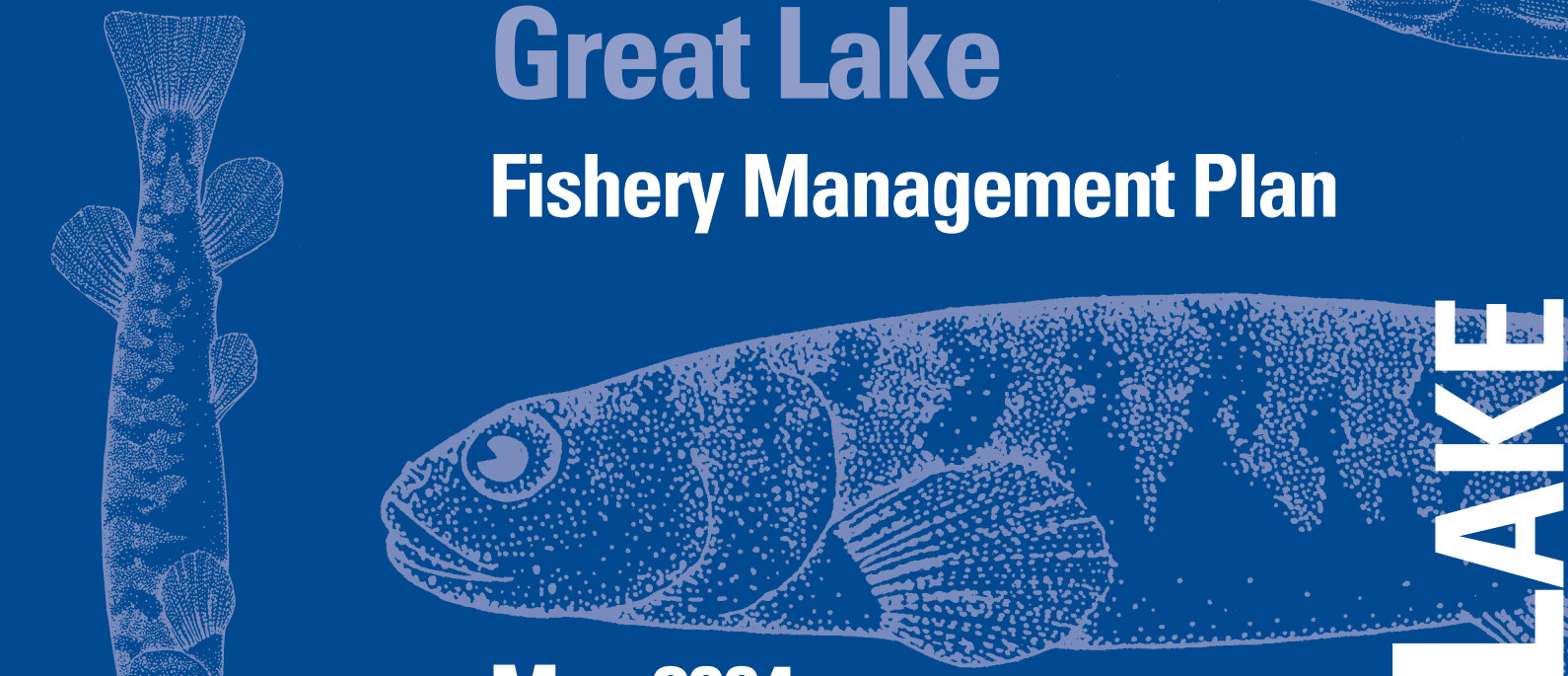
Inland Fisheries SERVICE

Great Lake

Fishery Management Plan



May 2004

GREAT LAKE

EXECUTIVE SUMMARY

The Great Lake Fishery Management Plan establishes a vision, a set of goals with linked objectives and a series of actions for the management of fish and the fishery at Great Lake.

The vision for the fish and fishery of Great Lake is *"To develop the recreational trout fishery whilst ensuring, managing and advocating for the sustainability of biodiversity values."*. The vision will be challenging but will provide direction for the Service's management of the fish and fishery at Great Lake.

The plan includes goals, objectives and actions in the areas of the trout fishery, native fauna, aquatic environment and habitats, pest biota and infrastructure (Appendix 1). Policy positions and statements on fishery management matters are determined and are summarised in Appendix 2.

The plan provides a focus and direction for the future management of the recreational trout fishery. The primary focus of the plan is the enhancement of the rainbow trout fishery through measures such as increasing natural recruitment, a stocking program, in addition to protective regulatory measures for rainbow trout. A list of regulations to apply to the Great Lake fishery is contained in Appendix 3.

An improvement in the rainbow fishery will deliver important benefits to the Great Lake fishery and other fisheries around the State. Rainbow trout are generally easier to catch than brown trout so increases in angler catch rates and harvests are expected as the population is increased. Great Lake is also an important source of wild rainbow trout ova that once on-grown can be used to supplement trout populations in other fisheries.

The environment and native biota, particularly threatened fish, are recognised as important elements of the Great Lake fishery. The need for balanced management of the recreational fishery, native biota and other aquatic resources such as water underpins the vision. However, it is recognised that further research is required in some areas to achieve this balance. The increase in the rainbow trout population will be compensated by the removal of brown trout with the aim to maintain the combined population of salmonids within historical bounds. The brown trout population will be used to supplement trout stocks in other fisheries. Water level management is an important factor in the health of aquatic environments and yet little is known about the nature of impacts caused by different water level management regimes at Great Lake. The Service will advocate for sound ecological outcomes from the management of water.

The plan also identifies the need to promote and encourage research across a wide range of areas such as habitat requirements of native fish, native fish interactions with salmonids and impacts of water level management.

The plan highlights the significant threats that pest fish and other biota pose to the fishery, native fish and ecology of the lake and seeks to minimise threats from introduced biota through a number of strategies and actions. Introduced Canadian pondweed also poses an unknown threat that requires further

investigation. Management options for the control of pest flora and fauna also need to be identified and assessed.

An emphasis is also given to improving community awareness, education and interpretation with the development of strategies to assist in information flow to tourists and anglers. Information booths and signage infrastructure are identified as important elements to deliver this information and to promote the fishery.

Other infrastructure requirements, such as formal camping areas and public conveniences, are provisionally recognised although greater consultation and more detailed consideration is required before seeking their delivery.

The initiatives and strategies in the plan are expected to have benefits for interstate and local tourism. The increase in the abundance of the rainbow trout population together with the provision of infrastructure and signage is expected to improve the overall attractiveness of Great Lake as a fishing destination and increase visitation. The trout fishery management goals are expected to deliver economic benefits to the States economy, particularly the Central Highlands region.

Overall, the plan integrates a wide range of actions to achieve a common vision and goal for the Great Lake fishery. The plan recognises the need for balanced management whilst delivering more from the recreational fishery.

LIST OF ABBREVIATIONS

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
CHC	Central Highlands Council
DPIWE	Department of Primary Industries, Water and Environment
DTPHA	Tourism, Parks, Heritage and Arts
FACT	Freshwater Anglers Council of Tasmania
HT	Hydro Tasmania
IFAC	Inland Fisheries Advisory Council
IFS	Inland Fisheries Service
IFSBC	Inland Fisheries Service Biological Consultancy
MAST	Marine and Safety Tasmania
mg/l	Milligrams per litre
ML	Megalitre
NCB	Nature Conservation Branch (DPIWE)
NTU	Nephelometric turbidity units – measure of turbidity
PWS	Parks and Wildlife Service
TEMSIM	Tasmanian Electricity Market Simulation Model
TGALT	Trout Guides and Lodges Tasmania
TSRTA	Tasmania's South Regional Tourism Association
µS/cm	Micro siemens per centimetre – measure of conductivity

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1. INTRODUCTION

1.1 PURPOSE OF THE PLAN

This plan is one of a series of fishery management plans that are being developed by the Inland Fisheries Service (IFS) to provide vision, goals, objectives, directions and guidance for the management of Tasmania's freshwater fisheries. Each plan is designed to offer directions for fisheries management for a specified period.

The plan identifies priority areas of management and research necessary to achieve the vision and goals for the fish and fishery of Great Lake. This will also assist the Service to plan work programs and assign resources.

The plan strives to recognise and manage the competing needs of our fishery whilst ensuring the development of our valuable recreational fishing resource.

1.2 SCOPE OF THE PLAN

The primary focus of the plan is the fish and fishery of Great Lake, however, it is necessary to include and consider other facets of Great Lake such as the environment and infrastructure that have a direct linkage with the fishery. The intention of the plan is to engage with the relevant Government Departments, agencies or bodies about issues where the Service does not have direct responsibility. The Service will be a strong advocate on issues that are important to the Great Lake fishery.

The plan examines the management of the recreational trout fishery, native fish, commercial fisheries and pest species. Other areas considered include the environment and infrastructure.

In some instances, policies are presented to clearly define the Service's position on fishery management issues. These policies have been formulated to support the achievement of the fishery management goals and to link with other Service policies.

