Profile of Catchment

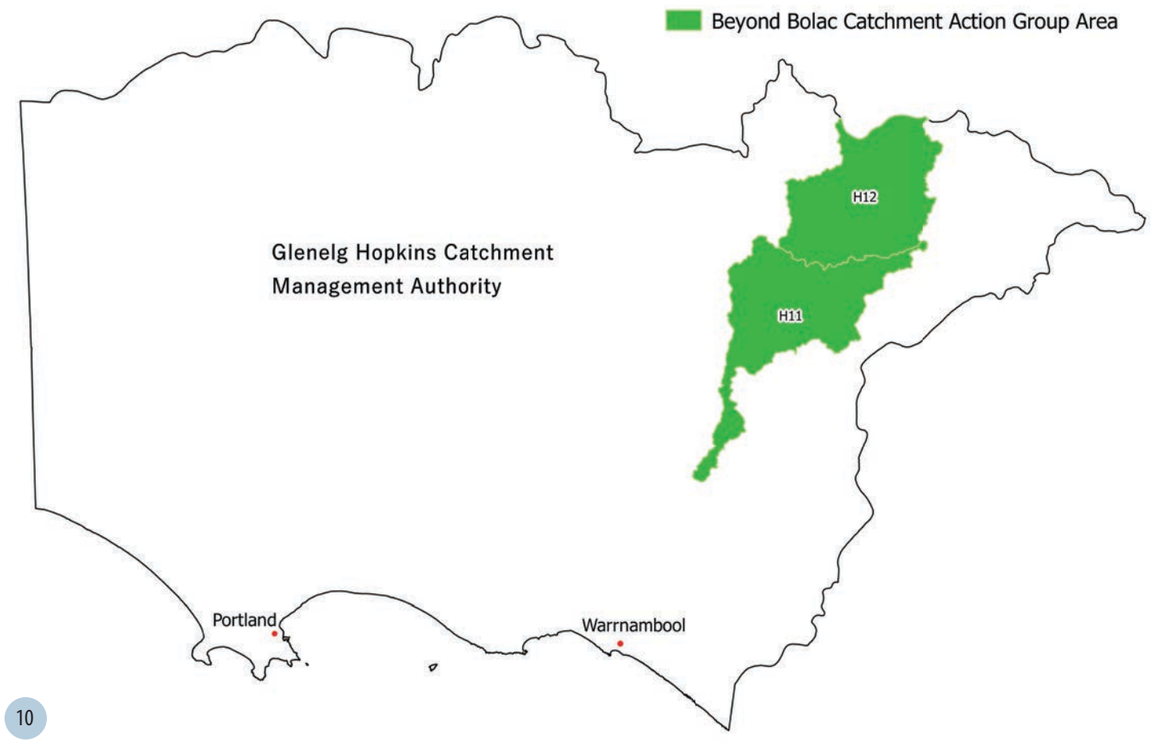
The H11 H12 Catchment Health Report – Lake Bolac, Fiery & Salt Creeks

The H11 H12 Catchment Health report – Lake Bolac, Fiery & Salt Creeks was prepared in 2006 and the main objective was to review all the information relating to waterway health, land use and management within the Fiery and Salt Creeks as well as Lake Bolac, known as H11 & H12 sub-catchments, to identify knowledge gaps and enable the community and government agencies to coordinate activities that would lead to improved health of the sub-catchment.

The report found that the catchment had experienced many changes to vegetation cover, water quantity and quality and land use. Overall rainfall and rainfall events had decreased while water use had increased. In 2006, when the report was undertaken, the estimated water use across the catchment was more than 11,000 mega litres per annum, and large volume stream flows had not occurred for a number of years resulting in saline water in Lake Bolac not being flushed into Salt Creek. The combined effect of changed rainfall patterns, which decreased runoff and salinity had a dramatic impact on Lake Bolac, and the climate change prediction included lower average rainfall for the region was expected to exacerbate the situation (Gervasi & P&P Design, 2006).

The report concluded that the predicted change in the climate and rainfall patterns would necessitate a cooperative approach to the management of the catchments water resources and provided a number of recommendations in an attempt to achieve this. The Beyond Bolac Catchment Action Group took up the challenge to implement the recommendations from the report; the full report can be downloaded from the Beyond Bolac website at www.beyondbolac.org.

It has been 10 years since the report was undertaken, and there have been many environmental, social and economic changes across the catchment. This Biodiversity Blueprint will provide an update on the health of the catchment to assist its management into the future.



Indigenous Cultural Heritage

The original custodians of the H11 H12 sub-catchment were the Djab Wurrung people, who occupied the areas west of Fiery Creek, the Watha Wurrung people, who occupied the north east side of Fiery Creek and the Girai Wurrung people who occupied the south east side of Fiery Creek. The Fiery Creek formed the boundary between the Djab Wurrung to the west and the Watha Wurrong and Girai Wurrung people to the east. There were eight clans from the three groups known to exist within the sub-catchment area. There were five Djab Wurrung clans, these included the Buller buller cote gundidj clan at the junction of Salt Creek and the Hopkins River, the Bulukbara clan at Lake Bolac, Peeripar balug clan at Fiery Creek, 32 kilometres south of Mt Cole, Puppellenneerring clan at Fiery Creek, 48 kilometres southwest of Mt Cole and Terrumbehal gundidj clan, between the Hopkins River and Fiery Creek (Clark, 1995).

In season, eels were a stable food, and the Djab Wurrung people, the Watha Wurrung people and the Girai Wurrung people moved to fishing grounds at Lake Bolac.

Djab Wurrung country was mostly volcanic plain punctuated with a large number of perennial and intermittent lakes and swamps. The Djab Wurrung people camped along areas of overlap between major vegetation types and along streams, where timber and fuel were more abundant. A common campsite was a constructed earthen mound, usually located on the bank of a stream or on a good vantage point (Clark, 1995).

There was one clan from the Watha Wurrung people which was located at Carranballac, known as the Corrin corrinjer balug, who traded stones and adhesive gum at trade meetings near Lake Terang. There were two clans from the Girai Wurrung people, the Ngalug barar balug clan midway between Mount Shadwell and Lake Bolac near Lake Eyang, and the Flat Top Hill Clan at Flat Topped Hill half between Mt Shadwell and Lake Eyang (Clark, 1995). These clans would meet along Fiery Creek and at Lake Bolac to harvest eels and hunt emus and other game.

In season, eels were a staple food, and the Djab Wurrung people, the Watha Wurrung people and the Girai Wurrung people moved to fishing grounds at Lake Bolac. Lake Buloke (Lake Bolac) was the most celebrated place in the Western District for the fine quality and abundance of eels, in early autumn up to 1,000 people gathered to take advantage of the annual migration of the eels. Eels were captured in great numbers by building stone barriers across rapid streams and diverting the current through an opening into a funnel-mouthed basket pipe, three to four feet long, two inches in diameter and closed at the lower end. When the streams extend over the marshes in times of flood, clay embankments two to three feet high and sometimes three to four hundred yards in length were built across them to confine the current to a narrow opening in which the pipe baskets were placed (Dawson, 1881).

