COTTER DAM
PRE-READING MATERIAL

1 INTRODUCTION

In response to a severe reduction in water inflows, in 2007 ACTEW undertook another review of water supply options for Canberra. More than 30 options were considered to secure the water supply for the ACT. The options that were adopted and are now being implemented are:

- the Enlarged Cotter Dam
- the Murrumbidgee to Googong Water Transfer and
- the Tantangara Transfer

This booklet contains a variety of background information and references to other resources to assist in teaching the Cotter Dam curriculum units.

The information was compiled during the planning, design and construction of the Enlarged Cotter Dam.

Refer to the Environmental Impact Statement report, which is on the Planning approvals and documentation disc, for further information on any of the topics covered in the following sections.

2 LANDSCAPE

The Cotter River catchment is located almost wholly within the Australian Capital Territory (ACT), to the west and south west of Canberra. A small section of the northern extremity of the catchment is found within the Brindabella National Park in New South Wales. The majority of the catchment which lies in Namadgi National Park covers approximately 50,000 hectares (ha) of sharply dissected terrain with a mixture of sub-alpine, wet and dry sclerophyll forests, perched swamps and valley floor grasslands.

Climate and terrain have a dominating influence on the hydrology of the Cotter catchment and hence on the hydrological values attributed to the landscape - water supply and aquatic ecology. Elevation ranges from 500 to 1,900 metres (m) with higher elevations associated with increased rainfall, wetter forests - except on ridge tops, and lower temperatures. Three major river reaches feed respectively into the Cotter, Bendora and Corin Dams. These reaches are:

- lower northern landscape with extensive undulating terrain surrounded by mountainous ranges to the west
- a central deeply incised valley system flanked by steep ranges to the east and west and
- an upper river landscape characterised by a series of alluvial valley flats, surrounded by mountainous ranges.

Away from valley floor systems, the terrain is precipitous with slopes averaging more than 20 degrees.

The primary use of the Cotter Catchment since the completion of the Cotter Dam in 1915 is as the water supply for Canberra and Queanbeyan. Other land uses within the Cotter catchment have included grazing, forestry, mining and recreational activities. Though many of these activities have been confined or removed entirely from the catchment since 1915, their impact is still visible. The catchment is used extensively for research due to its intrinsic values and this has resulted in a large and diverse body of work on issues including vegetation, fauna, fire ecology, nutrient cycling and hydrological and water quality studies.

3 ANIMALS

There is a large range of animals that call the Cotter home. There are many uncommon, migratory and threatened animal species that have been recorded within the Cotter area. Some of these animal species include the Pink-tailed Worm Lizard, Speckled Warbler, Little Eagle, White Winged Triller, Brown Treecreeper, Eastern Bent Wing Bat and the Gang-gang Cockatoo (refer to Appendix A for a full list).

Other animals found in the Cotter include the Platypus, many species of microbats as well as many other native and introduced amphibians, birds, fish and mammals (refer to Appendix B for a full list).

The animals in the Cotter live in a range of different habitats including regenerating eucalypt woodland, open forest, former pine forests, riparian shrub and reedlands, rock outcrops, rocky gorges, tree hollows, mine workings and caves, riparian areas and wetlands.

Pine plantations and the 2003 bushfires have had significant impacts on the habitats for native animals in the Cotter area. Tree cover and ground cover has been completely removed in some areas. The consequence of this is that some native animal species may actually benefit, while others were adversely affected. It is expected that with continued vegetation recovery of animal diversity will increase over time.

3.1 PLATYPUS

Platypuses are relatively common in the Cotter River, having been recorded in all three reservoirs (Corin, Bendora and Cotter). They have also been seen in the Cotter River immediately below the Cotter Dam and at the campground. Whilst platypuses are not considered to be endangered, threatened or uncommon, they may be affected by an enlarged Cotter Reservoir through changes to food supply and increased water depth. Increased water depth may change suitability of habitat because platypuses are apparently unable to forage successfully for small food items at depths greater than about 5–10 m.

3.2 MICROBATS

Twelve species of microbats have been identified in the Lower Cotter Catchment. Microbats are very small bats that eat insects, moths and beetles and even very small fish.

They roost in dark places, such as crevices, caves, holes in trees, folded leaves, under bark and even in roofs. Microbats have large, sensitive ears reflecting their use of sonar to navigate in the dark. They produce pulses of ultra-high pitched sound and navigate by listening for the echoes. They are social animals and roost together in colonies. The newborn baby hangs onto its mother using its claws and teeth attached to her nipple, as she flies around. The mother finds her own baby among thousands by using her sense of smell.

3.3 FISH

There are four threatened fish and one crayfish species in the Cotter Reservoir and in the Cotter River that could potentially be affected by the Enlarged Cotter Dam.

The species and their conservation status in the ACT are:

- Macquarie Perch (*Macquaria australasica*) – endangered
- Trout Cod (*Maccullochella macquariensis*) – endangered
- Two-spined Blackfish (*Gadopsis bispinosus*) – vulnerable
- Murray Cod *(Maccullochella peelii)* – vulnerable
- Murray River Crayfish (*Euastacus armatus*) – vulnerable

3.3.1 How will the fish be affected?

There are many ways the fish may be affected during the construction and operation of the Enlarged Cotter Dam. Some of these issues are listed in Table 1.

Table 1 Issues and impacts of the Enlarged Cotter Dam project on species of concern

Issues	Potential impact
Dam operations	The way the dam is operated; including the level of the water in the dam and how often this level fluctuates could have potential impacts on food resources.
Flows downstream of the dam	Changes to the quantity, timing and temperature of these flows could have an effect on these species.
Introduction of pest species or pathogens	There is a significant risk of the introduction of pest species or pathogens to the water supply through the inappropriate recreational use of the reservoir or catchment, including illegal fishing.
Expansion of alien fish populations	The Cotter Dam wall has acted as a barrier and prevented some alien fish species migrating up the Cotter River. The design and construction of the Enlarged Cotter Dam will need to ensure that alien fish cannot be transported upstream. The changed environment in the new dam with water 50 m deeper in the reservoir may offer more habitat opportunities for alien fish species, such as trout, which may be detrimental to native species.
Increase in Cormorant numbers	A larger reservoir may result in more Cormorants who are known to prey on Macquarie Perch during spawning migrations into the Cotter River above the reservoir.
Introduction of EHN fish virus	The Enlarged Cotter Dam project could increase the risk of introducing the fish Epizootic Haematopoietic Necrosis (EHN) virus into the Cotter Reservoir.
Loss of preferred habitat	Loss of habitat and protective cover will occur when the new reservoir fills and the existing reed beds are submerged beneath the water.
Disruption of breeding cycles	Breeding cycles may be disrupted when the new reservoir fills and the critical spawning habitat in the Cotter River immediately upstream of the Cotter Reservoir is submerged and the fish must travel further upstream to find suitable spawning sites.

3.3.2 What is being done to protect the fish?

A number of projects have been carried out or are currently being carried out. There are nine projects in total and they are:

Project 1—Artificial habitats

A variety of artificial habitats were tested in the Cotter reservoir to determine which ones the Macquarie Perch and the Two-spined Blackfish will use as habitats (the adult Macquarie Perch for shelter and the Two-spined Blackfish for spawning habitat).

Artificial habitats are needed as current habitat for these fish (vegetation at the edge of the reservoir sticking out of the water called macrophytes) will be submerged when the reservoir fills and fluctuating water levels will make it hard for this vegetation to establish again. Macquarie Perch use this vegetation as shelter from Cormorants as well as a feeding habitat, especially on shrimps.

Project 2—Swimming capacity of Macquarie Perch

Not a lot was known about the swimming abilities of the Macquarie Perch other than that they only spawn in flowing water, so to breed they must leave the still water of the reservoir. However, if anything blocks their passage they will not be able to breed. This project investigated the swimming ability of Macquarie Perch in order to aid in the design of fish passages to help them move through barriers. This project has been completed and measures have been recommended to help the Macquarie Perch.

Project 3—Crayfish ecology

The aim of this project was to learn more about the Murray River Crayfish. The Murray River Crayfish may be an important indicator of river health so it was important to learn more about its ecology. The project investigated its distribution, population status, habitat requirements, competitors and predators.

Project 4—EHN virus occurrence

This project was undertaken to determine whether the Epizootic Haematopoietic Necrosis (EHN) virus was present or absent in the fish population of Cotter Reservoir.

The virus was first isolated in 1985 in the alien Redfin Perch. It causes a high rate of death in fish populations through rapid internal organ failure. Experimental work has demonstrated that Macquarie Perch is one of several species that is extremely susceptible to the disease. This project found that the EHN virus is not in the Cotter Reservoir. It is highly important to ensure that any monitoring, construction or post-construction activities continue to keep the virus out of the Cotter system upstream from the Enlarged Cotter Dam.

Project 5—Translocation of Macquarie Perch, Trout Cod and Two-spined Blackfish

A project to create populations of the Macquarie Perch in areas that they do not currently occur (called translocation) commenced in 2006. By establishing additional populations of these species outside the area potentially affected by the Enlarged Cotter Dam, their chances of survival and growth are greatly increased.

Juvenile fish are used for the translocation programs, as these fish would normally be expected to suffer high natural mortality in the first year or two of life and removing these fish from the Cotter Reservoir shouldn't have a negative affect on the donor population (ie. the adult fish).

Current translocation sites include the Cotter River above Corin Dam and Molonglo River above Molonglo Gorge. However, additional translocation sites also need to be established. This project will possibly take over 10 years to allow fish to establish (as juvenile fish will take longer to establish than adult fish) and also to minimise the impact on donor populations, only small numbers of fish will be translocated each year.

Project 6—Management program for alien fish species

The Enlarged Cotter Dam may result in increased numbers of alien fish as well as increased distribution and impacts on native fish species. The preferred habitat of some alien species will increase in area, and Trout populations and specimen size may also increase with an increase in food and water of the right temperature. These alien fish species may also bring diseases into the reservoir. Some alien fish species that may appear include Goldfish, Eastern Gambusia, Oriental Weatherloach, Trout, Carp and Redfin Perch.

Prior to completion of the Enlarged Cotter Dam, a team of specialists will produce a management program to protect native fish against these alien fish species.

Project 7—Food sources for Macquarie Perch

The ecosystems in the Enlarged Cotter Dam Reservoir that provide food for the resident fish populations will change significantly during construction and operation. Reeds, aquatic plants and large woody debris (post fire) all provide habitat for macro-invertebrates, which are the basis of the food chain in the reservoir.

This project is providing information to help protect fish food sources by investigating:

- the main food for Macquarie Perch and the other resident fish species
- what habitat supports the growth of these food sources
- what food items are available and in what amounts

- whether competition for food with other species is likely to limit the Macquarie Perch population and
- whether artificial habitats may be used to promote the production of food for fish.

Project 8—Mapping instream barriers

Macquarie Perch move into running water in order to spawn. Barriers that prevent access to suitable spawning habitat can lead to the extinction of population. This project was designed to map and investigate barriers to fish passage in the Cotter River upstream of the Cotter Reservoir. The results have been integrated with the findings on swimming capacity of Macquarie Perch (Project 2) to identify measures to overcome the barriers to fish movement. This project will also test if digital elevation models and geographic information systems can be used to identify physical fish barriers.

Project 9—Fish monitoring for the Enlarged Cotter Dam

An integrated monitoring program is required to enable the results of mitigation actions to be assessed and to complete the adaptive management cycle.

3.4 FACTSHEETS FOR FURTHER READING

As part of this education kit, you will find fact sheets on the following for further reading:

- Macquarie Perch
- Trout Cod
- Two-spined Blackfish
- Murray Cod
- Murray River Crayfish
- Pink-tailed Worm Lizard
- Speckled Warbler
- Brown Treecreeper
- Eastern Bent-wing Bat
- Gang-gang Cockatoo
- Golden Sun Moth
- Alpine Tree Frog
- Northern Corroboree Frog
- Yellow Spotted Tree Frog
- Grassland Earless Dragon
- Regent Honeyeater
- Freckled Duck
- Brush Tailed Rock Wallaby
- Smoky Mouse and
- Platypus.