Sound and effective management of the fishery can only be achieved through the mutual cooperation and commitment of stakeholders and the relevant natural resource managers. The Service will need to continue to foster existing relationships and linkages with anglers, Freshwater Anglers Council of Tasmania (FACT), Parks and Wildlife Service (PWS – DTPHA [Department of Tourism, Parks, Heritage and Arts]), Nature Conservation Branch (NCB – DPIWE [Department of Primary Industries, Water and Environment]), Central Highlands Council (CHC), Hydro Tasmania (HT), Tourism Tasmania (DTPHA) and Trout Guides and Lodges Tasmania (TGALT) in regard to many of the fishery related issues at Great Lake.

1.3 IMPLEMENTATION AND FUNDING

The plan will be implemented after it has been accepted by the Director of Inland Fisheries. The actions in the plan will be subject to availability of funding. Where possible, external funds will be sought to support actions contained in the plan.

1.4 COMMENCEMENT OF REGULATIONS

The angling regulations contained in this plan will only take effect once the regulations have been gazetted.

1.5 TERM OF THE PLAN

The term of the plan is 10 years with a five year interim review.

2. BACKGROUND

HISTORY OF GREAT LAKE

In 1815, Thomas Tooms was the first white settler to visit Great Lake. At the time Great Lake was the largest body of freshwater in Tasmania. It was a relatively shallow lake with an average depth of approximately 2 m.

The potential for power generation and irrigation supply from Great Lake was recognised as early as the 1850's. The Complex Ores Company formed the Hydro-Electric Power and Metallurgical Company to generate power and, as a consequence, the Great Lake Scheme commenced in 1910. The first dam increased the depth of the lake by about 3 m to a supply level of 1 022 m (AHD). Prior to this, a loose rock barrier had been built across the Shannon River by anglers to maintain the water level in Swan Bay. The company eventually failed and was purchased by the State and the Hydro-Electric Department was formed to complete the scheme. The second dam was the Miena Dam which was completed in 1922 and built downstream of the rock structure. It was a multiple arch dam built to store water for the Waddamana Power Station. This dam increased the level of Great Lake to 1 030 m (AHD). A third claycore rock fill-dam was completed in 1967 further downstream of the multiple arch dam. It increased the depth of Great Lake by a further 3.4 m to a full supply level of 1033.5 m (AHD). In July 1982, the height of this dam was increased by a further 6 m to a total of 28 m (Inland Fisheries Commission 1987).

In 1918-1919 the Hydro-Electric Department commenced construction on the Ouse River diversion canal (Liawenee Canal) to supply water to Great Lake. Work was completed in 1922 and the resultant canal provided an additional 10 km of suitable trout spawning substrate. Subsequent concreting of the canal has resulted in the confinement of trout spawning to the lower 2 km of the canal. This coincided with the completion of a new weir across the Shannon River which raised the potential water level of Great Lake by 10 m above the natural level. In 1964, the Poatina Power Station commenced operations and Great Lake outflow water was diverted to flow north via Brumbys Creek and the South Esk River instead of south through the Shannon River and Waddamana Power Station.

RECREATIONAL TROUT FISHERY

Brown trout (*Salmo trutta)* were first introduced to Great Lake in 1870 by James Wilson. By 1900 the Great Lake trout fishery was widely acclaimed and boasted about in early tourist guides. Releases of other species followed, with an Atlantic salmon (*Salmo salar*) stocking in 1907 and a small release of "Sebago salmon (*Salmo salar sebago*)" in 1911 (Gilmour 1997). Rainbow trout (*Oncorhynchus mykiss)* were introduced to Great Lake in 1910. A limited release of yearling quinnat salmon (*Oncorhynchus tschawytscha*) was also conducted in 1931 (French 1994). None of the releases of salmon were successful in establishing populations in Great Lake.

Great Lake produced some outstanding trophy trout in the late 1800's and early 1900's with the largest recorded trout from Great Lake weighing 11.3 kg (25 lb). The characteristics of the fishery have varied markedly since the early 1900's with average weights of fish and condition of fish linked to the inundation of new shoreline as new dams were developed on the Shannon River. Concerns about the low abundance of trout led to the establishment of a trout hatchery on the

banks of the Shannon River below the Miena Dam. The hatchery was operational between 1910-1962.

The Shannon River downstream of the Miena Dam supported a fishery phenomenon renowned across the world and is of great historical significance for Tasmanian anglers. The phenomenon resulted from water releases from Great Lake which promoted the mass emergence of caddis flies, namely the snowflake caddis (*Asmicridea grisea*) in the river as it joins Shannon Lagoon. The Shannon Rise was established in the 1930's as a result of the development of the Miena Hydro scheme and the releases of water down the Shannon River. These releases contributed to the establishment of a prolific snowflake caddis fly population. Fishing for significant numbers of well conditioned brown trout in December during the emergence of the caddis fly adults was considered a premier feature of the Tasmanian trout fishery. The decline of the Shannon Rise began during the mid-1950's as water release patterns changed and became irregular. The commissioning of the Poatina Power Station in 1964 and the subsequent cessation of major releases from the Miena Dam down the Shannon River was responsible for the eventual demise of the Shannon Rise (French 2002).

The average weight of brown trout did not change significantly in the period 1950-1985 (Davies and Sloane 1988) during which average weights have remained within the range of 1.5 kg – 0.8 kg. Over the last 15 years the average weights of brown trout in the annual spawning runs have also remained in this range.

In the late 1970's, a zig zag channel was constructed at Liawenee to provide additional spawning grounds for rainbow trout. The purpose of the channel was to increase rainbow trout recruitment. An additional channel was constructed in March 1983 on the northern side of Liawenee Canal.

A fish barrier was constructed in Liawenee Canal in 1999 to prevent the movement of unwanted fish (eg redfin perch, *Perca fluviatilis*) through the canal to waters further upstream. This barrier interferes with the natural spawning migrations of brown and rainbow trout in the canal. Manual trout transfers are conducted when trout are required above the barrier for the zig zag channels and display purposes for Liawenee Open Weekend.

Currently Great Lake supports a fishery dominated by brown trout and a substantially smaller, but highly valued, wild rainbow trout population.

ENVIRONMENT

Great Lake (Figure 1) has been significantly modified from its natural state by the construction of a dam and other water diversion infrastructure. This infrastructure has increased storage capacity and allowed for the manipulation and management of water levels. Details of the lake's water storage capacity and physical characteristics are shown in Table 1.

The lake is surrounded by extensive moorland on its southern and western shores, and alpine eucalypt forests on the eastern catchment. Full supply level is approximately 1039 m (AHD) and the lake level can fluctuate through a 21 m range over a long term cycle.

Figure 1. Map of Great Lake.

Below full supply level the shores are barren expanses of rock, gravel and mud. Drowned and semi-submerged trees litter the shoreline, particularly on the eastern shore. With the exception of a few sheltered bays scattered around the lake, much of the shore of Great Lake is devoid of aquatic plants, principally due to lake level variations and erosive wave action on exposed shores.

Table 1. Great Lake - water storage parameters (Hydro Electric Corporation 1999).

Parameter	
Water storage	3 178 720 ML
Full supply level (FSL)	1039.37 m AHD
Maximum depth at dam	25 m
Lake area (FSL)	176.12 km^2

Fulton (1983a) reported distinct differences in the substrates of the original lake bed and the "new" lake bed flooded by the impoundment. The original lake bed is generally characterised by clay based substrates with a low but variable content of organic material whilst the "new" lake bed has coarser substrates, higher content of organic material and aquatic macrophytes. Charophyte beds exist in the littoral zone around the lake but are apparently restricted to sheltered areas at depths below which drawdown is limited (French 1994; Inland Fisheries Commission 1987).

The main water inflow is via Liawenee Canal which diverts water from the Ouse River into the Great Lake. Water is also pumped from Arthurs Lake into Tods Corner and from Shannon Lagoon into Great Lake. The primary outflow from Great Lake was the Shannon River until 1964 when the Poatina Power Scheme was commissioned. Releases from Miena are made to maintain water levels in Shannon Lagoon and to supply riparian water for downstream users. The bulk of water is diverted north via a tunnel through the Great Western Tiers to the Poatina Power Station. This water is also used for irrigation.

Great Lake is the main centre for holiday shack developments in the Central Highlands. There are significant shack communities along the western shore at Miena, Breona, Brandum and the eastern shore at Tods Corner. The number of permanent residents in these areas, particularly around Miena, is also increasing.

CURRENT MANAGEMENT OF THE NATURAL RESOURCES OF GREAT LAKE

The Inland Fisheries Service is responsible for the management of fish (including freshwater invertebrates) and fisheries in Great Lake in accordance with the *Inland Fisheries Act 1995*. The present focus of the Service's management activities for Great Lake is the recreational trout fishery. There are no commercial fishing activities (ie eel fishing) permitted in Great Lake. At present the Service undertakes no formal management of native fish species apart from advocacy in relation to the protection of native fish and some basic recent monitoring.

Hydro Tasmania is responsible for the management of water resources of Great Lake and its catchment under licence from the Department of Primary Industries, Water and Environment (DPIWE). The licence, together with other legislation,

agreements and planning instruments, provide a basis for obligations to other water users and the environment.