Europeans first arrived in the area in the early 1800s and claimed the fertile lands as their own. There were many clashes in which both parties experienced deaths. Victoria was established as a separate colony in 1851 and government policies regarding Aboriginal people became increasingly intrusive into their lives. Demand for fertile farming land steadily increased and by the 1870s the Aboriginal people had mainly been dispersed to different areas across the region including to established missions (Weir, 2009).

The evidence of Aboriginal occupation in Victoria is present throughout the landscape in the form of Aboriginal cultural heritage places and in the personal, family and community histories of Aboriginal people (GHCMA, 2015). A stone arrangement, north of Lake Bolac, is believed to be a significant Aboriginal ceremonial site. The basalt stones are arranged in lines and are said to resemble a giant eel. Some of these stones were removed to make way for a road, now known as the Glenelg Highway (Wikipedia, 2015). Another site of archaeological significance can be found on the eastern shore of Lake Bolac in a dune complex which extends south of the Fiery Creek. Animal bones, stone tools and charcoal have been found at the site and some of

the remains have been dated back to approximately 12,480±560 before present, with reports referencing the site as far back as 1841. There are erosion issues at the site which has prompted a rock wall to be constructed at the base of the dune to help stabilise the site (Gervasi & P&P Design 2006).

Today, there are three registered Aboriginal Parties (RAPs) who are the voice of Aboriginal people in the management and protection of Aboriginal cultural heritage within the H11 & H12 sub-catchment. The Eastern Maar Aboriginal Corporation, Martang Pty Ltd and Wathaurung Aboriginal Corporation. The local community hosts a festival biannually known as the Lake Bolac Eel Festival which was inspired by the eel harvest gatherings once held by the traditional owners of the land. The Festival has an environmental and reconciliation theme, one of the aims of the festival is to foster reconciliation and mutual respect and understanding between indigenous and non-indigenous peoples, and a key part of the festival has included a Healing Walk.

Rivers and Creeks

Geographically a catchment is an area of land that drains to a single low point such as a gully, creek or river. A large catchment may be made up of a series of smaller sub-catchments and these are made up of soil, water, air and vegetation. Together these elements support life and make up an ecosystem that within it, has cycling of nutrients and other elements. Each component is linked, so when one changes it has an effect on the other elements. The H11 & H12 sub-catchment is located within the Hopkins River Basin in Western Victoria; the climate of the area is best described as Mediterranean, with hot summers and cool winters. The average rainfall ranges from 537 mm/year at Lake Bolac to up to 572 mm/year in the upper catchment around the headwaters of Fiery Creek at Buangor (BOM, 2015 Rainfall Data).

The major waterway in the H12 sub-catchment is the Fiery Creek, which stretches from the My Cole Range to the confluence of the Fiery Creek and Wongan Creek. Fiery Creek has a number of smaller tributaries of which Wongan Creek is the largest (Gervasi & P&P Design, 2006). The smaller tributaries include Billy Billy Creek, Cave Hill Creek, Challicum Creek, Charleycombe Creek, Dairy Maid Creek, Ditchfield Creek, Middle Creek, Sandy Creek and Wongan Creek. The two major waterways within H11 sub-catchment include the continuation of the Fiery Creek, from the confluence with Wongan Creek, and Salt Creek.

Fiery Creek has a length of approximately 100 kilometres through this sub-catchment and terminates at Lake Bolac. Its overflow becomes Salt Creek which has a length of approximately 25 kilometres. Fiery Creek's headwaters are located between Beaufort and Ararat on the southern slopes of the Great Dividing Range in the H12 sub-catchment. Salt Creek begins at the outlet of Lake Bolac, and flows through low-lying land and is dotted with a large number of wetlands. Historically the wetland areas retained water in the catchment during wetter periods and allowed water to leave the catchment through the year, however the land around Salt Creek appears to have been modified with improved drainage for pasture and crops, with many of the wetlands now drained.

Fiery creek has a length of approximately 100 km through the sub-catchment and terminates at Lake Bolac.

The rivers and creeks within the H11 H12 sub-catchment provide many benefits to the region, such as filtering water for agriculture and drinking water supply, as well as supporting unique flora and fauna populations. They also provide a range of social values including fishing, boating, camping, swimming, picnicking and bushwalking. There are a number of threats facing the rivers and creeks within H11 H12 sub-catchment. The value and condition of rivers and creeks are often compromised by erosion and sedimentation, particularly where catchments have been cleared and stock can directly access the waterway.

Increased nutrient loads in waterways as a result of uncontrolled stock access, agricultural fertilisers and urban storm water runoff, can cause blooms of toxic blue-green algae that impact on regional communities and the economy (GHCMA, 2014). Pest plants can significantly reduce waterway values by decreasing river access for recreational activities; pest animals impact native species by direct predation or competing for habitat and food; and climate change, water extraction, land use and river regulation can all alter flow regimes.

Lakes and Wetlands

Lake Bolac is situated at the centre of the H11 sub-catchment and has a catchment area of approximately 1680km2 (168,000 ha). The lake is primarily fed by flows from the Fiery Creek which discharge into the lake at the southeast corner. The geological history of Lake Bolac area is best described as volcanic in origin, the lake itself is formed in a natural depression and historical information suggests that Lake Bolac was ephemeral in nature and would have dried out completely during extreme dry periods (Gervasi & P&P Design, 2006).

At the outlet of Lake Bolac where Salt Creek begins, an artificial weir has been constructed which is believed to have significantly altered the natural hydrology and water quality of the lake. Historically, it is believed that the mouth of the outlet was blocked by sand, which under certain conditions was breached and allowed part of the water from wetlands to flood downstream. Due to local concern at the time that the sand bar could be washed away permanently and a valuable water resource lost, the outlet was blocked with rock. Various stages of construction upgrades and decommissioning have resulted in the current situation with a concrete spillway with no water level control device (Gervasi & P&P Design, 2006).

There are a large number of wetlands which exist throughout the catchment, most are small and ephemeral (only wet some of the time) and on private, agricultural land, however there are others which are larger. A wetland, as classified by the Ramsar Convention (1971), are areas of marsh, fen (swamp), peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water depth of which low tide does not exceed six meters. In 2006, it was reported that the H12 sub-catchment had 242

Spillway at entrance to Lake Bolac, February 2011

wetlands covering an area of 2293 hectares while H11 sub-catchment had 801 wetlands covering an area of 9639 hectares (Gervasi & P&P Design, 2006). These figures are from one point in time, the very nature of wetlands means that drought, heavy rains and the ease of which wetlands can be drained, can decrease or increase the number of wetlands present and the area they occupy.