4 PLANTS

There is a wide variety of vegetation and land cover in the Cotter catchment, including forest, open forest, riparian vegetation, woodland and grasslands at higher altitudes and on river flats, submerged aquatic vegetation, bog, fen and alpine heath communities are also present.

Many forest and woodland species are common throughout the catchment particularly Snow Gum (*Eucalyptus pauciflora)*, Broad Leaf Peppermint (*Eucalyptus dives*) and Mountain Gum (*Eucalyptus dalrympleana*). Tall open forests tend to be composed of Alpine Ash (*Eucalyptus delegatensis*) and Brown Barrel (*Eucalyptus fastigata*), and low open forests consist of Peppermint (*Eucalyptus radiata*) and Snow Gum (*Eucalyptus pauciflora*).

Sub-alpine and alpine woodlands are restricted to the higher altitudes and cold air drainage sites within the catchment. These are typically Snow Gum dominant communities found on the ridges and valley floors of the upper catchment.

Exotic tree species other than pine occur in the native forests of the catchment. These include willows, poplars and elms and are the result of activities associated with early European settlement of the area. There are also exotic plants and weeds particularly in areas that have been devastated by bushfires. Some of these weeds include African Lovegrass, Sweet Briar, Blackberry, Common Hawthorn, Paterson's Curse, St. John's Wort and Radiata Pine.

There are also a range of significant plant species in the Cotter that are considered threatened, endangered or critically endangered. A full list of these significant plant species can be found in Appendix C

The flora of the Cotter Catchment reflects the land use history of the area; including cleared forest areas, pine plantations, logging areas, bushfires, pastoral and agricultural activities.

A full list of plant species identified in the Cotter area can be found in Appendix D.

4.1 FACTSHEETS FOR FURTHER READING

As part of this education kit, you will find fact sheets on the following for further reading:

- Xanthorrhoea relocation and
- Coarse woody debris.

5 BUSHFIRES

Fires within the ACT have been recorded since 1830. All fires prior to 1920 were identified exclusively through the examination of tree rings, known as dendrochronology. Prior to approximately 1830, fire management by Aboriginal people through the montane and higher areas of the Australian Alps including the ACT, involved the burning of small patches of certain forest types at varying intervals. Burning was carried out for various reasons including:

- to encourage regeneration and the decrease of certain animals
- as fire drives
- for religious reasons and
- to clear ceremonial pathways.

Aboriginal fire management probably disappeared from the mountains in the first couple of decades after contact with Europeans as the numbers of Aboriginal people dropped very quickly and any subsequent introduction of fire by Aboriginal people was seen as an interference with the grazing industry.

Early European land management varied from one leaseholder to another dependent upon their views or inclinations, but, on average, fire frequency increased as the number of graziers increased. This increase was primarily from the intentional introduction of fire for the purposes of pasture management.

In the past 100 years, major bushfires occurred in the Cotter and surrounding areas in the summers of 1920, 1926, 1939, 1983 and 2003. With the exception of the 1920 fire, all have occurred during severe drought where rainfall in the months preceding the event was well below average.

5.1 1939 BUSHFIRES

The 1939 fires are considered to be part of the Black Friday Fires that burnt a substantial part of the Australian Alps within Victoria, New South Wales and the Australian Capital Territory, claiming 71 lives. These fires followed a significant drought where many fires in the Australian Alps were lit throughout the forested areas mostly for the purposes of fuel reduction. These fires were typically left to burn themselves out, rather than being properly attended or extinguished after they had burnt the desired area. As the weather picked up in January 1939, these burns combined with back-burns that had been lit without containment. These ACT fires are historically recorded as arson.

The summer leading up to the 1939 fire is documented as the driest since 1918 with daily temperatures exceeding 38ºC and average wind velocities at over 40 km/h and gusting to 72 km/h. These fires had a significant impact on the Cotter catchment effectively burning approximately a quarter of the catchment. As well as significant damage to the native forests within the catchment, approximately 1,500 ha of plantation pine forests planted at this time (Ecowise estimates of forestry planted prior to the fire that had been burnt) had been completely destroyed. The effects of the fire on water quality would have been significant with increased organic matter and sediment loads entering the Cotter Reservoir. Evidence available at the time indicates that the water quality within the reservoir was not as severely affected as was observed after the 2003 fires. This is likely due to a reduced area affected by the fire and less extensive forestry activities within the catchment. Rehabilitation activities within the catchment following the fires would have been limited to the replanting of the affected pine plantations.

5.2 1983 BUSHFIRES

The 1983 fire is referred to in the literature as the Licking Hole Creek or Gudgenby fire. This fire burnt approximately 30% of the Corin Dam sub-catchment along Licking Hole Creek and Rotten Swamp before entering the adjacent Gudgenby River catchment. As with the 1939 fires, this event followed a significant drought, however; rainfall in the previous three months was only one quarter of what was observed in 1939. The source of ignition is documented as being through a lightning strike.

The fire burnt largely mixed Eucalypt forests, woodlands, perched swamps, and grasslands. The Eucalypt species affected were typically fire resistant species that recovered by epicormic (trunk sprouting) and basal sprouting. Grasslands would have likely recovered within the first twelve months, however, the recovery of the swamps (particularly rotten swamp) would have taken some wetlands species such as sphagnum centuries to fully recover.

5.3 2003 BUSHFIRES

Fires initiated by lightning strikes on 8 January 2003, completely burnt out the Cotter Catchment over a three week period (though the majority was burnt from the 18-19 January) characterised by highly variable weather patterns and exceptionally dry conditions. Except for small refugia, all under storey within the catchment was burnt and the shrub and lower trees were severely scorched or killed. In some parts of the catchment, particularly on east and south facing slopes in the mid to upper catchment, unburnt tree canopies remained. In other areas the fire was so intense as to completely kill many of the trees. The most severely impacted areas contained fire sensitive ridge top Snow Gum (*Eucalyptus pauciflora*), valley floor Black Sally (*Eucalyptus stellulata*), Alpine Ash (*Eucalyptus delegatensis*), and Brown Barrel (*Eucalyptus fastigata*). All grasslands and bogs were severely impacted, although *Poa* grasslands and *Carex* fens have made a spectacular recovery within the first twelve months.

Severe soil loss occurred in the rainfall events that followed during February of 2003. Soil loss was principally through sheet erosion of ash, charcoal, fire debris and underlying soil. The majority of the eroded sediment in the upper catchment has remained in foot slopes and flats that flank the river and lower reaches of creeks. The sediment that did make its way to the reservoirs resulted in unprecedented increases in turbidity, iron and manganese.

During autumn 2004 to 2006 hazard reduction burns were performed to reduce the chance of forestry species growing back, whilst this has also impacted on the ability of some native species to grow back, it was important to do these hazard reduction burns in the forestry areas.

Recovery after the 2003 bushfires is ongoing. In some instances species have fully recovered. In other instances recovery may never occur.

6 GEOLOGY

The geological history of the Cotter area that we see today started about 425 million years ago (Ma). Initially between about 425 Ma and 405 Ma Canberra was under water; as part of a shallow sea with plentiful marine life and corals (evidence of this coral can be seen at the Limestone Caves near the Cotter Recreational Area). Approximately 300 Ma, the major geological processes that formed the Cotter River and catchment area occurred and created the current geological environment for the three Cotter River dams.

The Cotter Dam and the downstream reaches of the storage are located on the Walker Volcanics. Rock samples from the dam site have been classified as being mainly a porphyritic rhyolite (a volcanic lava flow). Overlying and west of the Walker Volcanics and also transecting the storage area is the thin Tarpaulin Creek Ashstone Member, which is a fine-grained bedded ashstone (a rock formed by a volcanic explosion or aerial ejection from a volcanic vent). The Uriarra Volcanics outcrop further west and underlie the remainder of the storage. These are described as consisting of dark grey to pink rhyodacite ignimbrite and air-fall tuff (both explosive volcanic rocks).

The rock types come from different geological areas. These areas at the Cotter are:

- The Walker Volcanics
  - Generally comprised of porphyritic rhyolite (ranging from green to purple in colour), bedded tuff, minor andesite, volcaniclastic sediment and limestone, calcareous and tuffaceous shale and siltstone.
  - Rhyolite from the Walker Volcanics.
    This rock can be described as a pyroclastic rock that formed by chunks of pre-existing rock and molten lava being blown out of a volcano and deposited on the ground. It is typically grey and has a porphyritic texture - which is when you have medium to coarse (up to say 5mm) crystals of quartz, feldspar and mafic minerals in a finely crystalline groundmass (the groundmass is too fine grained to be able to see the mineral crystals by eye).
- The Uriarra Volcanics
  - The rocks from the Uriarra Volcanics consist of rhyodacite ignimbrite, air-fall tuff and fine-grained bedded ashstone. All of these types of rocks were formed from volcanic eruptions with the material erupted being deposited away from the volcano and welded together due to the heat in the rock when the material is deposited.
- Tarpaulin Creek Ashstone
  - Tuff from Tarpaulin Creek Ashstone can be described as a pyroclastic rock formed when fine ash sized particles are blown out of a volcano and settle on the ground. It is typically grey-brown and too fine grained to see the minerals by eye.

The major geological faults in the area are:

- The Windslade Fault
  - located about 800 m to the south of the Cotter Dam site and trends approximately north east. The Windslade Fault intersects the Murrumbidgee Fault causing Murrumbidgee River to markedly change direction near the Cotter Pumping Station.
- The Murrumbidgee and Bullen Range Fault
  - located further south, trend north west and terminate on the Winslade Fault.
- The Pig Hill Fault
  - trends approximately north south and is located approximately 4 km north west of the proposed dam.

7 COTTER CAVES

The caves although formally in the Paddy's River area are close to the junction of Paddy's River and the Cotter River, so they are known as the Cotter Caves. There are three main caves:

- Cotter Cave – the largest cave; 65 m in length and up to 10 m high in some places
- The Powder Store Cave – 14 m in length; named because it was supposedly used to store blasting powder for a mine located nearby and
- The Blasted Cave – so named because someone had tried to use explosives to enlarge it.

It is believed that the caves were formed by a river a very long time ago. The caves are closed to the public and have in the past been inhabited by bats.

8 SOILS

8.1 SOIL CHARACTERISTICS

The geology of the Cotter consist of Ordovician and Silurian igneous rocks and marine metasediments from the Adaminaby and Tidbinbilla groups respectively, Silurian volcanics of the Uriarra and Paddy's River volcanics, and Silurian to Devonian granitic rocks. The Ordovician sediments and Devonian granites exist throughout most of the catchment with the volcanics appearing exclusively within the lower catchment near the Cotter Reservoir.

Soils derived from these geological units are highly variable in both their physical and chemical properties. The behaviour of different soils when exposed is controlled by their physical, chemical, and mechanical properties. Granitic soils are coarse textured that will erode but due to their texture will tend to accumulate coarse sediments within drainage lines with little suspended material that degrades water quality. Conversely, areas of soil derived from meta-sediments have a much higher percentage of fines and thus have a greater potential to degrade water quality.

The soils derived from the geology within the catchment have a moderate to high dispersibility and will require land use management that minimises ground disturbance wherever possible.

8.2 EROSION

Landscape disturbances within the Lower Cotter catchment have commonly occurred since the development of Canberra's water supply which commenced in 1912. Immediately upstream of the Cotter Reservoir, an area of approximately 6000 ha has been utilised as a commercial pine forest estate until recently when a policy decision subsequently reflected in the ACT Territory Plan (2008) returned the landuse to Mountains and Bushland.

Soils within the inundation area will be especially susceptible to erosion. The continuous changes in water level through normal operation of the reservoir will result in additional impacts for areas that are frequently exposed.

Erosion induced from these landscape disturbances predominately moves sediment from hillslopes and roads to valley tributaries and into the Cotter River system, which transports these sediments into the Cotter Reservoir. Sediment impacts the water quality within the reservoir in several ways, with the main issue and area of concern being the cloudiness or turbidity of the water.

