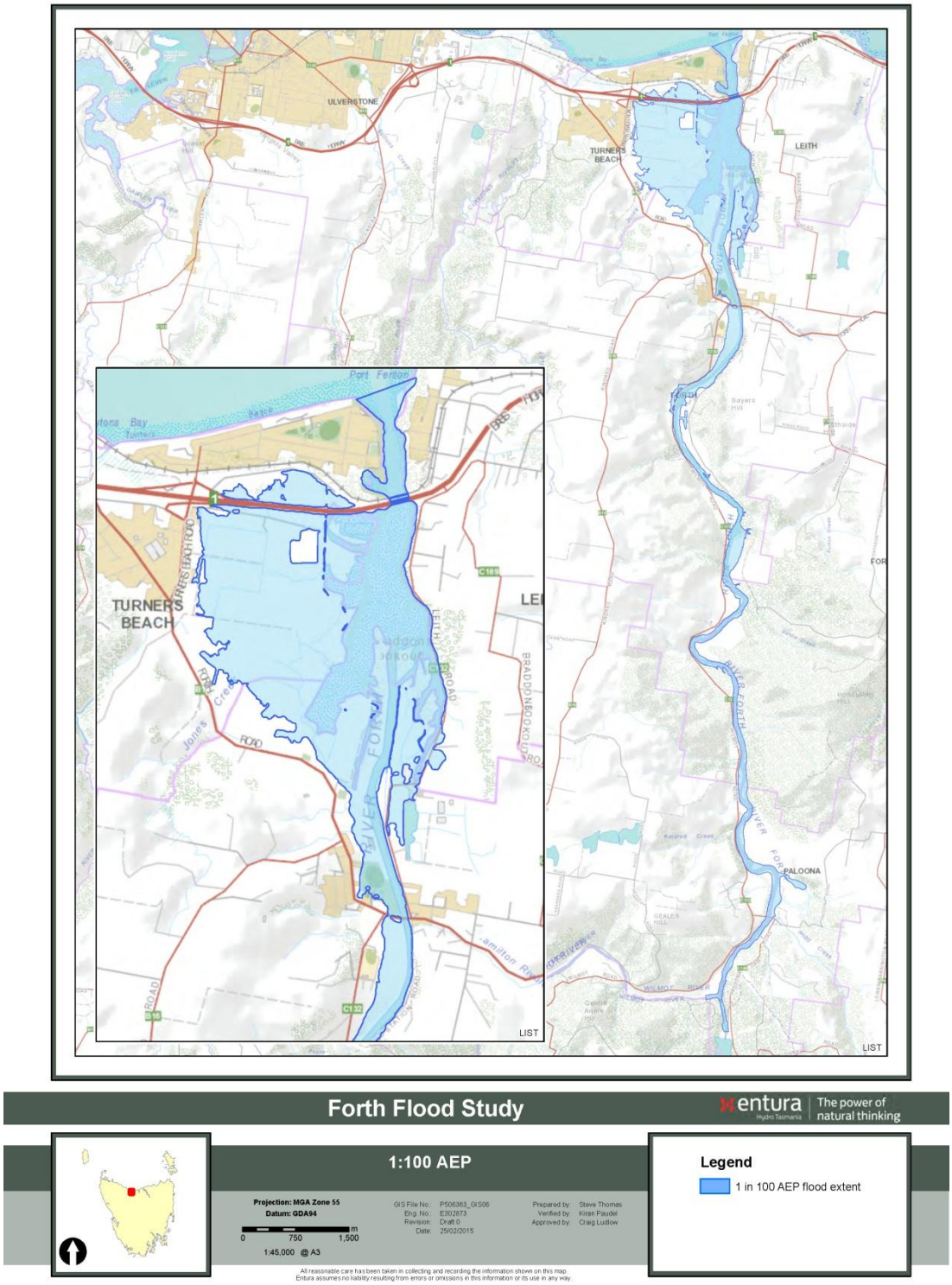
B.2 Figure 2



B.3 Figure 3


Lower Forth at Bass Highway Bridge Hydrographs
Note:
1 in 100 AEP rainfall, 1 in 10 AEP storm surge event results from updated modelling, existing climate.
1 in 1000 AEP and 1 in 2000 AEP results from superseded conservative modelling.
Flood level (AHD m)
Time (days)
1 in 100 AEP, Max 2.5m at Bass HW bridge
1 in 1000 AEP, Max 5.0m at Bass HW Bridge
1 in 2000 AEP, Max 5.6m at Bass HW Bridge
Bass Highway Bridge (D/S - deck 5.2m AHD)

C Updated 1 in 100 AEP flood extent



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