There is one highly valued wetland in the H11 H12 sub-catchment, the Nerrin Nerrin Wetlands system, which is located 11km east of Lake Bolac and consists of an inlet from Fiery Creek and five wetlands. Three of these wetlands are managed by Parks Victoria and two are located on privately owned land. Overflow from this system flows into Paddy Lake and terminates at Lake Gellie. The Nerrin Nerrin Wetlands are listed in the national directory of Important Wetlands in Australia and are considered a high priority wetland asset in the

Neerin Nerrin Swamp and homestead

Glenelg Hopkins Waterway Strategy 2014-2022. They support a rich flora, as well as large numbers of water birds, including nine species listed on international migratory bird agreements and significant occurrences of three threatened water bird species: Freckled Duck, Brolga and Whiskered Tern. The nationally vulnerable Growling Grass Frog also occurs at Nerrin Nerrin Wetlands (GHCMA, 2006).

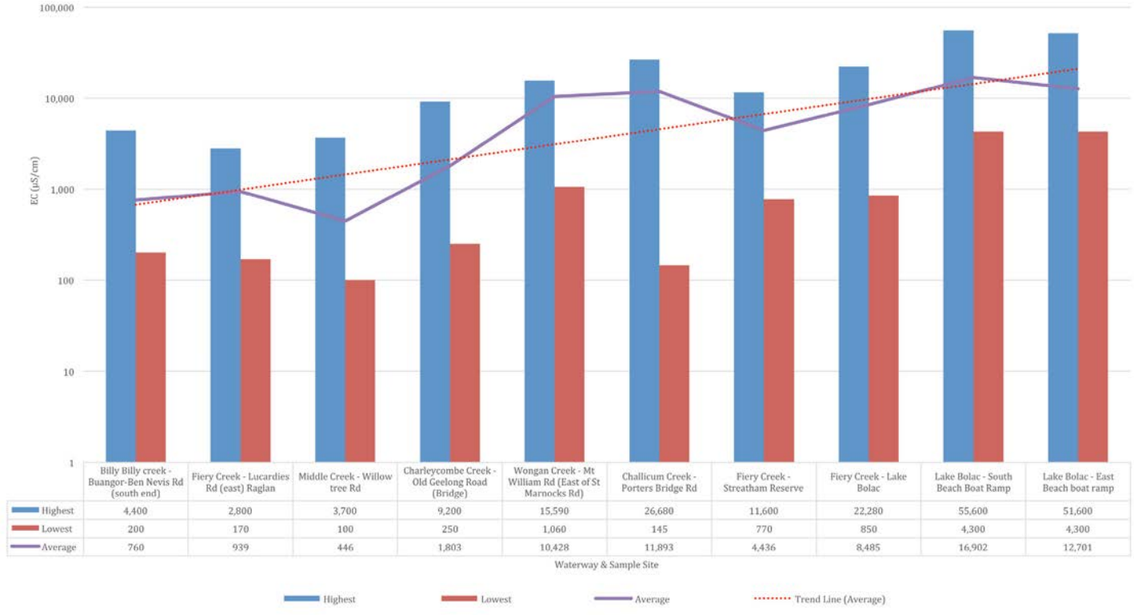
Many of the wetlands within the H11 H12 sub-catchment are located on private agricultural land. Wetlands can provide numerous benefits to agriculture, such as improving water quality, contributing to flood mitigation and the consistency of stream flows. Wetlands also aid soil conservation efforts, and contribute to the sustainability of natural food networks that enhance and protect agriculture animals and crops (Wetland Care Australia, 2016). The value of wetlands in agricultural systems is sometimes underestimated, numerous wetlands have already been lost through drainage and inappropriate management, cropping and more recently, land use and climate change. Reduced rainfall has severely impacted on runoff into wetlands, and as a result, wetlands that were wet every year might only be wet every second or third year (GHCMA, 2016).

Land manager's attitudes towards wetlands is changing, there is increasing recognition of the critical interdependencies between agriculture and healthy wetlands. Management practices are encouraging land managers to retain and restore wetlands. Further research into how to manage particular wetland types within different agricultural systems is needed to ensure that wetlands can be sustainably managed into the future.

Salinity

Salts occur naturally to some extent within the waterways, lakes and wetlands within the H11 H12 sub-catchment. However, there is evidence to suggest that the salinity within Lake Bolac has been increasing over time, and could be triggered by two separate processes. It is thought that long term increases in salinity could occur where changes in land use and impacts on ground water could be responsible for either salinity runoff or discharges of saline groundwater into surface waters. It is also thought that, in the short term, concentrations of salts and increased salinity levels result from an increase in evaporation and a decrease in precipitation over the hotter months of the year. During periods of low water flow, when Lake Bolac is not spilling into Salt Creek, the Lake acts as a sink for salt from the upper catchment. The moderately saline water which enters Lake Bolac become super saline when evaporation occurs and there is not enough flow to flush water down Salt Creek.

Figure 2. Salinity levels of waterways based on records from 2000 – 2016 (Allender U, 2016)

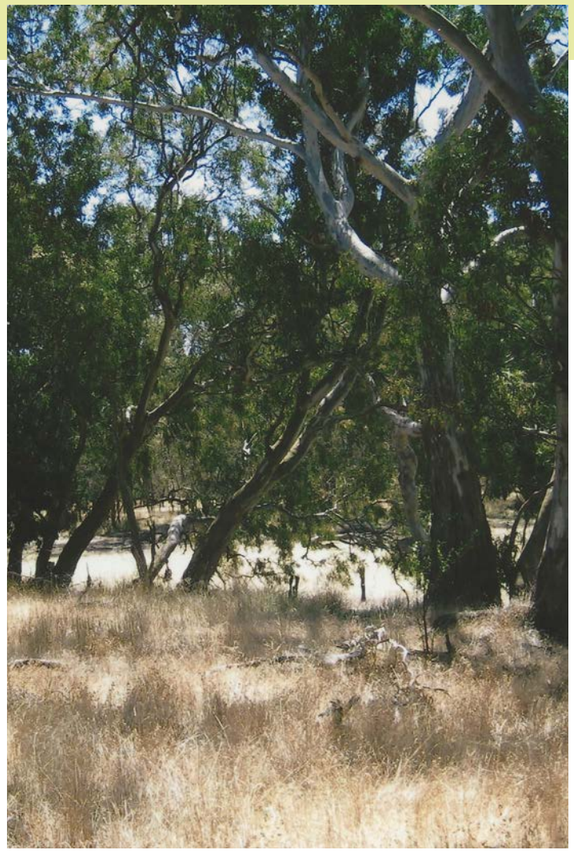


	Billy Billy creek - Buangor-Ben Nevis Rd (south end)	Fiery Creek - Lucardies Rd (east) Raglan	Middle Creek - Willow tree Rd	Charleycombe Creek - Old Geelong Road (Bridge)	Wongan Creek - Mt William Rd (East of St Marnocks Rd)	Challicum Creek - Porters Bridge Rd	Fiery Creek - Streatham Reserve	Fiery Creek - Lake Bolac	Lake Bolac - South Beach Boat Ramp	Lake Bolac - East Beach boat ramp
Highest	4,400	2,800	3,700	9,200	15,590	26,680	11,600	22,280	55,600	51,600
Lowest	200	170	100	250	1,060	145	770	850	4,300	4,300
Average	760	939	446	1,803	10,428	11,893	4,436	8,485	16,902	12,701