Major sources of erosion in the Lower Cotter Catchment include:

1. unsealed roads
2. sheet, rill and gully erosion of unstable slopes and
3. steep scree slopes within the native bushland area.

8.3 UNSEALED ROADS

Many of these roads were created for the commercial pine forestry operations. Since these forestry operations ceased many of these roads have been closed. Many of these roads have been particularly susceptible to erosion and high rates of runoff that has resulted in substantial loads of fine sediment and bedload being delivered into the nearby Cotter River and its tributaries, particularly Lees, Pierces and Condor Creeks.

Currently, mitigation measures are showing good signs for the recovery of several of the discontinued roads, with vegetative regrowth apparent especially in the Lees Creek sub-catchment.

8.4 SHEET, RILL AND GULLY EROSION

Hillslope erosion occurs in areas where the vegetative ground cover has not fully stabilised, especially after the 2003 bushfires. Currently, the vegetation cover is variable. There are good signs of ground cover recovery in other areas since the fires.

Gully erosion is a result of increased rainfall runoff causing erosion channels within a drainage path. These can rapidly increase in size becoming a significant contributor to the sediment load.

Work being undertaken by ACTEW and the ACT Government is addressing many of the erosion issues.

8.5 STEEP SCREE SLOPES IN NATIVE AREAS

Native areas within the Upper Cotter have significantly recovered from the fires in terms of ground cover to protect slopes from erosion. There are however many areas, particularly west facing slopes that have significant scree slopes with minimal under storey that are still problematic with significant gullies forming in bare areas. This remains an issue because following high intensity rainfall events there are often noticeable wash outs, which not only limit the re-establishment of native seedlings, but may dislodge establishing vegetation thereby maintaining or increasing the proportion of exposed ground, exacerbating the problem and increasing the sedimentation to downstream water ways.

8.6 SEDIMENTATION

Sedimentation and turbidity has continued to be a concern in the Cotter Reservoir. Since the volume increase of the Cotter Dam in 1951, 7.6% of this increased volume has been lost; however 40% of the 7.6% has been lost between 2003 and 2006. This equates to approximately 85,000 m3 of sediment entering the reservoir following severe erosion and sedimentation following the 2003 bushfires. Evidence from the soil type suggests that the majority of this sediment has come from areas immediately above the reservoir and the Lees Creek area.

The effects of erosion and sedimentation within the catchment on water supply depends largely on the connectivity between the source of erosion and the sink, in this case the Cotter reservoir. Connectivity depends on various physical and hydrological factors such as distance to the tributaries, surface roughness, overland flow, river flow and the erosion potential from the inundated area of an Enlarged Cotter Dam.

8.7 FACT SHEET FOR FURTHER READING

As part of this education kit, you will find a fact sheet on Topsoil relocation for further reading.

9 FORESTRY INDUSTRY

Prior to the establishment of the ACT, approximately 3000 ha of the Lower Cotter Catchment were cleared for grazing purposes. Over-grazing resulted in serious soil erosion which was further exacerbated by rabbits, and in order to protect the catchment (and Canberra's water supply) freehold and grazing leases within the Cotter catchment were terminated by 1913. In an effort to stabilise the landscape, a tree planting program was established with 3000 ha of pines (*Pinus radiata)* planted by 1931.

Over time more Eucalypt forest was cleared for pine plantations (1931 to 1961) however this practice ceased due to community pressure and concerns about the impacts on water quality in the Cotter River and Reservoir. Prior to the 2003 fires, 4200 ha of pine plantations were established in the lower catchment.

Concerns about water quality in the lower Cotter receded when Corin and Bendora dams were completed and water abstraction from the Lower Cotter Catchment was suspended for over thirty years.

The 2003 bushfires destroyed most of the Lower Cotter Catchment, including the pine plantations. Although small pockets of pine plantations remain the majority of the catchment is now managed as native vegetation or re-vegetation areas.

10 BRUMBY RUNNING

Brumby running was carried out from at least as early as the turn of the century, but the most intense period was from the late 1920's to the late 1960's. Apparently some attempts at catching horses continued on into the early 1980's. These horses were derived from several sources including Brindabella homestead, Yaouk and the last residents of Cotter House (the Oldfield family). The activity was considered a sport as well as being carried out for economic gain. Additionally, it was seen as protecting the Cotter Catchment (horses are considered a feral animal and degrade water quality).

The running of wild horses in Namadgi took place in three main areas being:

- the Brindabellas from Mount Franklin to Mount Bimberi and some of the adjacent parts of the Cotter Valley
- the area from Mount Scabby to Rotten Swamp and Creamy Flat and
- the areas of Kangaroo, Jumbuck and Emu Flats.

From the late 1920's to 1960's, Brumby running revolved largely around rangers (namely Jack Maxwell and Tom Gregory) whose responsibilities included keeping wild horse numbers down. Both running yards (where horses were chased into the yard) and salt yards (where horses were lured in by salt) were used. Yards were constructed from the 1930's to 1958 and were built with rails and uprights, constructed from the surrounding vegetation. Several of these yards remain and may be discriminated from stockyards by the existence of wings on either side of the yard entrance that funnelled the horses into the yards.

11 MINING

Prospecting and mining for precious minerals was initiated in the late 1800's via shallow pits and trenches at Mt Blundell. Exploration at Mt Blundell identified lead and zinc with minor copper deposits but very little gold or silver. Development for extraction of these minerals included a six metre shaft and two adits. Extraction activities were not continuous and no production records were ever kept. An iron ore mine located on the other side of the hill to the Cotter Caves was operational around the turn of the century. Mining activities were last conducted in the late 1920's with probable additional site developments.

Additional to Mt Blundell, mine shafts are known to exist near the location of the Cotter house site, and within Rotten Swamp. Scrapings for alluvial gold along the river banks in the upper Cotter are also known.

Quarrying occurred during the construction of the Corin Dam adjacent to the existing dam wall. On the banks of the Cotter River, downstream of De Salis Creek to Corin Dam, undocumented pits are still exposed. These pits were reportedly used to test the suitability of floodplain materials for dam construction during the creation of the Corin Reservoir Dam wall. Minor quarries and gravel pits were also created for construction and service of the existing roads and tracks. These quarries are periodically used for the supply of rocks and gravel for road maintenance, catchment management and environmental purposes.

12 OFFSETTING GREENHOUSE GAS EMISSIONS

Climate change and variability are widely agreed to be the factors most affecting water supply across Australia. Greenhouse gas (GHG) emissions are viewed as a key contributor and will have a significant global impact in regards to our future weather conditions, including increased temperatures and lower rainfall. ACTEW and the ACT Government have voluntarily agreed to offset all greenhouse gas emissions associated with the construction and operation of the dam.

The most significant emissions are likely to be derived from the following sources:

- use of energy and materials in the construction of the dam and ancillary infrastructure
- use of energy in the operation of the water supply system and
- emissions from biological processes in the reservoir.

ACTEW's abatement strategy for reducing and offsetting the GHG emissions includes:

- the use of biodiesel as a clean burning alternative fuel
- planned construction of a hydro generator for energy recovery in the Murrumbidgee to Googong Water Transfer
- a commitment to purchasing permanent carbon sink forestry offsets in Australia and
- reducing the impact via our planning processes.

12.1 BIODIESEL

Biodiesel is a clean burning alternative fuel, produced from domestic, renewable resources such as plant oils, animal fats, used cooking oil and even new sources such as algae. It is biodegradable, non-toxic, and essentially free of sulphur and aromatics. Biodiesel will be sourced from a manufacturer(s) that use sustainable feedstocks (e.g. used cooking oil, tallow, canola oil) and not from palm oil. It will also be required to meet the requirements of the Diesel Fuel Quality Standard.

The CSIRO has found that biodiesel can emit nearly 90% less total life-cycle greenhouse gas emissions than extra low sulphur petro diesel.

12.2 OFFSETS

Permanent carbon sink forestry offsets are being actively pursued for the Enlarged Cotter Dam project. Recently agricultural properties have been acquired that will be taken out of wheat production and utilised for sustainable offset purposes.

13 PEOPLE AND PLACE

The Cotter River is an important part of the traditional life of Aboriginal people from the region.

The pristine nature and reliable flow of the Cotter River made a major contribution to the decision to locate the Nation's Capital, Canberra, in its current location.

Many understandings of the heritage of Canberra are centred on the stories and experiences of the people who have used 'The Cotter'.

'The Cotter' became a popular recreation and leisure destination for the people of Canberra after the Cotter Dam construction resulted in improved access to the area.

Further information on the subjects in this section can be found in Cotter: Nature's Gift to Canberra which is included in this education kit.

Refer to Appendix E for a list of significant places near the Enlarged Cotter Dam.

14 WHY IS IT CALLED THE COTTER?

The Cotter River is thought to be named after Garrett Cotter, former convict and early resident of the area. Garrett Cotter was a ploughman born in County Cork, Ireland in 1802. In 1821 he took part in an insurrection against British troops and was transported to Australia, arriving in 1822 on the ship *Mangles.* Cotter grazed cattle for his Lake George employer in what is now the Cotter River area in 1828 and was befriended by Honyong, a local Indigenous leader. In 1834 Cotter was banished beyond the limits of the settlement. He settled in the Cotter River area, west of the Murrumbidgee, and therefore beyond the limits of settlement. He was conditionally pardoned in 1847 and had already moved to nearby Michelago, where he died in 1886.

Cotter had nine children; they and their many descendants continued to live in the region knowing that the Cotter River was named after 'their' Garrett Cotter.

Further information on Garrett Cotter can be found in the work sheet *Biography: Garrett Cotter.*

15 THE LOCATION OF CANBERRA – BECAUSE OF THE COTTER CATCHMENT

The Cotter is Canberra's original water source and has provided high quality water to the ACT Region for nearly 100 years.

It is often said that the reason the location of Canberra was chosen to be on the Limestone Plains was because of the Cotter River and the reliable water source that it provided. When deciding where to locate the national capital a few stipulations were put forward. The national capital had to be in NSW, at least 160 km from Sydney, be well inland (away from the reach of hostile naval guns), have an ample supply of water and have a bracing climate. In order to get Canberra selected as the site of the national capital, it had to be proven that the Cotter River could provide as good a water supply as the Snowy River that would provide water to other preferred sites such as Dalgety or Tumut. The Cotter Catchment wasn't as completely pristine as it was described in some of the debates on the capitals future water supply. Pastoralists had done some damage, particularly in the lower catchment, and rabbits had infested the area since the 1880's (a problem that would not be brought under control until the 1950's). The water was of high quality though and lacked high volume of human interaction (in 1910, the cotter catchment had only about 50 residents).

By 1908, debate about the capital site had come down to a choice between Dalgety and Yass-Canberra. Transport played a big part in the decision, Dalgety would be difficult to get to and Yass-Canberra meant only a reasonably short diversion from the existing Sydney-Melbourne railway line. On 6 November 1908, a final vote in the Senate of 19 votes for Yass-Canberra and 17 votes for Tumut (which had been substituted for Dalgety) was cast and the location of the capital was decided.

A very influential person in the process of deciding the location of the capital was Ernest de Burgh, an engineer from the New South Wales Public Works Department. De Burgh wrote a report in 1907 where he spoke very highly of the Cotter's potential:

> *"It is impossible to imagine a catchment from which a purer supply of water could be obtained. The water is soft, and even in times of fresh (after flood), is clear and of good colour…There are few cities in the world where such a magnificent supply of pure water is available. From an absolutely uninhabited catchment, I have pointed out that an average of 85,000,000 gallons (386 megalitres) of water per day, or seventeen times the requirement for 50,000 persons, runs down the Cotter River…"*

De Burgh's words resonated for a long time and were arguably the deciding factor in securing Canberra as the capital's location, as the Senator who changed his mind in the final vote quoted his words when he cast the vote.

16 THE COTTER DAM

16.1 ORIGINAL DAM

The original dam was designed by Henry Connell and began construction in 1912. The dam was a gravity concrete structure, with a straight wall and an overshot spillway that sent water down the face of the wall. The dam was completed in 1915 to a height of 18.3 m.