Hydro Tasmania currently undertakes and funds research on aquatic biological and hydrological matters, manages infrastructure associated with water management and power generation, and monitors water quantity and quality.

Recently, Hydro Tasmania has undertaken several investigations linked to a broader environmental assessment of the potential impacts of the Basslink proposal. Basslink is a project that will connect Tasmania to the national electricity grid of mainland Australia. Hydro Tasmania is also addressing issues identified through its Water Management Review project for the South Esk - Great Lake Catchment.

3. LEGISLATION AND GUIDING DOCUMENTS

There are several significant statutes, guiding policies and strategies that have a direct bearing on the management of the biota and the environment of Great Lake. These are listed below:

3.1 STATUTES

- *Threatened Species Protection Act 1995*[1]
- *Threatened Species Protection Regulations 1996*[1]
- *Environment Protection and Biodiversity Conservation Act 1999*[2]
- *Nature Conservation Act 2002*[1]
- *National Parks and Reserves Regulations 1999*[1]
- *Inland Fisheries Act 1995*[1]
- *Inland Fisheries (Recreational Fisheries) Regulations 1999*[1]
- *Hydro-Electric Corporation Act 1995*[1]
- *Electricity Supply Industry Act 1995*[1]
- *Water Management Act 1999*[1]

[1]www.thelaw.tas.gov.au

[2]www.ea.gov.au/epbc/about/index.html

3.2 GUIDING DOCUMENTS

The following documents provide information and prescribe policy relevant to this plan that needs to be taken into account in setting and progressing towards the fishery management goals.

- Inland Fisheries Service Translocation and Fish Stocking Policy
- State Policy on Water Quality Management 1997[3]
- Hydro Tasmania: Environmental Review, South Esk – Great Lake Hydro Catchment
- Hydro Tasmania Aquatic Environmental Policy
- Tasmania's Nature Conservation Strategy 2002-2006[3]
- Threatened Species Strategy for Tasmania[3]

[3]www.dpiwe.tas.gov.au

4. VALUES

Great Lake, although altered from its natural condition, has many significant values that require highlighting within this plan and these are listed below.

ENVIRONMENTAL

- High standard of water quality
- High biodiversity of aquatic fauna

CONSERVATION

- A number of endemic species (invertebrates and fish)
- Several threatened species (invertebrates and fish)
- Important communities of aquatic algae and macrophytes

RECREATIONAL

- Important recreational trout fishery
- Significant and popular lake for boat angling
- Source of trout stocks for other fisheries
- Significant recreational and permanent shack communities
- Access point for the Central Plateau Protected Area and Western Lakes trout fishery (World Heritage Area)
- Popular camping area for anglers

COMMERCIAL

- Professional fishing guides
- Local accommodation
- Hotels and a small general store
- Campground at Miena (8 serviced and 4 unserviced sites)

TOURISM

- Tourism services linked to the recreational trout fishery
- Central location to most fisheries on the Central Plateau
- Gateway to the Western Lakes area
- Key destination for sightseers and interstate and local anglers
- Highland Lakes Road is a significant link road
- Professional fishing guides
- Parks and Wildlife Service facilities
- Popular camping area for anglers

POWER GENERATION

- Important hydro-electric impoundment

HISTORICAL

- Recreational trout fishery

5. VISION AND GENERAL GOALS OF THE PLAN

The Service is committed to achieving balance in the management of the fishery resources of Great Lake, including developing and maintaining a strong and vibrant recreational trout fishery. The vision statement reflects this intent by the Service.

5.1 VISION STATEMENT

VISION

To develop the recreational trout fishery whilst ensuring, managing and advocating for the sustainability of biodiversity values.

5.2 MANAGEMENT GOALS

The Service aims to manage the fish and fishery resources to optimise the performance of the recreational fishery whilst maintaining conservation and environmental values. The challenge will be to ensure that all values are managed equitably and competing goals and objectives are appropriately balanced. To achieve this balance attention will be given to relevant policies, strategies, management plans, legislation and research. Efforts will be made to overcome knowledge gaps in instances where there is a lack of understanding of important aspects of the lakes ecology.

The central management goals for this plan are to develop, conserve and protect the fisheries. A number of general goals have been established for different components of the fishery (eg recreational fisheries and native fish). These goals reflect the overall vision for Great Lake and provide the basis of a framework to focus and direct the Service's management strategies, policies and actions.

6. RECREATIONAL FISHERIES MANAGEMENT

6.1 INTRODUCTION

Great Lake contains a significant recreational trout fishery which is consistently ranked in the top two Tasmanian lake fisheries in terms of the number of anglers, angler effort and harvests. The popularity of the fishery has contributed to the development of shacks and commercial establishments, such as hotels, a general store and campground. From a tourism and recreational perspective, there is little doubt that the fishery is important to the socio-economic health of the Central Highlands region (F. Hussey, Tourism Tasmania, *pers. comm*.). Centrally located, Great Lake also provides a gateway to other regions and fisheries on the Central Plateau. The fishery has provided anglers with sustained angling for both brown and rainbow trout since their introduction in 1870. Historically, Great Lake was recognised as a rainbow trout water and significant management efforts have at times been directed at improving rainbow trout stocks as brown trout became dominant. As a key recreational fishery, it is critical that fishery performance is optimised and its full potential realised within the constraints of other factors such as threatened fauna and power generation.

6.2 PAST MANAGEMENT

BROWN TROUT

Brown trout (*Salmo trutta)* were first introduced to Great Lake in 1870 by James Wilson (Clements 1988). The trout population developed well and formed the basis for the present fishery. By 1900 the Great Lake trout fishery was widely acclaimed and boasted about in early tourist guides. The brown trout fishery went through several periods of boom followed by decline. Between 1890 and 1910, the average size of brown trout caught was between 3.5-4 kg. The largest recorded trout from Great Lake weighed 11.3 kg and was caught in 1897. From 1910, the average weight of trout began to decline and by 1916 had reached 2 kg. Another boom in the brown trout fishery occurred after the second dam was built in 1922. This period lasted only six years before the fishery began to decline. The average weight has since decreased to 1.5-2 kg in the 1940s, 1-1.2 kg in the 1980's to present day average weights of 0.85-1.1 kg (Davies and Sloane 1988, IFS unpublished data). A hatchery was built in 1910 at the Shannon River outlet to supply trout stock for the Great Lake fishery. First reports of the famous 'Shannon Rise' arose during the 1922-23 angling season.

Presently, the main brown trout spawning run occurs in Liawenee Canal. The brown trout spawners provide most of the wild fishery stock for other waters around the State. Ova are stripped and fertilised at Liawenee before being transported to the Service's Salmon Ponds hatchery at Plenty where fry are reared and subsequently restocked throughout the State.

RAINBOW TROUT

Rainbow trout (*Oncorhynchus mykiss)* were first introduced to Great Lake in 1910. Rainbow trout averaged 2.5-3.5 kg in the first few years. This average declined until the 1916 dam was built. As with brown trout, rainbow trout increased in weight to an average of 2.7 kg with a maximum recorded weight of up to 5.7 kg in 1919. After the second dam was built in 1922, the fishery increased dramatically, with fish reaching average weights of 3 kg - 3.5 kg with maximum weights of 7.5 kg. This coincided with the opening of Liawenee Canal which provided rainbow trout with ideal spawning conditions. The rainbow trout population grew dramatically between 1925 and 1932 with approximately 95-

99% of the catch comprised of rainbow trout. During the 1940's Liawenee Canal was progressively lined with cement, gradually reducing the amount of suitable spawning beds for rainbow trout. This change appears to have had a negative impact on the rainbow trout population. By the early 1950's, brown trout out numbered rainbow trout 10:1 in the annual spawning runs. The catch rate of rainbow trout in proportion to brown trout dropped during the 1950's stabilising at 50 %. By this time the average weight of rainbow trout was 1-1.5 kg.

Several attempts were made to reverse the declining catch rate and average weight. In the period 1930-1950, a rainbow trout stocking program was commenced to arrest the decline of the rainbow trout fishery. However, the relatively poor returns in angler catches and the numbers of rainbow trout in the spawning run, indicated that the strategy was unsuccessful (Davies and Sloane 1988). Between 1960 and 1980 another strategy was implemented to enhance the rainbow trout fishery. Over 108 000 adult brown trout were removed from Liawenee Canal and distributed to other waters in the State. This strategy was meant to reduce overall brown trout numbers and therefore reduce competition with rainbow trout. The removals of brown trout were complemented by an aggressive rainbow trout stocking strategy in 1972-1982 to improve rainbow trout stocks. The desired outcome of this strategy was to reduce competitive pressure on rainbow trout and to improve the size and condition of brown trout (Davies and Sloane 1988). This strategy did not produce any long-lasting results.

During this period, five million fry were released resulting in a small increase in catch rates however the natural dominance of the brown trout remained unchanged (Davies and Sloane 1988). The reasons for the failure of the strategy are unclear although water level variation and the intensity of the management strategies have been identified as likely factors (Davies and Sloane 1988).