Measurement of salinity levels along Fiery Creek began back in the year 2000 by local landcare members. Salinity levels are measured when water levels are high enough to get a reasonable sample. In March 2007, salinity levels in Lake Bolac were recorded to be 85,000EC which was up from 27,000EC in September of 2006 (Gervasi & P&P Design, 2006) In March 2016, the salinity level at Lake Bolac's South Beach was 50,000EC and at Lake Bolac East Beach it was 51,600EC, which was well above the 13,200EC which was recoded the same time the year before (Allender U, 2016). The graph below shows the highest, lowest and average salinity for various waterways within the H11 H12 sub-catchment between the year 2000 and 2016. It's important to note that this data represents only a small snapshot in time, and a larger time period would provide a better picture of the salinity levels within the upper catchment. Between the year 2000- 2016 many waterways were dry preventing salinity levels to be measured, however in 2011, the catchment experienced a significant flooding event triggering a flush of the system and good water levels across the catchment. Based on the data collected, the graph indicates that the salinity levels are increasing as the water flows from the upper catchment to Lake Bolac.

Native Flora

The H11 H12 sub-catchments stretches across four of Victoria's bioregions, the Victorian Volcanic Plains and the Dundas Tablelands in the south and Goldfields and Central Victorian Uplands in the north. Most of the catchment is covered by the Victorian Volcanic Plain Bioregion which is dominated by Cainozoic volcanic deposits which formed extensive flat to undulating basaltic plain with stony rises, old lava flows, numerous volcanic cones and old eruption points and is therefore dotted with shallow lakes both salt and freshwater. The soils are generally grey loams (Weatherly, 2016) with small patches of shallow reddish-brown to black loams and clays which are highly fertile. Wetland formations include inland salt marshes, permanent and intermittent freshwater and saline/brackish lakes, permanent freshwater ponds and marshes and inland, subterranean karst wetlands (DELWP, 2015).



Eurambeen Redgum and Wetland

Within the Victorian Volcanic Plain bioregion, the Australian Government has identified the Natural Temperate Grassland, Grassy Eucalypt Woodland and Seasonal Herbaceous Wetlands as critically endangered ecological communities which are protected under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Temperate grasslands and grassy woodlands are among the most under-represented ecosystems in Australia's conservation estate and are recognised nationally as among the most threatened vegetation types. Both ecological communities were formerly extensive on the Victorian volcanic plain but now comprise mostly small, highly fragmented remnants in a landscape that has been largely cleared for agriculture (DSEWPC, 2011).

Less than five per cent of the original extent of both communities remains, although patches in good condition are likely to constitute less than one per cent. Most known remnants are small – under 10 hectares in size. Many patches of these ecological communities require recovery efforts because they are so degraded, due to weed and feral animal invasion and loss of native biodiversity, that their capacity to maintain ecosystem function is impaired (DSEWPC, 2011)

Seasonal Herbaceous Wetlands are temporary freshwater wetlands that are inundated on a seasonal basis, typically filling after winter-spring rains, and then drying out. The vegetation is generally treeless and dominated by an herbaceous ground layer, often with grasses, sedges and rushes with small flowering plants present. The species present are characteristic of wetter locations and are typically absent or uncommon in any adjoining dryland grasslands and woodlands. The dominant plants present are subject to seasonal and site conditions, and the diversity of the flora may range from relatively species-poor to species-rich composition (Department of Environment, 2016).

The land tenure within which the Seasonal Herbaceous Wetlands ecological community occurs, is primarily private land and the main land use is agriculture, mainly grazing and cropping. The generally flat landscape and fertile soils where Seasonal Herbaceous Wetlands occur are conducive to agriculture. Freshwater Meadows and Shallow Freshwater Marshes are typical wetland types found in the Victorian Volcanic Plains Seasonal Herbaceous Wetlands ecological community, within Glenelg Hopkins CMA area. They are shallow and dry for most of the year and may not be recognised as wetlands, which means that they are easily drained or cropped. At least 70 per cent of freshwater meadows in the Glenelg Hopkins catchment have been drained and many of the smaller wetlands that remain on private land are grazed by domestic animals or cropped during dry years. The greatest threats to these wetlands are ploughing, farm chemicals and sprays, pest plants, vegetation removal and unrestricted grazing (GHCMA, 2016).

Ecological Vegetation Classes (EVC) are the standard unit for classifying vegetation types in Victoria and are based on early approaches to mapping the floristic communities for Victoria's five regional forest agreements in the 1990's. Through the regional forest agreement process and subsequent mapping projects in the non-productive forest regions of the state, the whole of the state of Victoria was mapped with

Salt Creek near Woorndoo

EVCs at 1:100,000 scale. EVCs are described through a combination of floristics, lifeforms and ecological characteristics, and through an inferred trustworthiness to particular environmental attributes. Each EVC includes a collection of floristic communities that occur across a biogeographic range, and although differing in species, have similar habitat and ecological processes.

Within the Victorian Volcanic Plains bioregion, the Australian Government has identified the Natural Temperate Grasslands, Grassy Eucalypt Woodland and Seasonal Herbaceous Wetlands as critically endangered ecological communities.

Based on the Victorian State Government EVC mapping in 2005, the dominant EVC found within the H11 H12 sub-catchment VVP bioregion area is Plains Grassland, which is characterized by treeless vegetation mostly less than 1 m tall dominated by largely grasses and herb life forms. Species usually found within this EVC include Kangaroo Grass, Wallaby Grass, and herbs such as the iconic Blue Devil, Slender Sun Orchid, Lemon Beauty Heads and Pink Bindweed. This area is also dotted with Plains Grassy Woodland and small patches of Heathy Dry Forest, which normally includes eucalyptus species such as Grey Box, Yellow Box and Yellow Gum, Red Stringybark, Broad-leaved Peppermint and Narrow-leaf Peppermint. Both these EVCs are listed as endangered by the State Government of Victoria.