16.2 WORKERS ON THE ORIGINAL DAM

The Cotter from 1912 to the mid 1920's, when the majority of public works were being constructed, was home to hundreds of people; men, women and children. Their accommodations, however, were definitely not luxurious. No proper cottages were erected for workmen; instead 12 m by 30 m blocks were set aside close to work projects for workmen's cottages, both married and single. Residents paid one shilling a week rent for the land and had to build their own accommodation.

Workers scavenged for materials like galvanized iron, hessian, box boards and canvas. The residences offered little or no protection from the cold of winter or the heat of summer. There was no running water, no electricity and no sewerage system. The alternative was living in Canberra or Queanbeyan and cycling to work (which could mean a 75 km roundtrip daily with no sealed roads!) and those who chose to do this were given an extra allowance for living more than 9 km from their place of work.

Another problem faced by workers was the lack of access to alcohol. At the time Canberra was a 'dry' town and the nearest hotel was more than 15 km as the crow flies. In April 1913 *The Queanbeyan Age* reported that a former Cotter Dam worker was convicted of selling 'sly grog' at one of the workers camps. The alcohol seller admitted bringing the liquor from Sydney after receiving orders from Cotter workers. He was fined 42 pounds, which was quite a severe penalty at the time. A 'yes' vote in a 1928 referendum lifted the ban and allowed alcohol to be sold in the ACT.

In January 1915 the body of a former dam worker had been found on the banks of the Cotter River, not far from workers' homes. The 30-35 year old man, known as William Newton (it was suspected that this was not his real name) had shot himself in the head with 32-calibre revolver which was still clasped in his hands. The body remained on the riverbank for 2-3 months. The man was known to have had problems with alcohol, but an unopened flask of whisky was found near his body. He had told fellow workers that he had come from London.

Food arrived for the original workers in boats since there were continual problems with completing the bridge over Murrumbidgee. On 1 June 1913, a boat with 6 people on board and carrying about 150 kg of mutton, 100 loaves of bread, tried to cross the river. An accident occurred and two people died, one of those drowned was a man named George Fairhurst and the other a 10-year old boy named Charles Taylor, who was the son of a worker.

The workers on the original dam had a great sense of solidarity. When a worker working on the pipeline from the Cotter Pumpoing Station to Canberra was sacked for absenteeism, 30 men went on strike. The worker felt that he had really been fired for being an active member of the Railway Workers and General Labourers Association. The workers wanted him to be reinstated and they also demanded a school at the Cotter. The workers were also, ironically enough, upset about the water quality. While they were working to distribute the pure Cotter Dam water, they themselves had to drink water pumped from the Murrumbidgee through tarred pipes that had been used by nesting rabbits while in storage. In the end a full strike of all workers was narrowly averted by providing better water to the workers, building a school and transferring the sacked worker to work at Duntroon.

16.3 RAISING THE DAM WALL

In 1947-48 it was decided to raise the dam to increase its storage capacity, and in 1949 work commenced. It was hampered by faults in the old wall, and by a big flood in March 1950 that halted work for a month. By 1951 the dam wall was raised to 88 feet (26.8 m). This is the height that the wall remained until the construction of the Enlarged Cotter Dam in 2009 - 2011. Originally the wall was to be raised to 102 feet (31 m), but the original concrete was not strong enough to cope with that height.

17 COTTER PUMPING STATION

Water from the Cotter Reservoir needed to be raised 250 m to Mount Stromlo Reservoir, so that it could be gravity-fed to Red Hill Reservoir. Having a dam that required pumping was controversial for the time as most other Australian dams at the time did not require pumping.

Tenders for the design and construction of the Cotter Pumping Station closed on 24 November 1913. Haes and Eggers Pty Ltd of Sydney, Electrical and Mechanical Engineers and Machiners Merchants were the successful tenderers. The exterior of the Cotter Pumping Station, comprising two single-storey buildings of rendered brick, was designed by the architect John Smith Murdoch, who also designed old parliament house and the Kingston power station. Construction of the Cotter Pumping Station began in 1914 and two Gwynne pumps were ordered from the UK. By October 1918 the Cotter Pumping Station was pumping water to Mount Stromlo Reservoir. At first the Cotter Pumping Station operated for only several days a month, but as Canberra's population grew, six more pumps were added—one in 1935, one in 1942, two in 1955, and two in 1963, when a two-storey extension was built to accommodate their vertical orientation. The Cotter Pumping Station was no longer required after water from Bendora and Corin dams became available in 1967, and it did not operate again until 2004, after the 2003 Canberra bushfires.

Water from the Cotter Dam travels to the Cotter Pumping Station through cast iron pipes running along the left bank of the Cotter River to a tunnel on the left bank of the Murrumbidgee, through another tunnel under the Murrumbidgee River, then up to the Cotter Pumping Station on the right bank of the river. Construction of the tunnel was difficult, and it was regarded as a marvel of engineering at the time.

18 TOURISM

Prior to the original Cotter Dam's construction getting to the Cotter was a difficult task. There was an access road constructed in 1913 for the dam's construction but the public were not allowed to use it from 1913 to mid 1916. An official pass had to be shown to get through the gate which was also a rabbit control point. When the road did open up to tourists it was a very slippery road and vehicles would slide along it. In 1915, a journey from Queanbeyan to the Cotter by horse and cart would take 2.5 hours. In 1915, the first mention of the Cotter being used as an excursion location was made in the *Queanbeyan Age*. Twenty seven Boy scouts camped at the Cotter for a week. They used the tent from the Cotter School.

The Cotter would soon become a popular tourist destination but the bridge crossing the Murrumbidgee was a continual problem as it kept being washed away. Three attempts finally produced the bridge that still stands today. This final bridge was made impassable by floods in July 1922 and this was not rectified until it was extended by three spans in October 1924. During this time tourism at the Cotter was not encouraged.

When the *Canberra Times* was established in 1926, events at the Cotter began to get better coverage. But with this new coverage of good times, came equal coverage of the bad times. In 1926, the *Canberra Times* reported a bus crash near the Cotter which resulted in the death of Miss Vivian Rouse, aged 21, a visitor from Sydney and injured four others.

Prime Minister William Morris Hughes was so impressed with the Cotter area that he planned the construction of an elaborate 12 room accommodation house that was designed to be extended to 40 rooms. The project was estimated to cost £3,850 ($7,700), a major outlay in tough economic times. Hughes was soon be deposed as Prime Minister and the project was scrapped.

In spite of the increasing interest in the Cotter as a tourist attraction there was little in the way of facilities at the Cotter. In 1924, extensive planting of poplars and casuarinas took place but little other had been done to improve the appearance of the Cotter, except for the construction of a dusty carpark. In 1927, it was announced that the Federal Capital Commission would provide amenities at the Cotter. Part of this plan was to build a kiosk described in the *Canberra Times* as a "handsome octagonal building built in a rustic style with a red shingle roof". The kiosk was built near the Cotter River bridge. Small shelter kiosks were built along the river banks. Parking for 150 cars was provided too as was a children's playground. The kiosk owner and the Angler's Club also provided for private use or overnight stays. The kiosk was demolished in 1971.

In 1927, the Federal Capital Commission started a bus service to the Cotter Reserve on Saturdays and Sundays. Marketing of the Cotter had also begun. In the 1930's the Cotter Caves were marketed to tour groups. By the 1940's motor vehicle ownership was growing, a trip to the south coast still took 10 hours by bus and Lake Burley Griffin did not yet exist. All these factors combined to make the Cotter a favourite destination of Canberrans on hot summer days. In the decade after WWII the Cotter reached the height of its popularity. It did not seem to matter that the facilities at the Cotter were often in a poor state of repair. Heavy rains from 1948 to 1952 resulted in an overflow of the dam wall which was visually spectacular but also resulted in debris being piled up on riverbanks, giant boulders blocking walking paths and trees and branches rotting in shallow water. Large scale events started at the Cotter in 1939, when the Canberra Trades and Labour Council organised an Australia Day Labour Picnic attended by 2,000 people. In 1949, Canberra Legacy organised a 'bathing beauty' contest. The raising of the dam wall in 1951 opened up the Cotter River area to visitors and contributed to its reputation as a beautiful natural setting and a key recreational area for the growing city of Canberra.

The Cotter remained a highly popular recreation area even when picnic areas were provided on other rivers in the area. When Canberra's lakes were created in 1964, this provided even more competition but none of it seemed to deter visitors to the Cotter.

In 1971, the National Capital Development Commission issued a report outlining a five-year development program which included providing most of the facilities that now exist in the area. A new licensed restaurant, night club and convention centre was built on the site of the demolished Cotter Kiosk. It was successful for a time but there were many closer facilities in Canberra. By 2001 it was a commercial failure, sometimes taking as little as $25 to $50 in a weekend. The hotel was destroyed in the 2003 bushfires.

As Canberra's population rose from 30,315 in 1954 to 221,609 in 1981, the Cotter remained a highly popular recreation spot. By the mid-to-late 1980's the Cotter was losing popularity. Visitor numbers declined dramatically and the Cotter now accounted for only 14.8 percent of all Canberra outdoor recreation, down from 37 per cent in 1970. The reason for the decline was mainly due to the increase in competition with places like Uriarra Crossing, Pine Island, Kambah Pool, Tidbinbilla Nature Reserve and Canberra's lakes (Burley Griffin and Ginninderra) all attracting large numbers.

The 2003 bushfires devastated the Cotter area. Most of the houses near the Pump Station were destroyed as were bridges and walkways. Many of the magnificent old trees were destroyed too or badly damaged. The main Cotter bridge was rebuilt and some of the damaged trees were saved. The area is still recovering and the area is still a popular spot for weekend visitors but a full recovery will take time.

18.1 LEGACY BEAUTY CONTEST

In 1949, Canberra Legacy organised a 'bathing beauty' contest at the Cotter Reserve. Although there were only 4 contestants and the day was dull with rain expected, 4,000 people from Canberra and Queanbeyan attended, a significant proportion of the 25,000 Canberra-Queanbeyan population.

Eighteen buses and hundreds of cars transported the crowd to the area. As well as the beauty contest, a fishing competition took place as well as other sideshow activities and the lessee of the Cotter Kiosk created a Legacy Pool of Remembrance which raised a lot of revenue for the Canberra Legacy Club.

The event was held again the next year and this time was attended by 6,000 people with 18 'beauties'. By 1951, the event attracted more than 9,000 visitors and had 23 contestants. The last contest was held in 1952. The next year the event was moved to Queanbeyan showgrounds.

18.2 CONFEST

In 1976 a five day festival known as ConFest was held at the Cotter. The festival was called *Down to Earth: A Shaping of Alternatives.* It was attended by 10,000 people many of whom camped on site. It was the first of many ConFests held around Australia. The festival was organised and funded by Dr Jim Cairns, the Member of the House of Representatives from Labor, and formerly Deputy Prime Minister in the Whitlam Labor Government. He was assisted by Junie Morosi and her husband David Ditchburn, who was treasurer for the event. In a pamphlet distributed to promote the event, Cairns said the event would host to "Aborigines, ethnic communities, women's liberation groups, peace activists, homosexuals, lesbians, members of rural and urban communes and cooperatives, and those concerned with self-management and work democracy, law reform, ideology, theories of social change, alternative food, health, energy, living structures, education, psychotherapy, yoga and meditation". The event was definitely a different one with vegetarian meals, chanting and nude swimming. One participant said that "at the height of the festival 7,000 people walked around naked in Eden. The festival was a learning exchange and it was fantastic".

18.3 CASUARINA SANDS

A series of weirs constructed in 1961 made Casuarina Sands an attractive place for swimming. The Murrumbidgee River flow had always been 'extremely variable', making it difficult for swimmers to judge conditions. The weir made the water appear calm but underneath it pulled swimmers downstream effortlessly. In November 1966, three young Canberra men were drowned and 10 people were rescued on the same day after they were swept over the weir. The men were Frank Bree, 18, of Red Hill, Mark Dwyer, 15, of Deakin and John Lahey of O'Connor. The shocking drownings led to a request to Royal Life Saving officials from interstate to visit the site and make recommendations for preventative measures. They recommended that a facilities block be moved, as its location just opposite the weir encouraged swimmers to enter the water at that spot rather than upstream where a safer beach could be found. By the end of 1966 a surf lifesaving group operated at Casuarina Sands on weekends. This continued until 1981.