SALMON

In 1931, Quinnat salmon (*Oncorhynchus tschawytscha*) were released into Great Lake followed by a further liberation in 1936. The species did not establish. Experimental releases of Atlantic salmon occurred in 1907, 1936 and again in the late 1980's. This species also failed to establish.

BROOK TROUT

A small number of brook trout (*Salvelinus fontinalis*) have been held at Liawenee in two small dams and a section of the zig zag channels. A very small proportion of these fish escaped and were reportedly caught in Canal Bay (P. Potter, Inland Fisheries Service, *pers. comm.*).

6.3 PRESENT MANAGEMENT

In general, the management of the Great Lake trout fishery has largely remained unchanged since the mid-1980's. The brown trout fishery is self-sustaining with significant recruitment from the major spawning streams of Liawenee Canal and Sandbanks Creek, and lesser spawning streams such as Brandums, Pine and Doctors creeks along the north western shore. The number of spawning brown trout in Liawenee Canal varies between years, but generally numbers total between 16 000–20 000 per year (Davies and Sloane 1987).

The large number of spawning brown trout in Liawenee Canal provides the opportunity to stock other waters with adult brown trout collected from the canal

during the spawning run. In the past, as a by-product of a strategy to reduce brown trout numbers in Great Lake, there have been significant transfers of adult brown trout from Great Lake to other waters. Fisheries that have benefited recently include Penstock Lagoon, Western Lakes and Pawleena Dam. These transfers have provided some excellent fishing in those waters stocked. Presently, brown trout transfers are undertaken to supplement fish stocks, to fill gaps in recruitment, to maintain fisheries where there is negligible recruitment or where the performance of a fishery can be enhanced.

In recent times there has been concern that the rainbow trout population is suffering a slow decline in abundance. Presently, the population is supported through a management program designed to maintain the fishery. Stocks are being supplemented by a stocking program and the on-going provision of dedicated spawning areas (Liawenee zig-zag channels). Recent modifications to fisheries infrastructure and a pest fish barrier on Liawenee Canal have imposed some significant difficulties in trapping sufficient rainbow trout for stripping and the transfer of spawners to the zig-zag spawning channels. This problem should be rectified with the reinstatement of the anti-jump structure in the lower section of Liawenee Canal. A specific trapping program has been established to ensure that adequate numbers of rainbow trout are available for stripping on an annual basis. When possible, excess spawning fish are presently being transferred to the zig-zag channels to assist in improving recruitment.

REGULATIONS / ORDERS

Many of the fishing regulations that apply to the Great Lake fishery have a strong historical basis and most have remained unchanged for several years. Whilst present regulations are widely accepted by anglers, some do little in the way of meeting fishery management objectives or assisting in optimising the return to anglers from the fishery.

Presently, the angling season is open all year, with the exception of Canal Bay which opens at the end of October and closes at the end of March. All legal angling methods are permitted, although bait fishing is prohibited in Canal Bay and Tods Corner. There is a legal minimum fish length of 220 mm for both brown trout and rainbow trout and a daily bag limit of 12 trout. Angling is prohibited in all in-flowing waters and for a radius of 50 m where these waters enter the lake. The *Inland Fisheries Act 1995* enables the Governor to make regulations in respect to a number of matters pertaining to the fishery such as the taking of fish and the Minister to make orders in respect to a variety of other matters such as seasons. Regulations are approved by the Minister and the Governor and then tabled in both houses of Parliament. Regulations are contained in the *Inland Fisheries (Recreational Fishing) Regulations 1999*. Orders and regulations are announced in the State Service Gazette.

The regulations and orders can be obtained from the Printing Authority of Tasmania or from www.thelaw.tas.gov.au. Most of the regulations and orders are summarised in the annual angling code which is published prior to the start of the brown trout season.

FISH RECRUITMENT AND STOCKING

The brown trout population is self-sustaining and there is no requirement to supplement numbers of brown trout in the lake.

Rainbow trout stocks are generally maintained by natural recruitment which includes recruitment derived from the zig-zag channels at Liawenee. There have been significant, but inconsistent, historical stockings of rainbow trout but since 1990 to 2000 only 87 500 rainbow fry have been stocked into the lake. A stocking program has commenced recently to boost recruitment of rainbow trout to the fishery involving the transfer of 100 000 fry in 2001 and a further 295 000 fry in 2002.

FISHERY PERFORMANCE

Performance of the Great Lake fishery is monitored through an annual angler postal survey, and by sampling the spawning runs of both brown trout and rainbow trout in Liawenee Canal. The angler postal survey provides information on catch rates, harvests, angling effort and participation in the fishery. Trout spawning runs at Great Lake have been studied in detail over time. The information from these monitoring strategies provides evidence to measure the performance of management strategies. The monitoring of the spawning runs also provides long term information about trout size in Great Lake.

6.4 ISSUES

There is a suite of issues that need to be addressed to ensure that the fishery can be sustained and developed consistently with the expectations and aspirations of anglers, including:

- Improvement of recruitment of rainbow trout.
- Enhancement and maintenance of fishery management infrastructure (eg fish diversion structures, fish traps and spawning channels).
- Management and regulation of the rainbow trout fishery.
- Balancing the development of the recreational fishery with native fish conservation.
- Development of meaningful regulations that balance biological and social needs.
- Introduction of trout food sources such as forage fish.
- Interpretative information about the fishery at Great Lake.

These issues and the management solutions are expanded on in later sections.

6.5 GOAL FOR FUTURE MANAGEMENT

The goal for the recreational trout fishery is simple and founded, to a large extent, on the present expectations and experiences of anglers.

GOAL ***To provide a reliable, well-utilised and accessible recreational fishery based on a multi-species trout fishery, offering a quality angling experience for all anglers.***

To achieve this goal, specific attention will be given to the rainbow trout fishery. The rainbow trout population has been shown to be under considerable pressure which could threaten it's on-going sustainability (Inland Fisheries Commission 1987). This plan will provide a basis for the implementation of initiatives as part of a strategy to improve the status of the rainbow trout fishery

There are many significant benefits flowing from a large and healthy rainbow trout fishery. Firstly, the Service will be able to ensure the long-term sustainability of the most important wild rainbow trout population in Tasmania. Secondly, anglers will benefit directly by being able to catch more rainbow trout at Great Lake. Thirdly, the Service will be able to stock other important fisheries with highly valued wild rainbow trout instead of relying on donated domesticated rainbow trout stock from commercial fish farms.

One benefit that will flow from this strategy is the removal and transfer of a limited number of adult brown trout spawners. This will be done as a precautionary measure to ensure that native fish remain buffered from excessive predation pressure from an increase in the size of the rainbow trout population. The transfer of brown trout will provide some significant benefits to other fisheries such as were realised for the fisheries at Bradys Lake, Lake Binney and Tungatinah Lagoon during the 2003/04 angling season. These are real benefits that provide a certain return to anglers and at negligible impact on the brown trout fishery at Great Lake.

The brown trout population of Great Lake is grossly under-exploited by anglers (Inland Fisheries Commission 1987) and this contributes to the maintenance of a large population of brown trout. This abundant brown trout population, intra-specific competition and lake levels have been recognised as important factors implicated in the high number of slabby, poor conditioned trout caught by anglers from time to time (Davies and Sloane 1988; Inland Fisheries Commission 1987).

In the period, 1960-1980, a strategy was implemented to reduce the abundance of brown trout. This strategy was based on the removal of adult brown trout from the spawning run. During this period 108 000 spawners were removed from the population with no detectable effect on angler catch's or aspects of the spawning migration (Davies and Sloane 1988; Inland Fisheries Commission 1987). Davies and Sloane (1987) concluded that the removal of brown trout had no major effect on the fishery.

The brown trout removals proposed in this plan will be undertaken for a much different purpose than in 1960-1980. The removal of brown trout during this period was undertaken to improve the size and condition of brown trout (Davies and Sloane 1988). The current proposal to remove trout from the population is a conservation strategy to contribute to the protection of native fish whilst providing the opportunity to improve trout stocks in other waters. The removal of brown trout is planned to ensure that predation pressure on native fish is not increased but maintained within historical levels. The strategy is a compensatory measure that provides room for the expansion of the rainbow trout population.

Clearly, the removal of brown trout from Great Lake is sustainable at low to medium levels although monitoring and consequential analyses would be required to rigorously define the range of sustainable levels of removals.

6.6 POLICY

The following policies provide clarification on some recreational fishery management issues at Great Lake.

POLICIES

1 ***Forage fish will not be introduced into Great Lake to enhance food resources for trout.***

2 ***All trout stockings will be conducted in accordance with the IFS Fish Translocation Policy and other relevant policies.***

3 ***Domestic rainbow trout are not to be introduced into Great Lake.***

The use of forage fish to enhance the growth of trout in waters such as Great Lake has been regularly advocated by anglers. The reported success of an introduction of common smelt (*Retropinna retropinna)* to the trout fishery at Lake Taupo (New Zealand) prompted interest in forage fish. This led to the Inland Fisheries Commission in the 1960s undertaking investigations into the feasibility of introducing Australian smelt (*Retropinna semoni*) into Tasmania waters. A number of fish were imported from Victoria and maintained at ponds on Redlands at Plenty while the investigations were being conducted. The Commission decided not to introduce smelt into waters such as Great Lake because of the risks to native fauna and its potential to spread uncontrollably around the State. Consequently, the population was eradicated. Such an introduction was also considered to be unnecessary because Great Lake contained several species of small native fish.