Along the creek lines, the mapping suggest that the dominant EVC includes Floodplain Riparian Woodland and Creek-line Grassy Woodland, which includes species such as River Red Gums and Swamp Gums with understory species including wattles, grasses, sedges and lilies, these two EVCs are also listed as endangered. The wetland area EVCs include Plains Grassy Wetlands, which is endangered, and Plains Sedgy Wetlands which is listed as vulnerable and characterised by a sparse shrub and ground cover dominated by grasses and small sedges and herbs. The vegetation is typically species-rich on the outer verges but is usually species-poor in the wetter central areas; it has been presumed that these EVCs are now extinct within the catchment (GHCMA, 2006), however there is local evidence to suggest there are some very small pockets in existence.

The Dundas Tablelands covers a small section of the catchment along the western side of Lake Bolac and Salt Creek from Lake Bolac to half way between Woorndoo and Hexham. Dundas Tablelands is predominantly a hard ironstone layer caps the Paleozoic deposits, resisting erosion. Streams have cut deep narrow valleys across the tablelands. The mapping suggests that the dominate EVC in this area is Plains Grassy Woodlands, which is characterised by an open, eucalypt woodland of River Red Gums with an understory which consists of a few sparse shrubs over a species-rich grassy and herbaceous ground layer and listed as endangered.

H12 sub-catchment landscape

The headwaters of Fiery Creek flow through the Central Victorian Uplands Bioregion, which is dominated by granitic and sedimentary terrain with metamorphic and old volcanic rocks which have formed steeply sloped peaks and ridges (DELWP 2015). The EVC mapping implies that the three most dominant EVCs within this bioregion include Heathy dry forest, Herb-rich foothill forest and Grassy dry forest. Heathy dry forest grows on shallow, rocky skeletal soils on a variety of geologies and on a range of landforms from gently undulating hills to exposed aspects on ridge tops and steep slopes at a range of elevations. The over-storey is a low, open eucalypt forest to 20m tall and includes species such as Red Stringybark and Broad Leaved Peppermint eucalypts. The understorey is typically dominated by a low, sparse to dense layer of shrubs including the common heath, Golden Bush pea and the iconic Grass tree. Grasses are frequently present in the ground layer, but do not provide much cover (DELWP, 2015).

Grassy dry forest has a similar canopy to the Heathy dry forest however it is characterised by a smaller tree layer including a number of Acacia species. The understorey consists of a sparse shrub layer and ground layer dominated by a high diversity of drought-tolerant grasses and herbs, often including a suite of fern species. Along the easterly and southerly aspects of the lower slopes and in gullies is where the Herb-rich foothill forest thrives. It is characterised by a medium to tall open forest or woodland to 25m tall with a small tree layer over a sparse to dense shrub layer. A high diversity of herbs and grasses in the ground layer characterise this EVC (DEWLP, 2015).

It's important to note that the native vegetation within the H11 H12 sub-catchment has been highly modified and many of the EVC which should exist may no longer be present. There may only be a few key species which survive in any one area, which makes it difficult to determine what existed in the past and therefore what should be re-planted to increase the biodiversity value for the future, especially within a changing climate. Local knowledge suggests that the soils across the catchment are grey/loams, and that Grey Box and Yellow Gums are no longer present. Swamp Gums are limited to Fiery Creek in the upper catchment, along with Candlebark, Messmate, Yellow Box and Scentbark species. The Fiery Creek also supports remnant Red Gums, Tea Trees and Tree Violets, however there are only limited areas where Sheoaks, Banksia's and Bursaria exist today.

The table below list flora species of national or state significance within the H11 H12 sub-catchment. This list was sourced from the Victorian Biodiversity Atlas, which has more than six million records of species distribution and abundance from systematic surveys and general observations for the State of Victoria, and only includes listings from 2005 – 2015. It's important to note that this list is not definitive, and it is likely that some of these species may no longer be present, while other species could be present but not listed below.

Table 3. Flora of National and State Significance for H11 and H12 Sub-catchment. Source: Victorian Biodiversity Atlas 2016

Flora of National and State Significance (2005 – 2015)	
Scientific Name	**Common Name**
Leucochrysum albicans var. tricolor	White Sunray
Pimelea spinescens subsp. spinescens	Spiny Rice-flower
Diuris basaltica	Small Golden Moths
Rutidosis leptorhynchoides	Button Wrinklewort
Senecio macrocarpus	Large-headed Fireweed
Daviesia laevis	Grampians Bitter-pea
Prasophyllum suaveolens	Fragrant Leek-orchid
Dianella amoena	Matted Flax-lily
Ptilotus erubescens	Hairy Tails
Senecio cunninghamii var. cunninghamii	Branching Groundsel
Boronia nana var. pubescens	Dwarf Boronia
Coronidium gunnianum	Pale Swamp Everlasting
Dianella sp. aff. longifolia (Benambra)	Arching Flax-lily
Sclerolaena patenticuspis	Spear-fruit Copperburr
Sida intricata	Twiggy Sida
Thelymitra gregaria	Basalt Sun-orchid
Ranunculus diminutus	Brackish Plains Buttercup
Diuris gregaria	Clumping Golden Moths
Poa physoclina	Wind-blown Tussock-grass
Bossiaea cordigera	Wiry Bossiaea
Comesperma polygaloides	Small Milkwort
Correa aemula	Hairy Correa
Diuris behrii	Golden Cowslips
Eucalyptus yarraensis	Yarra Gum
Galium curvihirtum	Tight Bedstraw

Native Fauna

The H11 H12 sub-catchment is home to a vast array of native wildlife. The Short Finned Eel (Anguilla Australis) is the most familiar species linked to Lake Bolac due to its significance in the Indigenous cultural heritage of the area. The Eel commences an extraordinary journey from where they spawn near Vanuatu, undertaking metamorphosis from larvae to a juvenile eel, prior to arriving in the freshwater estuaries of Australia and New Zealand.

In Victoria, juvenile eels begin their upstream migration between the months of March and October. Adult eels live in Lake Bolac and surrounding wetlands until the eels reach sexual maturity, around the age of 10, when they return to their birthplace to spawn and die. The Short Finned Eel is widespread and common in coastal river systems in southern Queensland, New South Wales, Victoria, Tasmania and the larger Bass Straight islands as well as the islands found in the south-western Pacific.

The H11 H12 sub-catchment is also home to a number of rare, threatened and endangered native species which are protected either under Victoria's Flora and Fauna Guarantee Act 1988 or the Australian Government's Environment Protection and Biodiversity Act 1999. A list of national or state significant species is provided in table 3. This list was sourced from the Victorian Biodiversity Atlas, which has more than six million records of species distribution and abundance from systematic surveys and general observations for the State of Victoria, and only includes listings from 2005 – 2015. It's important to note that this list is not definitive, and it is likely that some of these species may no longer be present, while other species could be present but not listed below.