A second weir was built at Casuarina Sands in 1980. In November 1986 another tragedy occurred at Casuarina Sands. A boy and a girl in an inflatable dinghy were swept over the weir. The girl was able to break free and swim to the shore but the boy was trapped under the weir and later swept downstream in the rapids. His body was found two days later, one kilometre downstream.

According to Government officials there had been eight drownings at Casuarina Sands from the time the weir was built in 1961 to 1986. In 1991, one of the weirs was removed to improve safety for people swimming at Casuarina Sands.

18.4 RECREATION

Recreation activities in the upper Cotter catchment include pleasure driving, trail bike riding, picnicking, snow sight seeing, skiing, bushwalking etc. Much of the upper catchment has restricted public access limited to walking access only. Camping occurs in the catchment to a minor degree; however, it is strongly regulated with permits required prior to camping. Most recreation occurs in the lower Cotter catchment to areas that will not impact on water quality. Activities that occur in these areas include driving and cycling on open public roads, sightseeing, picnicking, bird watching, walking and cycling. Swimming, fishing and boating are prohibited within the Cotter Reservoir. Fishing is only allowed in certain parts of the catchment.

Organised motor sport particularly rallying has had its place as a recreational activity within the catchment. The Rally of Canberra has held stages of its annual rally on forest roads within the catchment over preceding years, notably in areas off Laurel Camp Road and Brindabella Road. Some unorganised rallying has also occurred in the past.

Picnic facilities do occur in the Pierces Creek area but their regular use since the fires needs to be questioned. Fires are only permitted in designated fireplaces likely to be associated with picnic facilities and only at times outside the official fire season. There are no official overnight camping facilities within the catchment area, the closest camping grounds are located at Blue Range Hut and the Cotter Campground both located outside the catchment.

Horse riding is forbidden in the lower Cotter Catchment and is only permitted in adjacent forestry plantation areas located outside the catchment boundary. Dogs however are permissible under control and provided faeces is removed and not left to contaminate the water supply.

The main areas for recreation in the Cotter are:

- Cotter Avenue (previously Cotter Reserve)
- Cotter Bend (previously Cotter Pool) and
- Casuarina Sands.

19 FISHING

The *Cotter River Ordinance* of 1914-1928 strictly prohibited fishing, camping and picnicking in the reservoir. Camping and picnics could be allowed with the permission of the Minister. The *Fish Protection Ordinance* in 1929 banned the use of any artificial bait for fishing 'in any portion of the Cotter River, Gudgenby River or their tributaries'. The law also stated that 'any person who, for the purpose of fishing in that portion of the Cotter River which lies between the Cotter Dam and the Junction of Paddy's River and Cotter River shall be guilty of an offence….any person who wilfully disturbs any spawn, or spawning fish or any bed, bank or shallow on which there is any spawn or spawning fish, shall be guilty of an offence'. Prior to these ordinances and prior to the construction of the dams (Cotter, Bendora and Corin), the Cotter River was used for fishing although the Queanbeyan Age reported in the 1880's that there was a shortage of fish, this may mean that maintaining fish populations was problematic even in the early days.

In 1929 the Canberra Anglers Club was formed and lobbied for seasonal permits for fishing in the reservoir. They argued that applying to the Minister each time for a permit was time consuming. Instead of agreeing to their request, legislation was introduced that removed the power of the Minister to grant permits.

In 1995 the ACT declared four species as either engangered or vulnerable, these were Macquarie Perch, Two-spined Blackfish, Trout Cod and Murray River Crayfish.

In June 2008, the endangered Macquarie Perch was found to be breeding upstream in the Cotter River for the first time in 20 years. The fish program being conducted in association with the Enlarged Cotter Dam project will ensure the long term success of the fish populations in the Cotter River.

ACT recreational fishing legislation permits fishing in the Cotter River between Bendora Dam and the Pierces Creek confluence. This section of the Cotter River fishing is a designated Trout Water under the *Fisheries ACT 2000*. Fishing in the catchment is subject to seasonal restrictions (a closed season between the end of the long weekend in June to the beginning of the long weekend in October) and bag and size limits (a bag limit of 5 with a minimum size of 25 cm). The locally and nationally threatened Macquarie Perch (*Macquaria australasica*) and the Two-spined Blackfish (*Gadopsis bispinosus*) are not permitted to be taken and must be released if caught.

19.1 FISH HATCHERY

A fish hatchery started operating in the Cotter Reserve area in August 1930. The hatchery was designed to have an annual capacity of 200,000 eggs and cost £432 ($864). Two new tanks were added in 1933 as a part of a program to help the unemployed. The hatchery was designed to increase fish stocks in the Cotter River for recreational fishing. They soon found out that breeding fish was not easy, they lacked skilled staff, regulating water temperatures was difficult, water flows were often inadequate and the hatchery had been exposed to vandalism. In 1932, most of the eggs died before they could be released. The hatchery acted as a care facility for eggs and small fish until they were large enough to release. In 1956 the Department of the Interior noted that 1,010,000 trout had been released into Canberra rivers since the program started. The Cotter Fish Hatchery bred fish to stock Lake Burley Griffin when it filled in 1964. The hatchery did not operate in WWII. In 1947, the Department of the Interior prepared plans to demolish the existing hatchery and replace it with a much larger one on the other side of the river but cost and space were concerns and the hatchery was never built.

The Canberra Anglers Club provided two cubicles at the Cotter Reserve for its members' overnight stays. The members were enraged when plans were announced to increase the prohibited fishing area when the dam wall was raised in 1951 to ensure the purity of Canberra's drinking water.

20 ABORIGINAL HERITAGE

The Aboriginal people have strong attachments to the Cotter area. Firstly, they were in the area for thousands of years, far longer than the two centuries of European occupation of Australia, let alone the century or so of local European interest in the Cotter. Dated presence of Aboriginal people in the Canberra region dates back to 21,000 years ago based on analysis done at the Birrigai rock shelter in the Tidbinbilla nature reserve, but there could still be older sites based on sites in other parts of Australia dating occupation back to 40,000-50,000 years ago.

The Cotter River played a role in local Aboriginal life for thousands of years. The Cotter River bed was a rich source of rock material suitable for stone tool manufacture. There are many Indigenous stories associated with Murrumbidgee River and the Cotter River. This river system provided important resource and was lined with abundant food sources.

European settlement did not take place until the 1820's. In the 1828 census there were only 42 non-Aboriginal people living in Canberra, whereas a gathering of 500 or more Aboriginal people occurred often. Aboriginal people out numbered non-Aboriginal people for at least a decade or more after European occupation began. The expansion of European settlement in the Canberra region led to a decline in the Aboriginal population. Land was fenced and traditional hunting was curtailed.

Further information on Aboriginal heritage can be found in Cotter: Nature's Gift to Canberra which is included in this education kit.

21 THE ENLARGED COTTER DAM HERITAGE SALVAGE OPERATION

From mid February to July 2008, local Aboriginal groups and archaeologists working with the Enlarged Cotter Dam team found more than 5,000 artefacts in a 575 ha area near the Cotter River. This work formed part of the heritage assessments undertaken as part of the Enlarged Cotter Dam project.

There were four Indigenous organisations involved in the assessments. These groups were the traditional owner groups, Buru Ngunawal Aboriginal Corporation and King Brown Tribal Group as well as registered Aboriginal organisations – Ngarigu Currawong and little Gudgenby River Tribal Council. These organisations have stated an objective to represent traditional Aboriginal cultural values and interests within the ACT. These groups have been recognised by the Minister as Representative Aboriginal Organisations (RAOs) as defined under the ACT *Heritage Act 2004* (Heritage Act).

The cultural heritage assessments consisted of the following components:

- an ongoing consultation and field participation program with representatives of the RAOs
- a review of literature, existing databases, and heritage schedules
- a comprehensive program of archaeological field survey
- analysis and assessment of field recording data
- consideration of responses from the RAOs regarding significance assessments and management strategy proposals
- preparation of draft and final reports
- archaeological survey of the proposed inundation area and anticipated construction zones and
- survey, monitoring and artefact collection associated with ongoing geotechnical testing and the construction of a pilot fish habitat program.

Of the artefacts found, 24.7% were grinding stones suggesting that grinding stones near the Cotter River area may have placed a specialised part in Aboriginal food supply or simply reflect the fact that suitable stones were available there.

21.1 ABORIGINAL CULTURAL VALUES

Following the provision of a summary of field survey results and draft management strategies, an invitation was extended to the four ACT RAOs to provide a written report on the cultural values of the project area, to comment on the potential impact of the proposed Cotter Dam enlargement on those values, and to suggest ways of mitigating those impacts.

An outline of the RAO submissions are summarised below.

Buru Ngunawal Aboriginal Corporation

The Buru Ngunawal Aboriginal Corporation (BNAC) states that it is the traditional owner of the project area lands, which form part of the territory of the Ngunawal people.

The Aboriginal sites encountered in the project area are described as being important ‘because they show that local Ngunawal people have a rich culture, and a history recorded in the earth as the soul of our people and as recognisable symbols of our identity. These sites provide windows on the past from which we can learn to begin to understand.’

The BNAC states that local Aboriginal cultural property rights are fundamental to the continuation and maintenance of their heritage.

The BNAC notes:

> *The Aboriginal cultural and heritage sites identified in this region have all been heavily impacted on and in most cases totally destroyed … Local Ngunawal people have always known the importance of these sites to their existence. They serve as an important reminder of why we need to preserve and protect all facets of heritage … Furthermore, our sites provide a link back to the Dreaming and demonstrate that our people have a social, economic, cultural and spiritual heritage.*

The BNAC provided the following response to the recommendations made on the archaeological assessment of Aboriginal cultural values of the project:

- as all Aboriginal cultural heritage is of significance to us we would desire that a heritage agreement (ie a legally binding document which defines required management strategies) be put in place for the protection of all sites and artefactual material
- that full compliance with this agreement is mandatory
- that a Conservation Management Plan be prepared in full consultation with the Traditional Owners with provisions for any undiscovered artefacts or sites to be assessed and included in the overall management plan
- the BNAC would also like to have all artefacts salvaged and relocated back to country at a later date for cultural significance and not only archaeological significance
- the BNAC require all materials to remain intact for later relocation back to country and
- the BNAC state that consultation must be with the Ngunawal Traditional Owners only as we do not consider it appropriate that people that do not come from this country should be advising on how we should be managing our cultural heritage.

Ngarigu Currawong Clan

Members of the Ngarigu Currawong Clan (NCC) trace their lineage from Ngarigu ancestors described in the ethno-historic record and consider that the study area falls within the territory of the Ngarigu language group.

The NCC has identified the project area as having 'high' Aboriginal cultural significance. It notes that the number of sites is a reflection of a lot of Aboriginal activity in the area. The habitat value of the area to Bunjil (the Eagle) was also noted, together with the importance of preserving this value.

The significance of the Cotter River gorge is described in terms of its position relative to pathways the Ngarigu used. These include the Brindabella Range to the west, and beyond that, the valley of the Goodradigbee River (Brindabella Valley), and the Murrumbidgee River to the east. The importance of the surrounding high country for the collection of aestivating Bogong moths is also cited.

Little Gudgenby River Tribal Council

An assessment of the impact on Aboriginal sites within the survey area has covered about 70 per cent of the project area. Visibility levels in ground surface exposures was good, but represented a small component of the survey as a whole. The survey was an opportunity to revisit and find new sites within the survey area.

Recommendations:

- sites within the inundation area that have a high artefact concentration should be salvaged for future generations and educational purposes
- the sites outside the high water line should be left in-situ
- all new sites should be recorded and submitted to the Sites Register
- all collected artefacts should be stored until an appropriate permanent display can be established in the Cotter area
- artefacts present on the current reservoir island should be collected and
- these recommendations should not be final unless approved by all the groups.