Given the risks associated with freshwater fish introductions to the State's trout fisheries, native fish fauna and commercial salmonid industry, forage fish will not be introduced into Great Lake.

To contribute to efforts to prevent unwanted fish from being introduced into Great Lake, all IFS trout stockings will be in accordance with the IFS translocation policy.

Domesticated rainbow trout will not be stocked into Great Lake and it's catchment (except for the stocking of triploid trout in waters prescribed by the Western Lakes Fishery Management Plan 2002). This will ensure that the genetic structure of the wild rainbow trout population remains uncontaminated from domesticated rainbow trout from commercial fish farms.

6.7 OBJECTIVES AND ACTIONS

A specific objective to contribute to the achievement of the goal of the recreational trout fishery is the enhancement of the rainbow trout fishery. This objective will address the issue identified by previous studies which have shown that the rainbow trout population is under significant pressure compared to the brown trout population. This will be a challenging objective and a carefully developed strategy is required to identify the components and necessary resources. The strategy is likely to include a stocking program using the IFS Salmon Ponds hatchery and the zig-zag recruitment channels at Liawenee. The strategy will need to consider increasing and sustaining stocking levels of rainbow trout over the long term, removals of brown trout in greater numbers and other measures to improve the effectiveness of rainbow trout releases. In the long-term these measures are expected to contribute to an increase in the abundance of rainbow trout in Great Lake.

Monitoring of the performance of the fishery and fish stocks is essential to evaluate the management strategies. A monitoring program will be developed to measure important fishery attributes such as the abundance of the spawning populations, trout size and growth, catch rates and harvests, and levels of angler satisfaction.

The Great Lake fishery will be monitored as part of a Fishery Performance Assessment program and will include the following elements.

- Annual monitoring of the abundance of the brown and rainbow trout spawning runs in the Liawenee Canal.
- Monitoring of the relative abundance of the brown and rainbow trout populations and the collection of biological information such as growth and age structure.
- Preparation of a report that details the performance of the fishery using a variety of data (eg population surveys, angler postal survey and creel surveys).

The strategy to enhance the rainbow trout population will rely on the continuation and more effective implementation of on-going initiatives. Any new initiatives that are likely to significantly boost the rainbow trout population above historical levels must be assessed against impacts on native fish. The anticipated response of the rainbow trout population to the enhancement program is likely to be slow and remain within historical range of abundance in the short-term.

Some changes to the angling regulations will be made to support fisheries management goals and objectives. These will be based on biological information and social considerations. The two main changes to the regulations will apply to the daily bag limit and the minimum length of trout. These changes will effect brown trout and rainbow trout differentially and are discussed in more detail below. The objective of these regulations is to afford greater protection to the rainbow trout population.

BAG LIMIT – RAINBOW AND BROWN TROUT

The daily bag limit for salmonids will remain at 12 fish, however, the maximum daily harvest of rainbow trout will be restricted to three fish. This measure is needed to provide more protection for spawning rainbow trout thereby contributing to the maintenance of a greater number of spawning fish. Consequently, the greater the number of spawning fish then the greater potential exists for the recruitment of rainbow trout to the fishery. This regulation will be important in the weeks leading up to spawning when rainbow trout are particularly vulnerable to capture as they migrate towards Liawenee Canal. Without this regulatory measure, progress towards the objective of increasing the rainbow trout population is expected to be much slower.

The release of caught rainbow trout will also be encouraged as an additional measure for anglers to voluntarily contribute to the conservation of wild adult rainbow trout. Angling associations will be requested to assist in the extension to the wider angling community of measures to reduce mortality.

MINIMUM SIZE LIMIT- RAINBOW TROUT

Generally minimum size limits are applied to many fisheries to allow juvenile fish to spawn at least once before they are harvested (Burr 1991). This type of size limit is often imposed to lower the angling mortality component in vulnerable fish populations (Noble and Jones 1993). When these size limits have been set at the appropriate length, benefits have been detected in trout fisheries (Barnhart and

Engstrom-Heg 1984). As an example, at Raquette Lake in the United States, the minimum length limit for lake trout was increased from 350 mm to 490 mm and this resulted in a threefold increase in spawning fish within two years (Barnhart and Engstrom-Heg 1984).

There are however, cases when minimum size limits have been imposed at incorrect lengths and specific fishery objectives have not been met or problems have been created.

Prior to the 1970's, some fishery management agencies in the United States abandoned minimum size restrictions for brown trout in streams without causing significant impacts, however, rarely was the relaxation of the size regulation extended to rainbow trout or brook trout (Cooper 1970). Both rainbow trout and brook trout are very susceptible to angler exploitation and generally more sophisticated regulatory tools are needed to achieve species specific goals compared to brown trout.

Presently, at Great Lake the minimum size limit does not afford any protection to spawning rainbow trout. Rainbow trout can be legally harvested before they have the opportunity to spawn. Extensive research conducted on spawning trout migrations at Liawenee Canal during the period 1949-1985 and intensive monitoring in 1983, indicated that rainbow trout of the size 220 mm (present minimum size limit) and 300 mm (minimum size limit proposed by anglers during the consultation phase) were extremely rare in the spawning runs (Davies and Sloane 1987). This is further confirmed by the examination of rainbow trout length data collected by the Service for the spawning runs at Liawenee Canal since 1961. Using this data, if a 220 mm minimum length was maintained then none of the spawning trout would be protected and if a 300 mm minimum length limit was adopted then this would have protected less than 1.2 % of the spawning trout. Approximately 1.4 % of the spawning run would be protected at a 400 mm minimum length limit. An internal review of the existing minimum length in relation to the rainbow trout strategy indicated that a 460 mm limit would be more effective than the existing and proposed limit and provide for 18 % protection of the fish in the spawning run. However, the 460 mm limit was rejected because of concern that it would be unacceptable to the angling community.

The appropriate minimum length can be further examined by analysing the length data in respect to age classes in the spawning run. To protect rainbow trout so three year old females can spawn at least once, the estimated minimum size limit would need to be in the range of 340-470 mm and for 4 year old females to spawn twice the minimum length would need to be in the range of 470-510 mm. The basis for these length and age estimates is derived from information and analysis provided by Davies and Sloane (1987).

One of the primary objectives in this plan is to halt and reverse the slow decline of rainbow trout indicated by low numbers of trout observed in the annual spawning runs. Reducing harvest by imposing a minimum length limit of 400 mm will increase the number of rainbow trout that will be able to spawn, thus resulting in greater levels of recruitment and potential for consequential increases in the rainbow trout population. Tagging studies at Great Lake in 1985, indicated that 340 000 brown trout were recruited into the takeable component of the fishery and 24 000 were harvested (Inland Fisheries Commission 1987). A simple examination of these statistics indicates that the brown trout population is grossly

under exploited and there is considerable room for greater fishing pressure or management strategies that remove brown trout from the fishery. The situation is quite different for rainbow trout. The same tagging study indicated that 30 000 rainbow trout were recruited into the legal size component of the fishery during the season and 22 000 were harvested (Inland Fisheries Commission 1987). These estimates of takeable recruitment and harvest for rainbow trout indicate that there is little difference between recruitment (input) and harvest (output). This small differential would significantly limit the potential growth of the rainbow trout population. During this study, fishing pressure for rainbow trout was estimated to be 10 times greater than for brown trout and it was estimated that the fishing pressure on rainbow trout fishery had increased by two and half times since 1950. The data confirms the marked difference in catchability which exists between the two species of trout with the chance of a brown trout being caught by an angler is 2 % compared to 25 % for rainbow trout.

In light of this information, the Commission cautioned that the rainbow fishery may be approaching its limit (Inland Fisheries Commission 1987). Although fishing pressure has not increased significantly since this time, modifications to Liawenee Canal have further limited rainbow trout access to spawning habitat. Consequently, it is expected that continued high fishing pressure on rainbow trout and the low level of recruitment that is entering the takeable proportion of the population and surviving to spawn, are both factors retarding the growth of the rainbow trout population. If angling pressure increases significantly over several years then there is considerable risk that the rainbow trout fishery could not remain self-sustaining.

The Service has proposed some relatively simple regulatory measures to redress this issue and to strengthen the rainbow trout fishery. The minimum size limit is one of these measures.

The 400 mm minimum size limit represents a compromise between social considerations and a meaningful biological size restriction. It was considered that this limit should be set higher (ie 460 mm) to provide higher levels of protection for rainbow trout and ensure that the objective is met more efficiently and quickly. However, in recognition that the most suitable length limit may cause significant dissatisfaction amongst anglers, the limit has been set at 400 mm.