Juvenile Short Finned Eel

Table 4. Fauna of National and State Significance for H11 & H12 sub-catchment, source: Victorian Biodiversity Atlas, 2016

Fauna of National and State Significance (2005-2015)	
Scientific Name	**Common Name**
Actitis hypoleucos	Common Sandpiper
Tringa nebularia	Common Greenshank
Gallinago hardwickii	Latham's Snipe
Plegadis falcinellus	Glossy Ibis
Ardea modesta	Eastern Great Egret
Biziura lobata	Musk Duck
Litoria raniformis	Growling Grass Frog
Miniopterus schreibersii bassanii	Common Bent-wing Bat (southern ssp.)
Delma impar	Striped Legless Lizard
Circus assimilis	Spotted Harrier
Falco subniger	Black Falcon
Sminthopsis crassicaudata	Fat-tailed Dunnart
Pseudemoia pagenstecheri	Tussock Skink
Galaxiella toourtkoourt	Little Galaxias
Chlidonias hybridus javanicus	Whiskered Tern
Nycticorax caledonicus hillii	Nankeen Night Heron
Pseudophryne bibronii	Brown Toadlet
Climacteris picumnus victoriae	Brown Treecreeper (south-eastern ssp.)
Grus rubicunda	Brolga
Anas rhynchotis	Australasian Shoveler
Aythya australis	Hardhead
Oxyura australis	Blue-billed Duck

Four unique threatened species found within the Victorian Volcanic Plans of H11 H12 sub-catchment include the Corangamite Water Skink, the Striped Legless Lizard, the Growling Grass Frog, which are protected nationally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Brolga, protected in the State of Victoria by the *Flora and Fauna Gurantee Act 1988*.

The Corangamite Water Skink (*Eulamprus tympanum marnieae*) is endemic to Victoria where it is restricted to the rocky verges of a few wetlands on the Victorian Volcanic Plain. The skink is a medium sized lizard and grows up too 25cm long and is a pale olive to dark yellowish-brown colour with irregular black markings. A heavy, irregular, somewhat broken black stripe extends from the snout along the sides to the hind limbs, while the limbs are overlain by heavy black stripes and blotches. The skink has undergone a decline, disappearing from at least two historical locations, and is known from only 30 sites representing 11 discrete existing populations (DSE, 2011). It has been known to exist at two sites around Lake Bolac and also at the Nerrin Nerrin wetlands.

Striped Leggless lizard at Cross Roads, South West Victoria

Threats such as rock removal, vegetation clearance, inappropriate grazing, wetland loss and inappropriate water management have contributed to its decline and threaten the remaining populations. The Corangamite Water Skink is listed as Endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, Threatened under the Victorian Flora and Fauna Guarantee Act 1988, and is considered Critically Endangered in Victoria (DSE, 2011).

The Striped Legless Lizard (*Delma impar*) is a grassland specialist, being found only in areas of native grassland and nearby grassy woodland and exotic pasture. Superficially, these animals resemble snakes, but can be readily distinguished from the latter by the presence of external ear openings, a fleshy undivided tongue and a tail which, when unbroken, is longer than the body. The striped legless lizard is patchily distributed in grasslands of south-eastern NSW, the ACT, north-eastern, central and south-western Victoria, and, possibly, south-eastern South Australia. It is believed to have declined throughout its distribution and is known to have disappeared from many sites. It is the loss and degradation of native grassland, through a variety of processes that is primarily responsible for the decline of D. impar (Smith & Robertson, 1999).

The Growling Grass Frog is one of the largest frog species in Australia and reaches up to 104mm in length. They vary in colour and pattern but in general are olive to bright emerald green with irregular gold, brown, black or bronze spotting with warty backs. This species is found mostly amongst emergent or fringing vegetation in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams. It was previously widespread across Victoria, however has now disappeared from most of its former range. The species persists in isolated populations in the greater Melbourne area, in the south-west of Victoria and a few sites in central Victoria and Gippsland (Department of the Environment, 2016).

The Brolga is one of Australia's largest flying birds, measuring from anywhere between 1 to 1.3m in height, with a wing span ranging from 1.7 to 2.4m. The Brolga

Brolgas at Tiverton Station, Western Victoria.

is a pale grey colour with an obvious red to orange patch on their head with a black dewlap (piece of skin) hanging underneath their chin. The Brolga is found across north and north east Australia, north east Queensland and right through to Victoria and is listed as a threatened species under Victoria's Flora and Fauna Guarantee Act 1988.

The Brolgas survival depends on the presence of wetlands; during the breeding period, between July to December, there main habitat is freshwater meadows or shallow freshwater marshes, although they have been known to nest in the shallows of deep freshwater marshes and in association with vegetation on permanent open waters to provide protection from predators such as foxes. Brolga pairs bond for life and have been known to utilise the same nesting areas for up to 20 years. The birds also spend time on salt lakes throughout the region, probably feeding on brine shrimp and roosting. During the non-breeding period from late December to early May, habitat comprises deep freshwater marshes, vegetated areas in permanent open water and feeding areas in pasture, seed and stubble crops (Brolga Recovery Group, 2016).

The Brolga is one of Australia's largest flying birds, measuring from anywhere between 1–1.3m in height, with a wing span ranging from 1.7 – 2.4m.

The brolga feed on both plant and animal matter and will eat a variety of wetland plants, insects and amphibians, and have also known to eat mice. Brolgas are quite skilled at foraging for food, and can even do so with their head completely submerged in water. They will use their heavy bill as a type of crow bar to wedge the ground open and turn it over in search of food (DSE, 2010). An extensive drought, combined with draining and modification of wetlands and other pressures such as fox predation have driven brolga numbers in western Victoria to an historical low, at the April 2014 count, Brolga numbers in southwest Victoria were 464 (Brolga Recovery Group, 2016).

Drainage of shallow wetlands where Brolgas nest is the primary cause of the decline in Brolga numbers, compounded by predators such as foxes taking eggs and killing chicks. The cropping of swamps has been shown to result in a reduced diversity and density of plants compared with uncropped swamps, at a landscape level the widespread cropping of swamps could reduce the quantity and quality of Brolga habitat in the landscape (Brolga Recovery Group, 2016).

The Brolga Recovery Group was created in 2010 to implement the conservation objectives of the Department of Sustainability and Environment's Flora and Fauna Action Statement No. 119. This community-based group comprises of farmers, conservationists and interested people who organise workshops, field excursions and actively promotes the scientific collection of observations on brolgas. To address the lack of data on Brolga ecology, the Brolga Recovery Group has made available a free calendar for the community to use to record relevant observations of brolgas. This data is analysed and made available for researchers. (Birdlife Ballarat, 2016). For further information, visit www.brolgarecoverygroup.org.

Pest Plants and Animals

There are a number of pest plant and animal species present within the H11 H12 sub-catchment and effective management of these species is key to improving the economic, social and environmental wellbeing of the sub-catchment. Weeds are among the most serious threats to south western Victoria's primary production and natural environment. They reduce farm and forest productivity, displace native species and contribute significantly to land degradation. Significant costs are borne by private and public land managers, industry, local government and utility companies. However, the full extent of weed damage is difficult to quantify due to the intangible costs of a reduction in biodiversity.