22 ACT WATER SUPPLY

In the early 1900's, the lower Cotter Catchment was selected as the best position for a new dam because of its relatively reliable rainfall. In 1919, Canberrans were eagerly awaiting water supply from Cotter Dam. This water finally arrived on 13 October 1919. Queanbeyan residents were eager to connect to Canberra's water. They were dependant on tank water and buying from water carts if rainfall was low. Water from Cotter was connected to the first 70 Queanbeyan households on 11 November 1926.

The Cotter Dam provided the first water source for Canberra and the new Cotter Dam will form a critical component of our future water supply.

Cotter Reservoir was Canberra's main water source up to the 1960s. However, with the completion of Bendora Reservoir, Cotter became a back-up source, partly because of its smaller volume, higher pumping costs and poorer water quality, which was increasingly impacted by high iron and manganese concentrations. As a result of poor water quality, Cotter Reservoir was not used between the 1970's and the January 2003 bushfires.

Water quality further deteriorated following the January 2003 bushfires, as measured by a range of water quality characteristics important for drinking water supply (such as turbidity, iron and manganese), as well as for environmental management (such as nutrients, including phosphorus and nitrogen). The bushfires removed a large part of the groundcover in the catchment, and subsequent rain events resulted in increased erosion, which increased the entry of sediment and nutrients into Cotter Reservoir. The added nutrients, together with microbiological activity in reservoir sediments, reduced dissolved oxygen levels in the water column during the warmer months of the year. By the end of summer in 2003, and then again by the end of summer in 2004, most of the water column in Cotter Reservoir was anoxic (with dissolved oxygen levels under 0.2 mg/L). These low dissolved oxygen levels further increased the release of iron and manganese from reservoir sediments. This made the reservoir unsuitable for drinking water supply, as high iron and manganese concentrations provide a brown-black colour to water, which can stain laundry and cause taste and odour problems.

The low dissolved oxygen levels also increased environmental management problems at the reservoir, by increasing the release of nutrients (such as nitrogen and phosphorus) from the reservoir sediments into the water column. Low dissolved oxygen levels would have also had a significant negative impact on fish, which need over 4 mg/L of oxygen in the water for effective oxygen exchange through their gills.

In order to overcome these drinking water supply and environmental management problems, a mixer was installed to partly rehabilitate Cotter Reservoir water quality.

The solar powered mixer (installed in December 2004), has significantly improved water quality in Cotter Reservoir by increasing dissolved oxygen concentrations in the top 12 m of the water column. The operation of the mixer has:

- allowed the use of Cotter Reservoir water via the Stromlo Water Treatment Plant. The added oxygen has reduced total iron to about 0.3 mg/L and total manganese to 0.05 mg/L (a decrease of about 95 per cent on the April 2004 concentrations). This in turn has allowed the use of about 18 gigalitres (GL) of previously unavailable Cotter Reservoir water for the ACT (from 2005 to mid 2008) and

- restored the environment for a range of fish (which need over 4 mg/L for oxygen). Cotter Reservoir has a number of threatened fish species (including Macquarie Perch), and the added oxygen would have improved their survival in the reservoir.

The decision to build the Enlarged Cotter Dam came as part of a suite of water supply initiatives endorsed by the ACT Government in 2007. This suite of projects was based on more than four years of investigations to identify sustainable future water sources for Canberra and the region, in response to prolonged low inflows and drought conditions.

23 THE ENLARGED COTTER DAM

The current Cotter reservoir holds about 4 GL. The Enlarged Cotter Dam project will increase the reservoir size to around 80 GL, raising the ACT's water supply capacity by a third.

The Enlarged Cotter Dam will be constructed approximately 125 m downstream of the existing dam.

The Enlarged Cotter Dam will consist of a main dam and two adjacent saddle dams.

The new main dam wall will be approximately 80 m high and the saddle dams will be an approximate height of 11 m and 16 m high.

The existing dam and 231 hectares of land will be inundated, and a further 38 ha of land will be cleared for construction and ancillary works.

The scope of the works includes:

- detailed geotechnical investigation for all associated works
- design and construction of the main dam, the spillway and the saddle dams
- design and construction of protection works; that is, flood diversion around site works
- design and construction of dam outlet works, including flow control valves, control instrumentation and gauging
- design and construction of upgrade works required for site access routes, which may include improvements to Cotter Road
- development and implementation of a community and stakeholder engagement program and provision of community education and visitors services
- investigation, design and installation of power supply and communications infrastructure to service construction and ongoing operational requirements
- design and installation of a system to mix the water in the reservoir to maintain water quality and
- implementation of the Cotter Reservoir Fish Management Program, which includes a range of ecological studies as well as artificial habitat design and construction.

Work began in November 2009, with construction expected to be completed in December 2011.

APPENDIX A
UNCOMMON, MIGRATORY AND THREATENED ANIMAL SPECIES

Listed under the *Nature Conservation Act 1980*, *Environment Protection and Biodiversity Act 1999* and *Threatened Species Conservation Act 1995* that have been previously recorded within the Cotter area.

TABLE 1 Uncommon, migratory and threatened animals species

Common name	Scientific name	Legal status		
		NC Act	EPBC Act	TSC Act
Invertebrates				
Golden Sun Moth	*Synemon plana*	E	CE	E
Perunga Grasshopper	*Perunga ochracea*	V	-	-
Frogs				
Alpine Tree Frog	*Litoria verreauxii alpine*	-	V	E
Booroolong Frog	*Litoria booroolongnensis*	-	E	E
Northern Corroboree Frog	*Pseudophryne pengilleyi*	E	V	V
Yellow Spotted Tree Frog	*Litoria castanea*	-	E	E
Reptiles				
Grassland Earless Dragon	*Tympanocryptis pinguicolla*	E	E	E
Heath Monitor	*Varanus rosenbergi*	-	-	V
Pink-tailed Worm Lizard	*Aprasia parapulchella*	V	V	V
Striped Legless Lizard	*Delma impar*	V	V	V
Birds				
Australian Painted Snipe	*Rostratula australis*	-	V	-
Black-shouldered Kite	*Elanus axillaris*	U		
Brown Treecreeper	*Climacteris picumnus victoriae*	V	-	V
Blue-billed Duck	*Oxyura australis*	-	-	V
Clamorous Reed-warbler	*Acrocephalus stentoreus*		M	
Diamond Firetail	*Stagonopleura guttata*	-	-	V
Freckled Duck	*Stictonetta naevosa*	-	-	V
Gang-gang Cockatoo	*Callocephalon fimbriatum*	-	-	V
Glossy Black-cockatoo	*Calyptorhynchus lathami*	-	-	V
Hooded Robin	*Melanodryas cucullata*	V	-	V
Latham's Snipe	*Gallinago hardwickii*	-	M	-
Little Eagle	*Hieraaetus morphonoides*	V	-	-
Musk Duck	*Biziura lobata*	U		
Painted Honeyeater	*Grantiella picta*	V	-	V
Powerful Owl	*Ninox strenua*	-	-	V
Rainbow Bee-eater	*Merops ornatus*	-	M	-

Common name	Scientific name	Legal status		
		NC Act	EPBC Act	TSC Act
Regent Honeyeater	*Xanthomyza phrygia*	E	E/M	E
Rufous Fantail	*Rhipidura rufifrons*	-	M	-
Satin Flycatcher	*Myiagra cyanoleuca*	-	M	-
Speckled Warbler	*Chthonicola sagittata*	-	-	V
Swift Parrot	*Lathamus discolor*	V	E/M	E
Superb Parrot	*Polytelis swainsonii*	V	V	V
Varied Sittella	*Daphoenositta chrysoptera*	V	-	-
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	-	M	-
White-throated Needletail	*Hirundapus caudacutus*	-	M	-
White-winged Triller	*Lalage sueurii*	V	-	-
Mammals				
Broad-toothed Rat	*Mastacomys fuscus*	-	-	V
Brush-tailed Phascogale	*Phascogale tapoatafa*	-	-	V
Brush-tailed Rock-wallaby	*Petrogale penicillata*	E	V	V
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	-	-	V
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	-	-	V
Eastern Pygmy-possum	*Cercartetus nanus*	-	-	V
Grey-headed Flying Fox	*Pteropus poliocephalus*	_	V	V
Koala	*Phascolarctos cinereus*	-	-	V
Large-footed Myotis	*Myotis macropus (adversus)*	-	-	V
Smoky Mouse	*Pseudomys fumeus*	E	E	E
Spotted-tailed Quoll	*Dasyurus maculatus maculatus*	V	E	V
Yellow-bellied Glider	*Petaurus australis*	-	-	V

Key

E = Endangered

V = Vulnerable

U = Uncommon

M = Migratory

APPENDIX B
LIST OF OTHER ANIMALS

Compiled from Animal survey results, Bat survey result and Bird list from Canberra Ornithological Group (gathered over the past 20 years).

TABLE 1 List of other animals

Common name	Scientific name
Amphibians	
Peron's Tree Frog	*Litoria peronii*
Lesueur's Tree Frog	*Litoria lesueuri*
Plains Froglet	*Crinia parinsignifera*
Common Eastern Froglet	*Crinia signifera*
Eastern Banjo Frog	*Limnodynastes dumerilii*
Striped Marsh Frog	*Limnodynastes peronii*
Spotted Grass Frog	*Limnodynastes tasmaniensis*
Reptiles	
Eastern Water Dragon	*Physignathus lesueurii*
Common Bearded Dragon	*Pogona barbata*
Eastern Long-necked Tortoise	*Chelodina longicollis*
Red-bellied Black Snake	*Pseudechis porphyriacus*
Eastern Brown Snake	*Pseudonaja textilis*
Copper-tailed Skink	*Ctenotus taeniolatus*
White's Skink	*Egernia whitii*
Eastern Water Skink	*Eulamprus quoyii*
Delicate Skink	*Lampropholis delicata*
Common Blue-Tongue Lizard	*Tiliqua scincoides*
Birds	
Brown Goshawk	*Accipiter fasciatus*
Wedge-tailed Eagle	*Aquila audax*
Black-shouldered Kite	*Elanus axillaris*
White-bellied Sea-eagle	*Haliaeetus leucogaster*
Whistling Kite	*Haliastur sphenurus*
Australasian Shoveler	*Anas rhynchotis*
Pacific Black Duck	*Anas superciliosa*
Musk Duck	*Biziura lobata*
Australian Wood Duck	*Chenonetta jubata*
Black Swan	*Cygnus atratus*
White-faced Heron	*Egretta novaehollandiae*
Dusky Woodswallow	*Artamus cyanopterus*
White-browed Woodswallow	*Artamus superciliosus*
Grey Butcherbird	*Cracticus torquatus*
Australian Magpie	*Gymnorhina tibicen*

Common name	Scientific name
Pied Currawong	*Strepera graculina*
Sulphur-crested Cockatoo	*Cacatua galerita*
Galah	*Cacatua roseicapilla*
Gang-gang Cockatoo	*Callocephalon fimbriatum*
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
Brown Treecreeper	*Climacteris picumnus*
White-throated Treecreeper	*Cormobates leucophaeus*
Crested Pigeon	*Ocyphaps lophotes*
Common Bronzewing	*Phaps chalcoptera*
White-winged Chough	*Corcorax melanorhamphos*
Australian Raven	*Corvus coronoides*
Magpie Lark	*Grallina cyanoleuca*
Restless Flycatcher	*Myiagra inquieta*
Grey Fantail	*Rhipidura albiscapa*
Rufous Fantail	*Rhipidura rufifrons*
Brown Falcon	*Falco berigora*
Nankeen Kestrel	*Falco cenchroides*
Laughing Kookaburra	*Dacelo novaeguineae*
Sacred Kingfisher	*Todiramphus sanctus*
Welcome Swallow	*Hirundo neoxena*
Superb Fairy-wren	*Malurus cyaneus*
Yellow-faced Honeyeater	*Lichenostomus chrysops*
White-eared Honeyeater	*Lichenostomus leucotis*
Red Wattlebird	*Anthocaera carunculata*
Superb Lyrebird	*Menura novaehollandiae*
Rainbow Bee-eater	*Merops ornatus*
Richard's Pipit	*Anthus novaeseelandiae*
Clamorous Reed-Warbler	*Acrocephalus stentoreus*
Rufous Songlark	*Cinclorhamphus mathewsi*
Grey Shrike-thrush	*Colluricincla harmonica*
Golden Whistler	*Pachycephala pectoralis*
Rufous Whistler	*Pachycephala rufiventris*
Weebill	*Smicrornis brevirostris*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Yellow Thornbill	*Acanthiza nana*
Brown Thornbill	*Acanthiza pusilla*
Buff-rumped Thornbill	*Acanthiza reguloides*
Spotted Pardalote	*Pardalotus punctatus*
Striated Pardalote	*Pardalotus striatus*
Red-browed Finch	*Neochima temporalis*
Red-capped Robin	*Petroica goodenovii*
Scarlet Robin	*Petroica multicolor*