It is acknowledged that post-release mortality of undersized fish caught with baits and lures will diminish the level of this protection to a minor degree. However, overall it is expected that this regulatory change will contribute to the enhancement of the rainbow trout population and will also complement other proposed regulatory and fisheries management measures.

MINIMUM SIZE LIMIT- BROWN TROUT

During the consultation phase of the plan the angling community requested that brown trout be subject to a higher minimum length limit. The Service believes that this change is unnecessary and is counter to the rationale of maximising harvests of brown trout at Great Lake, particularly when significant levels of harvests can safely be sustained. However, the change will be implemented because (i) the increase in the minimum size limit for brown trout is not expected to retard the rainbow trout strategy and (ii) the change recognises the social desires of anglers. The minimum length of brown trout will be increased from 220 mm to 300 mm.

The above regulations are considered important measures to the strategy, but because they may cause hardships to a proportion of the angling community there will be a regulatory review 5 years after the commencement of the plan. At this time, progress of the rainbow trout strategy will also be reviewed and if necessary the regulatory measures can be altered.

The finer details of rainbow trout strategy will be clearly outlined in a separate paper (see Action 6.7.1.1). The paper will identify and detail specific actions such as stocking to increase rainbow trout abundance and measures to evaluate the strategy.

Great Lake will remain as a 'winter water' with angling permitted all year subject to other angling regulations. However, the Service reserves the right to alter the winter water status at anytime if recommendations are forthcoming from (i) a specific review on winter waters, (ii) an overarching plan, or if the Service receives a Ministerial direction.

All compliance activities will be planned and implemented in accordance with the goals and objectives of this plan. Fisheries Officers will also be involved in a community awareness and education program addressing Great Lake and general fishery management issues and new regulations.

The nature and amount of these activities will be identified and included in the annual compliance plan. This plan will define priorities and prescribe enforcement effort within predetermined programs on a statewide basis. The aim of this approach is to ensure that compliance effort is closely aligned to management goals and objectives of each fishery.

The following compliance issues which need to be specifically addressed during the term of this plan are:

- ensuring anglers are appropriately licensed;
- improve community awareness and education in the areas of: the use of inappropriate and illegal baits; implementation and rationale for new regulations and fishery management actions; safe and responsible boating and camping; and
- protection of spawning rainbow trout.

The following list sets out the objectives and actions for the recreational fishery.

6.7.1.0 Maintenance of the brown trout population and enhancement of the wild rainbow trout population.

6.7.1.1 Prepare and implement a strategy to enhance the rainbow trout population and which includes specific measures to evaluate the strategy

6.7.1.2 Develop a plan to monitor, evaluate and report on the performance of fishery management actions (eg reviewing Liawenee spawning channels) and the fishery's general performance.

6.7.1.3 Develop policy and implement measures to ensure the protection of the stock of wild rainbow trout and to prevent the risk of genetic contamination with domesticated rainbow trout.

6.7.2.0 Application of meaningful angling regulations and focused compliance activities that serve to promote fishery objectives.

6.7.2.1 All inflowing waters (including water within a 50 m radius of the inflowing stream mouth) will remain closed to angling. Liawenee Canal will remain closed all year.

6.7.2.2 All legal methods of angling will be permitted in the waters of Great Lake except Tods Corner and Canal Bay which will remain as artificial lures only.

6.7.2.3 Canal Bay will remain closed for the period April to November inclusive to protect spawning brown and rainbow trout.

6.7.2.4 The present boundary defining the prohibition of fishing in Canal Bay will be moved to increase the area of protection for spawning fish. The white post at Clarks Point near Canal Bay, which presently marks the southern Canal Bay boundary point, will be moved 100 m southwards.

6.7.2.5 The daily bag limit for salmonids will be 12 fish although only three may be rainbow trout.

6.7.2.6 The minimum size for brown trout will be 300 mm.

6.7.2.7 The minimum size for rainbow trout will be 400 mm.

6.7.2.8 Ensure the annual IFS compliance plan contains specific priorities and activities for Great Lake.

6.7.3.0 Strategically build and enhance our knowledge about the recreational fishery.

6.7.3.1 Submit a list of research projects to research organisations in relation to the recreational fishery.

6.7.3.2 Actively promote research on the recreational fishery at Great Lake.

6.7.3.3 Seek funding for the implementation of priority research projects.

6.7.4.0 Increase the popularity of Great Lake as an angling and tourism destination.

6.7.4.1 Liaise with Tourism Tasmania, Central Highlands Council, FACT, TGALT and TSRTA about promotional and interpretative initiatives for the recreational fishery at Great Lake.

6.7.4.2 Facilitate the preparation of a promotional strategy (including interpretation infrastructure) with Tourism Tasmania, Central Highlands Council, FACT, TGALT and TSRTA to promote the Great Lake fishery.

6.8 RESEARCH REQUIREMENTS

The management of the fishery and aquatic resources of Great Lake could be improved with greater knowledge and information in the following areas.

- Interactions of salmonids with native fauna, particularly native fish.
- Impact of water level management on salmonids, the recreational fishery, habitat and native fauna.

6.9 RESPONSIBILITIES

The Inland Fisheries Service is responsible for fisheries management in Great Lake. Marine and Safety Tasmania (MAST) is responsible for regulating boating. IFS fisheries officers undertake regulatory compliance of boating regulations often with the assistance of Marine Police.

7. NATIVE FISH MANAGEMENT

7.1 INTRODUCTION

Four species of native galaxiids are known to be present in Great Lake. Two species, the climbing galaxias (*Galaxias brevipinnis*) and the spotted galaxias (*G. truttaceus*), are widespread and common in Tasmania whilst the two other species are endemic paragalaxiids, the Great Lake paragalaxias (*Paragalaxias eleotroides*) and Shannon paragalaxias (*P. dissimilis*) Both paragalaxiids are only found in Great Lake and Shannon and Penstock lagoons. The climbing galaxias population of Great Lake is morphologically unique in having distinctly fewer vertebrae than other Australian populations of the species (McDowall and Frankenberg 1981).

Two other endemic fish, the Arthurs paragalaxias (*P. mesotes*) and the saddled galaxias (*G. tanycephalus*) are only found in Arthurs and Woods lakes however the potential exists for these fish to be introduced into Great Lake from Arthurs Lake via the Arthurs Lake siphon. Native fish, possibly the Arthurs paragalaxias has have been found in the Arthurs Lake flume which drains into Great Lake (Hydro Electric Corporation 1999). Surveys will be required to determine the presence of these species in Great Lake.

There is also potential for the endemic western paragalaxias (*Paragalaxias julianus*) to colonise Great Lake from Lake Augusta, where it is indigenous, via Liawenee Canal. The risks and nature of impacts associated with the western paragalaxias colonising Great Lake also needs further investigation.

Short-finned eels (*Anguilla australis*) are no longer abundant in Great Lake because dams in the Derwent River have prevented natural migrations. However, there is a possibility that some elvers stocked into Lake Meadowbank may have migrated into Great Lake via the Ouse River. The Service has not conducted eel stockings directly into Great Lake. Any population of eels is expected to be very small.

The life history and diet of the Shannon paragalaxias and the Great Lake paragalaxias were studied in the mid 1970's (Fulton 1982a). The fish have been recorded at maximum lengths of 59 mm and 75 mm respectively. Both species inhabit the rocky margins and charophyte beds of Great Lake, Shannon Lagoon and Penstock Lagoon. The Shannon paragalaxias spawns on rocks in summer and the Great Lake paragalaxias in spring although it's spawning habitat has not been determined. Diet differs between species but is primarily of aquatic origin comprised of benthic macroinvertebrates such as caddisflies and chironomid larvae, galaxiid eggs, algae and a variety of planktonic crustaceans (Fulton 1982a).

7.2 PAST MANAGEMENT

There has been no management of native fish in Great Lake to date although the Service conducted research on the ecology of the paragalaxiids of Great Lake during the 1970s (Fulton 1982a) and, more recently, Hydro Tasmania has attempted to examine the importance of the charophyte beds to native fish (Hydro Tasmania 2003a). This more recent research indicated that the Shannon paragalaxias was present in greater densities in charophyte habitat than rocky

shore habitat and supports previous research about the importance of the charophyte beds.

7.3 PRESENT MANAGEMENT

There is no management program for native fish in Great Lake, although the protection of the native fish fauna has been identified as an important issue at Great Lake. Factors which may impact on native fish include predation and competition by salmonids, water level fluctuations, the introduction of pest fish such as redfin perch (*Perca fluviatilis*) and other species that can be introduced as bait. Presently the Service is concerned about the impacts of water level management on native fish habitat and recognises the potential risk associated with increasing trout abundance above historical levels. Water level management will impact directly on fauna, flora and habitat and needs to be assessed with regard to minimising these impacts. However, it is important that all threats to native fish be recognised and managed and the risks be minimised. There is a need for further research in the areas of water level impacts and interactions between salmonids and native fish. Hydro Tasmania has recently announced their commitment to conduct more research into the algal beds of Great Lake (Hydro Tasmania 2003b). This research will examine movement of algal beds in relation to water level fluctuations and faunal relationships with the algal beds.