Weed species are classified into two main types, environmental weeds and agricultural weeds. Environmental weeds are those species that threatened the natural values of native areas such as bushlands, grasslands, waterways and wetlands. They can be introduced species or native species outside their normal rage and outcompete other indigenous species. Agricultural weeds threatened sustainable productivity, such as being toxic to stock, causing loss of condition and or death, or they out-compete desirable crop pasture species reducing production (Ararat Rural City Council, 2016).

Both environmental and agricultural weeds can be declared noxious, meaning they have been declared under the Catchment and Land Protection Act 1994 (CaLP Act) as a significant threat. Pest animals can also be declared under the CaLP Act if they pose a significant threat to the natural values of native areas. It's important to note that most environmental weeds will not be declared under the CaLP Act, however if the plant species is causing damage to a native environment, then it is defined as an environmental weed and should be managed to control its spread or eradicated if possible.

In Victoria, the CaLP Act is the main legislation covering weeds and pest animal management. One of the main objectives of the CaLP Act is to protect primary production, Crown land, the environment and community health from the effects of weeds and pest animals. The CaLP Act defines roles and responsibilities and regulates the management of declared weeds and pest animals (Department of Economic Development, Jobs, Transport and Resources, 2016). Under the CaLP Act all land owners have legal obligations regarding the management of declared noxious weeds and pest animals on their land. The level of threat posed by a weed species determines who is responsible for its control under the CaLP Act. Responsible agencies and/or individuals are required to control or eradicate these weeds according to the following categories:

- Regionally prohibited weeds are not widely distributed in a region but are capable of spreading further and it is reasonable to expect that they can be eradicated from a region. Land owners, including public authorities responsible for crown land management, must take all reasonable steps to eradicate regionally prohibited weeds on their land.
- Regionally controlled weeds are usually widespread in a region and to prevent their spread, ongoing control measures are required. Land owners have the responsibility to take all reasonable steps to prevent the growth and spread of regionally controlled weeds on their land.
- Restricted weeds pose an unacceptable risk of spreading in Victoria and are a serious threat to another State or Territory of Australia. Trade in these weeds and their propagules, either as plants, seeds or contaminants in other materials is prohibited (Department of Economic Development, Jobs, Transport and Resources, 2016).

The status of weeds in continually being reviewed and therefore the current category for certain weeds may change over time.

Below is a list of some of the weeds present within the H11 H12 catchment, this list is not definitive, and other weed species may be present within the catchment. If you know of a weed species which is not listed, or notice a different weed emerging on your land, please notify the Beyond Bolac CAG.

Table 5. Declared weed species and their current classification found in H11 H12 sub-catchment 2016

Common Name	Species Name	CaLP Act 1994 Classification	Weeds of National Significance 1999
Willow	*Salix Spp.*	Restricted	WoNS
Bridal Creeper	*Asparagus asparagoides*	Restricted	WoNS
Hawthorn	*Crataegus monogyna*	Restricted	
English Broom	*Cytisus scoparius*	Restricted	WoNS
Paterson's Curse	*Echium plantagineum*	Regionally Controlled	
Serrated Tussock	*Nessella trichotoma*	Regionally Controlled	WoNS
Spiny Rush	*Juncus acutus*	Regionally Controlled	
Bathurst burr	*Xanthium spinosum*	Regionally Controlled	
Gorse	*Ulex eutopaeus*	Regionally Controlled	WoNS
Blackberry	*Rubus fruticosus L. agg.*	Regionally Controlled	WoNS
Box Thorn	*Lycium ferocissimum Miers*	Regionally Controlled	WoNS
Boneseed/Bitou Bush	*Chrysanthemoides monilifera (L.) Norl.*	Regionally Controlled	WoNS
Cape Tulip	*Moraea Spp.*	Regionally Controlled	
Horehound	*Marrubium vulgare L.*	Regionally Controlled	
Sweet Briar	*Rosa rubiginosa L.*	Regionally Controlled	
St Johns Wart	*Hypericum perforatum L. Family Clusiaceae*	Regionally Controlled	
Amsinckia	*Amsinckia spp.*	Regionally Prohibited	

Taskforce was created in 1999 by active Victorian community members who were concerned about the impacts of gorse.

The VGT is an advisory committee made up of passionate individuals and Natural Resource Management organisation representatives who uses investment attracted from government to develop community-led projects that aim to rid areas of Victoria from this pest and reduce its impact where that is not possible (VGT, 2016). Managing Gorse is a long term commitment and requires many techniques, the four parts of a successful gorse control program include prevention of spread, removal of above-ground mass of gorse, destruction of regrowth and follow-up seedlings for at least five years and up to 25 years (National Gorse Taskforce, 2006).

Gorse on roadside beside Fiery Creek

Amsinckia

There are two emerging weeds within the H11 H12 sub-catchment, Amsinckia and St Johns Wart, which should be monitored and managed appropriately. Amsinckia is also commonly known as yellow burr weed, buckthorn, tar weed or yellow gromwell. It is a small flowering plant which grows to a height of 30cm – 70cm and has branches covered with fine, stiff hairs or bristles. The flowers are self-pollinating and resemble a trumpet – shape. They are bright yellow to slightly orange in colour and are positioned on one side of the stem. The plant is found in degraded pastures, roadsides and in dry sandy areas and can rapidly spread by maintenance activities such as slashing and grading. This species is listed as regionally prohibited under the CaLP Act, and is not widely distributed but is capable of spreading further. It is likely that it could be eradicated from H11 H12 sub-catchment with a collaborative targeted approach by public authorities and land managers.

St Johns Wart is a flowering plant which grows to about 80cm. It produces woody flowering stems to 1.2 m in spring and are golden yellow with black dots on the margins. It invades grasslands, woodlands, open forest, pastures, forestry plantations, roadsides, railway lines and river banks. Seed can remain dormant in soil for at least 20 years. Well-established infestations can largely eliminate all other plants and restrict recruitment to the over storey. The plant is poisonous to livestock, when eaten, St John's wort causes inflammation of face, ears, lips; affects the nervous system (panting, salivation, respiratory distress) and alters heart, blood vessel and intestinal function. Affected animals can generally recover between 3 to 6 weeks once removed from access to the plant. Other weeds which have spread more widely across the catchment in recent years include Paterson's Curse and Serrated Tussock (Andrews D, 2016).

St Johns Wart

Pest animals also pose a serious threat to south western Victoria's primary production and natural environment. Rabbits wreak havoc across the sub-catchment and are declared as an established pest animal (wild or feral populations) under the CaLP Act. Rabbits are recognised as the most serious vertebrate pest in Victoria, responsible for major environmental and agricultural damage. Rabbits are a major factor in the loss and reduction of many native plant and animal species by causing detrimental habitat change, direct grazing competition and prevent natural regeneration of native species. Current techniques available for controlling rabbits can be categorised broadly as biological, chemical and mechanical.