Common name	Scientific name
Flame Robin	*Petroica phoenicea*
Varied Sittella	*Daphoenositta chrysoptera*
Great Cormorant	*Phalacrocorax carbo*
Little Black Cormorant	*Phalacrocorax sulcirostris*
Pied Cormorant	*Phalacrocorax varius*
Little Pied Cormorant	*Phalacrocorax melanoleucos*
Australasian Grebe	*Tachybaptus novaehollandiae*
Crimson Rosella	*Platycercus elegans*
Eastern Rosella	*Platycercus eximius*
Satin Bowerbird	*Ptilonorhynchus violaceus*
Eurasian Coot	*Fulica atra*
Purple Swamphen	*Porphyrio porphyrio*
Silvereye	*Zosterops lateralis*
Birds (Introduced)	
Common Myna	*Acridotheres tristis*
Common Starling	*Sturnus vulgaris*
Common Blackbird	*Turdus merula*
Other Birds (From COG list)	
Australasian Darter	*Anhinga novaehollandiae*
Australian Hobby	*Falco longipennis*
Australian King-Parrot	*Alisterus scapulars*
Australian Owlet-nightjar	*Aegotheles cristatus*
Australian Pelican	*Pelecanus conspicillatus*
Australian White Ibis	*Threskiornis molucca*
Azure Kingfisher	*Ceyx azureus*
Bassian Thrush	*Zoothera lunulata*
Brown Quail	*Coturnix ypsilophora*
Brush Cuckoo	*Cacomantis variolosus*
Chestnut Teal	*Anas castanea*
Cicadabird	*Coracina tenuirostris*
Collared Sparrowhawk	*Accipiter cirrocephalus*
Common Sandpiper	*Actitis hypoleucos*
Crescent Honeyeater	*Phylidonyris pyrrhopterus*
Dollarbird	*Eurystomus orientalis*
Eastern Great Egret	*Ardea modesta*
Eastern Spinebill	*Acanthorhynchus tenuirostris*
Eastern Whipbird	*Psophodes olivaceus*
Eastern Yellow Robin	*Eopsaltria australis*
Emu	*Dromaius novaehollandiae*
European Goldfinch	*Carduelis carduelis*
Fan-tailed Cuckoo	*Cacomantis flabelliformis*
Fuscous Honeyeater	*Lichenostomus fuscus*
Grey Currawong	*Strepera versicolor*

Common name	Scientific name
Grey Teal	*Anas gracilis*
Hoary-headed Grebe	*Poliocephalus poliocephalus*
Horsfield's Bronze-Cuckoo	*Chalcitesbasalis*
House Sparrow	*Passer domesticus*
Jacky Winter	*Microeca fascinans*
Leaden Flycatcher	*Myiagra rubecula*
Little Eagle	*Hieraaetus morphnoides*
Little Raven	*Corvus mellori*
Masked Lapwing	*Vanellus miles*
Mistletoebird	*Dicaeum hirundinaceum*
Nankeen Night Heron	*Nycticorax caledonicus*
New Holland Honeyeater	*Phylidonyris novaehollandiae*
Noisy Friarbird	*Philemon corniculatus*
Noisy Miner	*Manorina melanocephala*
Northern Mallard	*Anas platyrhynchos*
Olive-backed Oriole	*Oriolus sagittatus*
Pallid Cuckoo	*Cacomantispallidus*
Peregrine Falcon	*Falco peregrinus*
Pilotbird	*Pycnoptilus floccosus*
Red-browed Treecreeper	*Climacteris erythrops*
Red-rumped Parrot	*Psephotus haematonotus*
Rock Dove	*Columba livia*
Rose Robin	*Petroica rosea*
Satin Flycatcher	*Myiagra cyanoleuca*
Shining Bronze-Cuckoo	*Chalciteslucidus*
Southern Boobook	*Ninox novaeseelandiae*
Speckled Warbler	*Chthonicola sagittata*
Spotted Quail-thrush	*Cinclosoma punctatum*
Straw-necked Ibis	*Threskiornis spinicollis*
Striated Thornbill	*Acanthiza lineata*
Stubble Quail	*Coturnix pectoralis*
Tawny Frogmouth	*Podargus strigoides*
Tree Martin	*Petrochelidonnigricans*
Western Gerygone	*Greygone fusca*
White-browed Scrubwren	*Sericornis frontalis*
White-naped Honeyeater	*Melithreptus lunatus*
White-plumed Honeyeater	*Lichenostomus penicillatus*
White-throated Gerygone	*Gerygone albogularis*
White-throated Needletail	*Hirundapus caudacutus*
White-winged Triller	*Lalage sueurii*
Willie Wagtail	*Rhipidura leucophrys*
Wonga Pigeon	*Leucosarcia picata*

Common name	Scientific name
Mammals	
Echidna	*Tachyglossus aculeatus*
Brown Antechinus	*Antechinus stuartii*
Eastern Grey Kangaroo	*Macropus giganteus*
Common Wallaroo	*Macropus robustus*
Red-necked Wallaby	*Macropus rufogriseus*
Swamp Wallaby	*Wallabia bicolor*
Mormopterus sp.	*Mormopterus sp.*
White-striped Freetail Bat	*Tadarida australis*
Water Rat	*Hydromys chrysogaster*
Brushtail Possum	*Trichosurus sp.*
Common Brushtail Possum	*Trichosurus vulpecula*
Gould's Wattled Bat	*Chalinolobus gouldii*
Chocolate Wattled Bat	*Chalinolobus morio*
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*
Large-footed Myotis	*Myotis macropus (adversus)*
Lesser Long-eared Bat	*Nyctophilus geoffroyi*
long-eared bat	*Nyctophilus sp.*
Large Forest Bat	*Vespadelus darlingtoni*
Southern Forest Bat	*Vespadelus regulus*
Little Forest Bat	*Vespadelus vulturnus*
Common Wombat	*Vombatus ursinus*
Mammals (Introduced)	
Wild Dog (feral)	*Canis familiaris*
Fox	*Vulpes vulpes*
Cat (feral)	*Felis catus*
Brown Hare	*Lepus capensis*
Rabbit	*Oryctolagus cuniculus*
Bats	
Chocolate Wattled Bat	*Chalinolobus morio*
Southern Forest Bat	*Vespadelus regulus*
Large Forest Bat	*Vespadelus darlingtoni*
Common Bent-wing Bat	*Miniopterus schreibersii*
Little Forest Bat	*Vespadelus vulturnus*
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*
Gould's Wattled Bat	*Chalinolobus gouldii*
Large-footed Myotis	*Myotis adversus*
White-striped Freetail bat	*Nyctinomus australis*

APPENDIX C
TERRESTRIAL FLORA LISTED UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY, NATURE CONSERVATION, THREATENED SPECIES CONSERVATION AND FLORA AND FAUNA GUARANTEE ACTS THAT MAY OCCUR IN THE LOCALITY

TABLE 1 Threatened terrestrial flora

Common name	Scientific name	EPBC Act	NC Act	TSC Act	FFG Act
Mountain Cress	*Drabastrum alpestre*				V
Baeuerlen's Gentian	*Gentiana baeuerlenii*	E	E	E	
Hoary Sunray	*Leucochrysum albicans var. tricolor*	E			
Tuggeranong Lignum	*Muehlenbeckia tuggeranong*	E	E		
Pale Pomaderris	*Pomaderris pallida*	V		V	
Austral Toad-flax	*Thesium australe*	V		V	
Canberra Spider Orchid	*Arachnorchis actensis*	CE	E		
Brindabella Midge Orchid	*Corunastylis ectopa*	CE	E		
Mountain Cress	*Drabastrum alpestre*				V
Baeuerlen's Gentian	*Gentiana baeuerlenii*	E	E	E	
Erect Peppercress	*Lepidium ginninderrense (= Lepidium pseudopapillosum)*	V	E	E	
Hoary Sunray	*Leucochrysum albicans var. tricolor*	E			
Tuggeranong Lignum	*Muehlenbeckia tuggeranong*	E	E		
Pale Pomaderris	*Pomaderris pallida*	V		V	
Tarengo Leek Orchid	*Prasophyllum petilum*	E	E	E	
Button Wrinklewort	*Rutidosis leptorrhynchoides*	E	E	E	
Small Purple Pea	*Swainsona recta*	E	E	E	

Key

C = Critically Endangered

E = Endangered

V = Vulnerable

APPENDIX D
PLANT SURVEY RESULTS

TABLE 1 Plant species identified in the Cotter area

Common name	Scientific name
Bristly Cloak Fern	*Cheilanthes distans*
Narrow Rock-fern	*Cheilanthes sieberi* ssp. *sieberi*
Inland Sickle-fern	*Pellaea calidirupium*
Necklace Fern	*Asplenium flabellifolium*
Blechnum 9126	*Blechnum* sp.
Bracken	*Pteridium esculentum*
Black Cypress Pine	*Callitris endlicheri*
Monterey Pine	*Pinus radiata*
Vanilla Lily	*Arthropodium milleflorum*
Yellow Autumn-lily	*Tricoryne elatior*
Rock Lily	*Bulbine glauca*
Tall Sedge	*Carex appressa*
Knob Sedge	*Carex inversa*
Bergalia Tussock	*Carex longebrachiata*
Carex 9178	*Carex* sp.
Umbrella Sedge	*Cyperus eragrostis*
Tall Spike Rush	*Eleocharis sphacelata*
Variable Sword-sedge	*Lepidosperma laterale*
Schoenoplectus 7452	*Schoenoplectus validus*
Fluke Bogrush	*Schoenus apogon*
Juncus 9493	*Juncus* sp.
Billabong Rush	*Juncus usitatus*
Wattle Mat-rush	*Lomandra filiformis* ssp. *coriacea*
Wattle Mat-rush	*Lomandra filiformis* ssp. *filiformis*
Spiny-headed Mat-rush	*Lomandra longifolia*
Many-flowered Mat-rush	*Lomandra multiflora*
Hyacinth Orchid	*Dipodium punctatum*
Pale Flax-lily	*Dianella longifolia*
Agrostis 9025	*Agrostis* sp.
Aira 9027	*Aira* sp.
Aristida 1578	*Aristida ramosa*
Austrodanthonia 9098	*Austrodanthonia* sp.
Kneed Spear-grass	*Austrostipa bigeniculata*
Rough Spear-grass	*Austrostipa scabra*
Austrostipa 9102	*Austrostipa* sp.