The Service has recently submitted threatened species nominations for the Great Lake paragalaxias (*P. eleotroides*) and Shannon paragalaxias (*P. dissimilis*). The nominations propose these species to be listed as 'vulnerable' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. These fish are presently listed under the *Tasmanian Threatened Species Protection Act 1995* as 'vulnerable'.

The *Inland Fisheries Act 1995* and subordinate legislation offer mechanisms to provide some protection of native fish, however, powers are limited in some areas and penalties are possibly inadequate. The legislation needs to be reviewed and improved to meet fisheries management requirements. Some important areas to be addressed include the control of illegal fish introductions and the control of inappropriate angling baits.

The initiation and implementation of community awareness and education about these issues will assist in ensuring compliance with regulations and contribute to sound ecological outcomes for native fish.

7.4 ISSUES

There are several important management issues relating to the native fish of Great Lake, including:

- Impacts of resource management on threatened species (eg water level and trout management).
- Pest fish species such as redfin perch and the mainland yabby and introductions of native species not naturally occurring in Great Lake.
- Fish habitat protection, particularly the extensive charophyte algal beds.
- Stocking of eels for environmental purposes.
- Effect of introduced paragalaxiids on the two endemic Great Lake paragalaxiids.

These issues and the some of the management responses are expanded on in other sections.

7.5 GOAL FOR FUTURE MANAGEMENT

The following goal will focus and guide planning and management activities for native fish conservation in Great Lake. It will also contribute to achieving the vision for the Great Lake fishery.

GOAL

Protect and conserve the native fish fauna and fish habitats of Great Lake.

7.6 OBJECTIVES AND ACTIONS

There are several specific objectives listed below that relate to this goal and the issues identified earlier. Although these issues specifically relate to Great Lake many also apply in a broader and statewide context.

Many of the issues identified in relation to native fish will be addressed in the Tasmanian Galaxiidae Recovery Plan - 2003-2007, (presently in draft form) or are discussed in other sections of this plan. Issues such as the impacts of water level management and trout need to be thoroughly assessed and the risks managed. Water level and its rate of change are important factors in determining the quality and quantity of native fish habitats within the lake. The Service has identified the need to liaise closely with Hydro Tasmania to address this issue.

The Tasmanian Galaxiidae Recovery Plan - 2003-2007, once completed will identify future conservation strategies for the Great Lake and Shannon paragalaxiids. Conservation nominations are presently being assessed and the implementation of the recovery plan for these species is contingent on Commonwealth acceptance of the nominations. The conservation strategies are similar for both species and include management and research components. Management strategies include regular monitoring of populations, preparation of threat abatement plans, preparation of listing statements, development and implementation of water level management rules and public awareness programs. Research strategies for both species are also similar and focus on knowledge gaps such as genetic diversity of populations and understanding of each species' habitat requirements. Some interim management actions (eg monitoring of native fish populations) which are consistent with the recovery plan may be commenced prior to it's adoption. The plan is expected to be considered by the State and Commonwealth governments in the period mid 2004 –early 2005.

The issue of whether eels should be stocked into Great Lake for environmental reasons will be specifically addressed and evaluated.

The following list sets out the objectives (in bold) and actions for native fish.

7.6.1.0 Ensure the protection of native fish and important fish habitat at Great Lake.

7.6.1.1 Implement the relevant sections of the Tasmanian Galaxiidae Recovery Plan - 2003-2007 (if the plan and conservation listings for the Shannon and Great Lake paragalaxiids are accepted by the Commonwealth).

7.6.1.2 Ensure all natural resource management is consistent with the Tasmanian Galaxiidae Recovery Plan, the Tasmanian Threatened Species Strategy and other relevant legislation.

7.6.1.3 Negotiate a water level management agreement with Hydro Tasmania to protect important habitats of threatened fish and invertebrates.

7.6.1.4 Develop and implement a plan to assess the impact of recreational fishery management on native fish populations.

7.6.1.5 Implement the monitoring program for threatened galaxiids in Great Lake as prescribed in the Tasmanian Galaxiidae Recovery Plan 2003-2007 (draft).

7.6.1.6 Liaise with Hydro Tasmania in relation to the translocation of non-endemic Great Lake paragalaxiids into Great Lake.

7.6.1.7 Develop a contingency plan for native fish to address the possibility of redfin perch and other introductions of undesirable fish.

7.6.1.8 Prepare an evaluation of stocking short-finned eels into Great Lake for environmental purposes.

7.6.2.0 Obtain resources for the management, research and protection of native fish and their habitats at Great Lake.

7.6.2.1 Seek external funds to support the management, protection and research into threatened native fish and their habitats at Great Lake.

7.6.3.0 Strategically build and enhance our knowledge about native fish and their environment.

7.6.3.1 Submit a list of research projects to research organisations.

7.6.3.2 Promote research on Great Lake native fish and their habitat requirements.

7.6.3.3 Liaise with Hydro Tasmania in relation to the findings of the Great Lake technical studies program and Environmental Management Program which forms part of the Hydro Tasmania South Esk – Great Lake Water Management Review.

7.6.4.0 Increase community awareness about the issues which affect native fish in Great Lake.

7.6.4.1 Prepare and implement a strategy to increase awareness about the native fish fauna and threatened fish of Great Lake amongst stakeholders, resource managers and the wider community.

7.6.5.0 Ensure all natural resource managers and relevant stakeholders consider native fish issues in the management of resources.

7.6.5.1 Provide advocacy for the conservation of native fish and the aquatic environment at Great Lake.

7.6.5.2 Establish and maintain partnerships with stakeholders with interests in native fish at Great Lake.

7.7 RESEARCH REQUIREMENTS

To contribute to the fulfilment of the goals and objectives in this plan, some research is required. Areas identified are listed below and the Service will:

- Actively encourage research into the native fishes and invertebrate fauna of Great Lake particularly in relation to aquatic habitat utilisation and requirements, gaps in ecological knowledge, genetic conservation, impact of introduced fish, protection of habitat, management of threats and interrelationships of aquatic faunal species.
- Facilitate an assessment of the effects of water level fluctuations on native fish, especially threatened fish, and on the availability and quality of native fish habitat.
- Enhance the understanding of the life history of native fish species, particularly *Paragalaxias spp,* in relation to habitat requirements for all life history stages including habitat for spawning, feeding and refuge. Population dynamics in relation to threats, such as water level management and trout predation, also requires investigation.

7.8 RESPONSIBILITIES

The Inland Fisheries Service is responsible for the management of all native fish (including invertebrates) and other fish at Great Lake. The Threatened Species Unit in the Department of Primary Industries, Water and Environment (DPIWE) administers threatened species legislation, policy and programs and collaborates with other agencies responsible for managing key threatened groups.

Hydro Tasmania is a significant water manager and has obligations to ensure that its operations are consistent with the *Water Management Act 1999* and the *Threatened Species Protection Act 1995*, particularly in relation to native fish, aquatic invertebrates and habitat.

Environment Australia administers the *Environmental Protection Biodiversity Conservation Act 1999*.

8. COMMERCIAL FISHERIES MANAGEMENT

8.1 INTRODUCTION

There are a number of commercial fishery activities that could be undertaken at Great Lake or in its catchment (eg eel and mudeye (Odonata) harvesting, cage culture of salmonids and establishment of fish hatcheries). Many of these could pose a direct threat to the recreational and aquatic native fauna values of the lake.

8.2 PAST MANAGEMENT

Great Lake has never supported a commercial eel fishery, although some exploratory fishing occurred in the early 1960's (P. Boxall, Inland Fisheries Service*, pers. comm.*). The absence of an exploitative fishery ensured that there was no demand to restock the lake to sustain the fishery. The damming of Great Lake prevented natural recruitment of eels and the eel stocks were slowly depleted as eels emigrated from the lake. Great Lake has never been stocked with eels for commercial or environmental purposes.

Great Lake is a relatively large, cold and oligotrophic water and would not be likely to sustain a commercially short-term viable fishery. Any eels stocked into Great Lake would exhibit extremely slow growth rates. For example, a 2 200 gm (1 055 mm) eel from Arthurs Lake, which is located at a slightly lower altitude compared to Great Lake, was aged at least 50 years of age (IFS, unpublished data). It is likely that eels would grow at similar or slower rates at Great Lake. This is considered relatively slow growth compared to eels in other commercially harvested waters. Large, shallow, warm and more productive waters, commonly found at lower altitudes, support more rapid growth in eels and are more suited to supporting eel fisheries (P. Boxall, Inland Fisheries Service, *pers. comm.*).

The aquatic ecology of Great Lake has been altered markedly by hydro-electric development and the subsequent management of water resources. Eels can no longer naturally migrate into Great Lake and have not been a significant element of the lake's ecology for a number of decades.

There has been little interest in the establishment of other commercial activities apart from a private fishery at Tods Corner. A private fishery registration was issued by the Service in mid-1999 for this development but the registration was cancelled in late 1999.