Biological control for rabbits has been particularly effective and include the myxoma virus causing the disease myxomatosis, which only affects rabbits. The main chemical control used for rabbits is the poison; sodium flouroacetate (1080) which has an effective toxin providing a high mortality rate of up to 90 per cent. Destruction of warrens and above-ground harbours is the most widely used mechanical method for rabbit control. Warren ripping can be a cost-effective and efficient method for suppressing rabbit numbers and inhibiting reinvasion of the treated area, because it deprives rabbits of a safe place for breeding. Other methods used less widely are fencing, shooting, trapping and explosives to destroy warrens (DSEWPC, 2011).

Below is a list of some of the pest animals present within the H11 H12 catchment, this list is not definitive, and other pest animal species may be present within the catchment.

Table 6. Some pest animal species found within H11 H12 sub-catchment.

Common Name	Speceis Name	CaLP Act 1994	Fisheries Act 1995	EPBC Act 1999
Fox	*Vulpes vulpes*	Established Pest Animal		Threatening Process
Rabbit	*Orycotolagus cuniculus*	Established Pest Animal (wild/feral populations)		Threatening Process
Mosquito Fish	*Gambusia holbrooki*		Noxious aquatic species	
Carp	*Cyprinus carpio*		Noxious aquatic species	

Bill Sharp at the Southern Farming Systems field day

Land use

Agriculture is the most extensive land use in the H11 H12 sub catchment, in the past, the area was known for its high quality Merino wool however; recently there has been an increased emphasis on intensive agriculture, broad acre agriculture and horticulture, such as wine production. The Water and Land Use Change Study undertaken in 2004/2005 for Glenelg Hopkins CMA suggested that 31% of the catchment was used for cropping while 43.7% was used for broad acre grazing. The report predicted that broad acre grazing activities would decline with a large shift to crop based agriculture. By 2020, 25.7% of the catchment will be broad acre grazing and 42.3% will be crop based agriculture, by 2030; broad acre grazing will drop to only 15.3% with crop based agriculture increasing to 48.8% (Gervasi & P & P Design, 2006).

This change is due to a number of reasons, including drought, generational change and farm aggregation (Ararat Rural City Council & Planisphere, 2014). Other significant changes for the agricultural sector include an increase farm size together with decreased farmer numbers, increase use of contractors, an increasing use of technology and more corporate farms in the fertile cropping country in the south (Ararat Rural City Council, 2010).

Changes in farming methods have, over the years, led to improvements in water use efficiency, however, reduced run-off, salinity, acidification and erosion remain important issues for the catchment. Other emerging issues include cropping of wetland remnants, the removal of volcanic plains rocks (habitat) to increase viable cropping land and the potential for contamination by genetically modified crops. The agricultural sector is also facing prolonged drought and the projected variability of the climate. These shifts impact rural towns and communities with young people leaving farms and others moving away from farm work, this creates gaps in the social infrastructure of rural districts and small towns (Ararat Rural City Council & Planisphere, 2014).

Surface water and groundwater resources are heavily utilised for urban, industrial and agricultural uses. Population growth, intensification of agriculture and growth in dams associated with rural residential land use will place increasing demand on streams that are already highly 'stressed' (Clifton C, Daamen C & Horne A, 2005).

Climate Variability

Climate projections for the Glenelg Hopkins Regions suggest that the weather will be hotter and drier in the coming years which will impact on land use, natural resources, the community and the biodiversity of the H11 H12 sub-catchment.

Temperature predictions suggests that there will be a greater number of hot days and few very cold days overall which is likely to have a significant impact on terrestrial habitats. The geographic range of both flora and fauna species will be altered, as will life cycle processes such as migration, flowering and breeding. The limited ability for fauna to move through the landscape will further impact upon species ability to adapt to the changes in climate. Ultimately the change in climate, will result in a decrease in the region's biodiversity and a change in the current location of species and ecological communities (GHCMA,2015).

Rainfall in the region is predicted to decrease with an increase in the intensity of extreme rainfall events leading to less moisture in the soil and more erosion events. Less rainfall and greater temperatures are likely to cause a reduction in pasture production and persistence which could lead to changes to feed management systems. With reduced rainfall land may become more suitable for cropping and this could increase pressures from production on remnant vegetation, wetlands and waterways (GHCMA, 2015). CMA Climate Change Strategy 9 9

Rivers, floodplains and wetlands would be greatly impacted by the reduction in rainfall and subsequent runoff and stream inflow. Rivers and wetlands that rely on direct precipitation will be most affected. The region's wetlands are likely to undergo a variety of changes such as reduction in size, conversion to dry land or a shift in wetland type. Despite wetlands being very vulnerable to climate change, they are by nature a resilient ecosystem (GHCMA, 2015).

The protection and enhancement of wetlands will become increasingly important due to their carbon sequestration potential and ability to act as 'stepping stones' for biodiversity through the catchment. Rivers are also critical for maintaining connectivity through the landscape. Riparian vegetation and refuge areas will become increasingly important with reduced stream inflow and more hot days. A reduction in water availability and possible increase in demand may intensify pressure on the region's water resources, including its rivers and groundwater (GHCMA, 2015).

Wetland at Blythdale, Streatham

Why is a blueprint needed?

The Beyond Bolac CAG was formed from a dedicated group of locals who recognised that the drying of and future management of Lake Bolac was a catchment wide problem and would require the co-operation of many individual landholders, industry bodies and government agencies from across the catchment to make a difference.

This dedicated group have been working hard over the last 10 years and have successfully achieved many strategies from the H11 & H12 Catchment Health Report. The Beyond Bolac CAG is now looking to the future and planning for the next 10 years to maximise the outcomes it can achieve.

The Norman Wettenhall Foundation landscape restoration project has enabled the Beyond Bolac CAG to review its aim, create objectives, re-connect with its many stakeholders and develop a formal Blueprint to work towards to achieve large scale landscape restoration for the H11 and H12 sub-catchment area.

What will the blueprint do?

Completing a Blueprint for the H11 and H12 sub-catchment will provide many benefits for Beyond Bolac CAG.

A Blueprint will

- Provide baseline information on the health of the catchment
- Enable the group to track change over time
- Provide an opportunity to
    - review the strategic plan for the group and key issues to focus on
    - re-connect with stakeholders and receive valuable feedback
    - make strategic decisions on where to invest funding and resources
    - view past projects and future projects visually using GIS mapping tools
- Assist the group to apply for future funding, and;
- Inspire community and stakeholders to take action on environmental and sustainability challenges facing the catchment

First Committee receiving start up funding from Beth Mellick, Executive Director, The Norman Wettenhall Foundation