Common name	Scientific name
Oats	*Avena* sp.
Red Grass	*Bothriochloa macra*
Shivery Grass	*Briza minor*
Barbed Wire Grass	*Cymbopogon refractus*
Silky Blue-grass	*Dichanthium sericeum*
Dichelachne 9309	*Dichelachne* sp.
Echinopogon 9339	*Echinopogon* sp.
Common Wheatgrass	*Elymus scaber*
Eragrostis 9358	*Eragrostis* sp.
Yorkshire Fog	*Holcus lanatus*
Swamp Millet	*Isachne globosa*
Lolium 9547	*Lolium* sp.
Weeping Grass	*Microlaena stipoides*
Chilean Needle Grass	*Nassella neesiana*
Poison or Hairy Panic	*Panicum effusum*
Paspalum	*Paspalum dilatatum*
Common Reed	*Phragmites australis*
Poa 9718	*Poa* sp.
Wild Sorghum	*Sorghum leiocladum*
Kangaroo Grass	*Themeda australis*
Vulpia 9917	*Vulpia* sp.
Blunt Pondweed	*Potamogeton ochreatus*
Typha 9899	*Typha* sp.
Austral Grass-tree	*Xanthorrhoea australis/ X. glauca*
Lesser Joyweed	*Alternanthera denticulata*
Alternanthera 1199	*Alternanthera* sp. *A sensu Harden*
Prunus 9742	*Prunus* sp.
Daucus 4255	*Daucus glochidiatus*
Stinking Pennywort	*Hydrocotyle laxiflora*
Shield Pennywort	*Hydrocotyle verticillata*
Australian Lilaeopsis	*Lilaeopsis polyantha*
Yellow Burr-daisy	*Calotis lappulacea*
Saffron Thistle	*Carthamus lanatus*
Shiny Cassinia	*Cassinia longifolia*
Cassinia 3528	*Cassinia quinquefaria*
Centipeda 9197	*Centipeda* sp.
Common Everlasting	*Chrysocephalum apiculatum*
Clustered Everlasting	*Chrysocephalum semipapposum*
Spear Thistle	*Cirsium vulgare*
Rough Conyza	*Conyza primulifolia*
Euchiton 9374	*Euchiton* sp.
Catsear	*Hypochaeris radicata*

Common name	Scientific name
Prickly Lettuce	*Lactuca serriola*
Jersey Cudweed	*Pseudognaphalium luteo-album*
Chamomile Sunray	*Rhodanthe anthemoides*
Jagged Fireweed	*Senecio biserratus/ hispidulus*
Fireweed	*Senecio madagascariensis*
Cotton Fireweed	*Senecio quadridentatus*
Saw Groundsel	*Senecio vagus*
Indian Weed	*Sigesbeckia orientalis*
Smooth Solenogyne	*Solenogyne dominii*
Prickly Sowthistle	*Sonchus asper*
Common Sowthistle	*Sonchus oleraceus*
Tolpis 7846	*Tolpis umbellata*
Narrow-leaf New Holland Daisy	*Vittadinia muelleri*
Vittadinia 9916	*Vittadinia* sp.
	Xerochrysum sp.
	Xerochrysum viscosum
Oregon Grape	*Mahonia aquifolium*
Sweet Hound's-tongue	*Cynoglossum suaveolens*
Patterson's Curse	*Echium plantagineum*
Myosotis 9620	*Myosotis* spp.
Buchan Weed	*Hirschfeldia incana*
Callitriche 9162	*Callitriche* spp.
Wahlenbergia 9918	*Wahlenbergia* sp.
	Wahlenbergia sp. (small)
	Wahlenbergia sp. (large)
Paronychia 9673	*Paronychia* sp.
Petrorhagia 9689	*Petrorhagia* sp.
Four-leaved Allseed	*Polycarpon tetraphyllum*
French Catchfly	*Silene gallica*
Prickly Starwort	*Stellaria pungens*
Casuarina 3565	*Casuarina cunninghamiana*
Nodding Saltbush	*Einadia nutans*
Small St John's Wort	*Hypericum gramineum*
St. Johns Wort	*Hypericum perforatum*
Convolvulus 3892	*Convolvulus erubescens*
Kidney Weed	*Dichondra repens*
Sieber Crassula	*Crassula sieberiana*
Grey Guinea-flower	*Hibbertia obtusifolia*
Erect Guinea-flower	*Hibbertia riparia*
Astroloma 9092	*Astroloma* sp.
Lissanthe 6168	*Lissanthe strigosa*
Urn Heath	*Melichrus urceolatus*
Silver Wattle	*Acacia dealbata*

Common name	Scientific name
Black Wattle	*Acacia decurrens*
Ploughshare Wattle	*Acacia gunnii*
Hickory Wattle	*Acacia implexa*
Black Wattle	*Acacia mearnsii*
Wedge-leaved Wattle	*Acacia pravissima*
Red-leaved Wattle	*Acacia rubida*
Acacia 9003	*Acacia* sp.
Varnish Wattle	*Acacia verniciflua*
Matted Bossiaea	*Bossiaea buxifolia*
Emu-foot	*Cullen tenax*
Blunt-leaf Bitter-pea	*Daviesia mimosoides*
Slender Tick-trefoil	*Desmodium varians*
Twining Glycine	*Glycine clandestina*
Variable Glycine	*Glycine tabacina*
False Sarsaparilla	*Hardenbergia violacea*
Common Hovea	*Hovea heterophylla*
Austral Indigo	*Indigofera australis*
Chinese Lespedeza	*Lespedeza juncea* ssp. *sericea*
Heathy Bush-pea	*Pultenaea procumbens*
Grey Bush-pea	*Pultenaea spinosa*
Haresfoot Clover	*Trifolium arvense*
Hop Clover	*Trifolium campestre*
White Clover	*Trifolium repens*
Centaurium 9195	*Centaurium* spp.
Geranium 9405	*Geranium* sp.
Native Storksbill	*Pelargonium australe*
Common Raspwort	*Gonocarpus tetragynus*
Myriophyllum 9622	*Myriophyllum* spp.
Austral Bugle	*Ajuga australis*
Australian Gipsywort	*Lycopus australis*
Horehound	*Marrubium vulgare*
Wild Sage	*Salvia verbenaca*
Coarse Dodder-laurel	*Cassytha melantha*
Native Flax	*Linum marginale*
Amyema 1279	*Amyema cambagei*
Purple Loosestrife	*Lythrum salicaria*
Hawthorn	*Crataegus monogyna*
Hempbush	*Gynatrix pulchella*
Red-flowered Mallow	*Modiola caroliniana*
Baeckea 9109	*Baeckea* spp.
River Bottlebrush	*Callistemon paludosus*
Apple Box	*Eucalyptus bridgesiana*
Broad-leaved Peppermint	*Eucalyptus dives*

Common name	Scientific name
Red Stringybark	*Eucalyptus macrorhyncha*
Brittle Gum	*Eucalyptus mannifera*
Eucalyptus 5124	*Eucalyptus polyanthemos*
Ribbon Gum	*Eucalyptus viminalis*
Burgan	*Kunzea ericoides*
Slender Tea-tree	*Leptospermum brevipes*
Tea Tree	*Leptospermum* sp.
Epilobium 9357	*Epilobium billardierianum*
Oxalis 9662	*Oxalis* sp.
Sweet Bursaria	*Bursaria spinosa*
Lamb's Tongues	*Plantago lanceolata*
Variable Plantain	*Plantago varia*
Sheep Sorrel	*Acetosella vulgaris*
Creeping Knotweed	*Persicaria prostrata*
Swamp Dock	*Rumex brownii*
Rumex 9782	*Rumex* sp.
Scarlet/Blue Pimpernel	*Anagallis arvensis*
Cat's Claw Grevillea	*Grevillea alpina*
Small-fruited Hakea	*Hakea microcarpa*
River Lomatia	*Lomatia myricoides*
Hairy Geebung	*Persoonia rigida*
Small-leaved Clematis	*Clematis microphylla*
Silky Cryptandra	*Cryptandra propinqua*
Narrow-leaved Pomaderris	*Pomaderris andromedifolia* ssp. *andromedifolia*
Pomaderris 7032	*Pomaderris andromedifolia* ssp. *confusa*
Narrow-leaf Pomaderris	*Pomaderris angustifolia*
Hazel Pomaderris	*Pomaderris aspera*
Pomaderris 7036	*Pomaderris betulina* ssp. *actensis*
Woolly-head Pomaderris	*Pomaderris eriocephala*
Pomaderris 7050	*Pomaderris pallida*
Australian Sheep's Burr	*Acaena ovina*
Sweet Briar	*Rosa rubiginosa*
	Cotoneaster sp.
Blackberry complex	*Rubus fruiticosus*
Native Raspberry	*Rubus parvifolius*
Asperula 9085	*Asperula sp.*
Slender Bedstraw	*Galium divaricatum*
Galium 9394	*Galium* sp.
Native Fuschia	*Correa reflexa*
Native Cherry	*Exocarpos cupressiformis*
Dwarf Cherry	*Exocarpos strictus*
Dodonaea 4592	*Dodonaea viscosa*
Digger's Speedwell	*Derwentia perfoliata*

Common name	Scientific name
Gratiola 9426	*Gratiola* sp.
Corn Toad-flax	*Linaria arvensis*
Lesser Broomrape	*Orobanche minor*
Blanket Weed	*Verbascum thapsus*
Twiggy Mullein	*Verbascum virgatum*
Blue Water-speedwell	*Veronica anagallis-aquatica*
Black-berry Nightshade	*Solanum nigrum*
Creamy Candles	*Stackhousia monogyna*
Kurrajong	*Brachychiton populneus*
Brachyloma 2696	*Brachyloma daphnoides*
Pimelea 6900	*Pimelea curviflora*
Purpletop	*Verbena bonariensis*
Viola 7998	*Viola betonicifolia*

APPENDIX E
SIGNIFICANT PLACES NEAR THE ENLARGED COTTER DAM

The following places within or in the vicinity of the Enlarged Cotter Dam project area are on the Register of the National Estate:

- Cotter Pumping Station and Electricity Substation, Cotter Road, Cotter, ACT (Place ID: 13623).
- Cotter Pumping Station Precinct, Cotter Road, Cotter, ACT (Place ID: 102447).
- *Pomaderris pallida* below Cotter Junction, Cotter Road, Cotter, ACT (Place ID: 14856). Four colonies of the nationally rare plant species are located 1.5 kilometres northeast of the Cotter Reserve, on the eastern bank of the Murrumbidgee River.
- *Pomaderris pallida* above Cotter Junction, Cotter Road, Cotter, ACT (Place ID: 14857). Around 200–300 plants of the nationally rare plant species are located 1.5 kilometres upstream of the Cotter River junction, on the eastern bank of the Murrumbidgee River.
- Cotter Caves Area, Paddys River Road, Cotter, ACT (Place ID: 13316). This diversity of rocks within one formation are located in the catchment of Paddys Creek, which enters Paddys River 400 metres south-east of its confluence with the Cotter River.

The following places within or in the vicinity of the Enlarged Cotter Dam project area are nominated for provisional registration, or are currently registered:

- Cotter Pumping Station and associated housing, including the Cotter Bridge, east abutment and Cotter Road Reserve. Registered (Entry No. 20079).
- Cotter Dam, parts of the Cotter Reserve and suspension bridge (Blocks 29, 30, 34, 38 and 39, District of Coree; and Blocks 63, 80, 178, 179, 213 District of Paddys River). Nominated.
- Three areas of a vulnerable compact rounded perennial shrub, Pomaderris pallida, on Blocks 1 (above the Cotter Junction), 493 and 451, and parts of Blocks 30 and 427 (below the Cotter Junction). The species is currently only known from the ACT, where it is scattered along the Cotter, Paddys and Murrumbidgee Rivers, and in Molonglo Gorge. Nominated.
- Pierces Creek Forestry Settlement. Nominated.
- Parts of the Uriarra Forestry Settlement (part of Block 5). Nominated.
- Paddys River (Cotter) Caves and mine precinct (Block 47 (part) and 201(part), District of Paddys River). Nominated.

The following places within or in the vicinity of the Enlarged Cotter Dam project area have been classified by the National Trust of Australia (ACT) and are those which, in the Trust's view, are essential to the heritage of the ACT and must be preserved:

- The existing Cotter Dam and tunnel.
- Cotter Bridge and Precinct.
- Cotter Pumping Station.
- Flora: Murrumbidgee River (above and below Cotter Junction)— *Pomaderris pallida*.
- Flora: Murrumbidgee River Corridor between Kambah Pool and Cotter Junction— *Pomaderris pallida*.
- The geological site of Cotter Caves.