8.3 PRESENT MANAGEMENT

Presently, licensing policy prevents both commercial eel and mudeye harvesting activities in Great Lake. Great Lake has not been included in any commercial fishing licences. The prohibition on eel fishing prevents conflict with recreational anglers and disturbance on the trout fishery, and eliminates the risk of fish translocations associated with the movement of fyke nets between waters and restocking of eels.

Similarly, the prohibition on commercial mudeye harvesting reduces the disturbance to aquatic habitats and protects mudeye populations.

8.4 ISSUES

At present there are a number of issues to be highlighted regarding commercial fisheries management.

- Impacts of potential commercial activities on the recreational fishery, primarily the rainbow trout fishery (eg contamination of wild rainbow trout stocks).
- Impacts of commercial activities (including risks associated with eel stocking) on native fish, particularly threatened fish.

8.5 GOAL FOR FUTURE MANAGEMENT

The goal for commercial fisheries management has been formulated to prevent additional pressures on an important recreational fishery and an important environment for native fish and threatened species.

GOAL

To prevent commercial fishery activities impacting on the recreational fishery and natural values of Great Lake.

The goal acknowledges that the introduction and development of commercial activities may cause an unnecessary and significant risk to the major values of Great Lake. Introducing possible additional threat factors (eg eels and eel fishing) poses an unacceptable management risk for the future balance of the aquatic ecology of Great Lake. The introduction of fish and other undesirable aquatic biota possibly through elver stockings and fyke nets is the primary area of concern. Recently developed elver grading protocols have markedly reduced the risk of contamination of elvers with other fish.

8.6 POLICY

To provide clear direction for the management of certain commercial fishery issues at Great Lake, the following policies are given.

POLICIES

1. ***Commercial eel and mudeye harvesting will be prohibited in Great Lake.***
2. ***Private fishery and commercial fish hatchery developments will be prohibited in Great Lake.***
3. ***Cage culture of fish will be prohibited in Great Lake.***

It is important to maintain and even improve the status of the natural values and the trout fishery of Great Lake. Commercial activities such as cage culture, private fisheries, and commercial eel harvesting have the potential to introduce significant risk factors to the lake that are considered unacceptable in light of the goals and objectives that are set for the recreational fishery, pest biota and native fish. The above policies restate and clarify the Services present stance on these issues.

8.7 OBJECTIVES AND ACTIONS

The goal and supporting policies clearly limit the scope of commercial fishery activities and this is reflected in the nature of the following objective and actions.

8.7.1.0 To prevent the licensing, development and establishment of commercial fishery activities in Great Lake.

8.7.1.1 Review existing policies on commercial fishery activities to ensure consistency with this plan.

8.7.1.2 Review and establish administrative protocols and procedures to ensure policies on commercial fishery activities are implemented.

8.8 RESEARCH REQUIREMENTS

No research priorities have been identified for the commercial fisheries area.

8.9 RESPONSIBILITIES

The Inland Fisheries Service is responsible for the management of commercial fisheries in Great Lake.

9. PEST FISH AND NOXIOUS AQUATIC PLANT MANAGEMENT

9.1 INTRODUCTION

Tasmania has several fish species that are considered as pest fish, three of which are highly undesirable and are listed as 'controlled fish' under the *Inland Fisheries Act 1995*. These species are European carp (*Cyprinus carpio),* freshwater crayfish of the genus *Cherax* (eg mainland yabby) and eastern gambusia (*Gambusia holbrooki*). These species are not known to be present in Great Lake. Other pest fish present in Tasmania include redfin perch *(Perca fluviatilis*), tench (*Tinca tinca*), goldfish (*Carassius auratus*). No pest fish species are presently found in Great Lake, however, in 1996 redfin perch were eradicated from a small dam (Haddens Bay area) which overflows into Great Lake. Pest fish pose a serious threat to the recreational fishery and the aquatic ecology of Great Lake. An example of the impacts of pest fish on native species in Tasmania is redfin perch being linked directly to the near extinction of a population of the Swan galaxias (*Galaxias fontanus*) (Crook and Sanger 1997, Jackson 2003).

Canadian pondweed (*Elodea canadensis)* is present in Tods Corner and Canal Bay (P. Davies, Freshwater Systems, *pers. comm.*) and is the only introduced aquatic plant known in Great Lake. This plant is listed as a 'noxious prohibited A category weed' under the *Weed Management Act 2000* and is generally considered an aggressive coloniser of benthic substrates. Canadian pondweed is relatively common throughout many Tasmanian lakes, such as Little Pine Lagoon.

9.2 PAST MANAGEMENT

PEST FISH

In 1996, redfin perch were located in a dam adjacent to the Central Highlands Hotel (Haddens Bay). The outflow of the dam flows directly into Great Lake. The population of redfin was poisoned with rotenone in early 1997 by the Service. Subsequent surveys of this dam, and electrofishing surveys along the shores of Great Lake in the vicinity of Haddens Bay, did not locate any redfin perch. If redfin perch were to become established in Great Lake then it is feasible they could spread to connected waterways. A fish barrier was constructed in 1999 by Hydro Tasmania in Liawenee Canal as a precautionary measure to prevent the invasion of redfin perch along Hydro Tasmania managed infrastructure towards the Western Lakes and upper Ouse River (Inland Fisheries Commission 1999).

NOXIOUS AQUATIC PLANTS

Infestations of Canadian pondweed were observed in Tods Corner in 1998 (D. Andrews, Hydro Tasmania, *pers. comm.*) and were probably the first confirmed sightings of the introduced macrophyte in the lake. Presumably Canadian pondweed was introduced from Arthurs Lake via the Arthurs flume because it has long been established in that impoundment. It occurs around the pump inlet at Pumphouse Bay at Arthurs Lake and the first sighting in Great Lake was in the vicinity of Tods Corner which receives water from Arthurs Lake. Canadian pondweed was also observed in Lake Augusta in 1998 and has, or may eventually be translocated downstream to Great Lake via Liawenee Canal. Canadian pondweed has never been managed in Great Lake.

9.3 PRESENT MANAGEMENT

PEST FISH

Regulations exist to prohibit the introduction of fish as bait to Great Lake and to prohibit the translocation of controlled fish (eg European carp*).*

The Service and Hydro Tasmania conduct periodic fish surveys to check for the presence of redfin perch.

Hydro Tasmania also funded the design and construction of the fish barrier in Liawenee Canal which prevents the movement of fish further up the canal (Inland Fisheries Commission 1999).

NOXIOUS AQUATIC PLANTS

The implications of the Canadian pondweed introduction to Great Lake are unknown, but several possibilities exist. For example, Canadian pondweed may compete against endemic aquatic plants for habitat in the littoral zone, occupy a vacant niche above that currently occupied by charophytes, or fail to establish significant beds in the lake. It is interesting to note that, although Canadian pondweed is listed as a noxious weed, in certain circumstances there is evidence that it may help stabilise benthic sediments. Fulton (1983a) reported that it provided additional habitat for aquatic invertebrates in Arthurs Lake.

9.4 ISSUES

- Translocation of fish and plants into Great Lake.
- Use of prohibited baits.
- Possible colonisation of redfin perch in Great Lake.
- Impacts of Canadian pondweed on the existing natural algal beds and the ecology of Great Lake.

9.5 GOAL FOR FUTURE MANAGEMENT

The goal set for pest fish management is simple but extremely challenging, because it relies on the cooperation and compliance of anglers and the wider community. Consequently, it is important to inform and educate the community about pest fish issues, fish translocations and risks associated with bait fishing.

GOAL ***To maintain an aquatic environment free of pest fish and to reduce the risks of further introductions of aquatic plants.***

Although challenging, it is extremely important to achieve this goal because many of the values of Great Lake will be diminished or compromised if pest fish become established.

9.6 OBJECTIVES AND ACTIONS

The objectives and actions have been developed to ensure that pest biota are not introduced into Great Lake and that strategies are prepared to detect and manage any outbreaks of pest fish. Objectives have been developed to focus fishery management activities.

Community awareness and education is critical to reducing the risk of the introduction of pest biota. The role of IFS fisheries officers is pivotal because of their regular lakeside contact with anglers. It is important to provide supporting information and contact protocols to increase the effectiveness of these contacts with anglers. Planning is also seen as an important element in assessing pest fish threats and effectively managing any realised threats.

The issue of Canadian pondweed needs careful assessment before any management actions are taken. A strategy is required which examines knowledge gaps and management options prior to the implementation of any on-ground actions.

The following list sets out the objectives (in bold) and actions for pest fish and noxious aquatic plants.

9.6.1.0 Ensure the community is fully informed and aware of the environmental risks associated with controlled and pest fish, noxious aquatic plants and diseases.

9.6.1.1 Prepare and implement a community awareness and education strategy about controlled and pest fish, fish translocations and the transfer of aquatic plants in the wider context.

9.6.1.2 Ensure that compliance staff is fully informed about pest biota, fish translocations and the risk these present to the aquatic environment.

9.6.1.3 Develop a program to highlight and reinforce bait-fishing regulations with a particular focus on interstate anglers.

9.6.2.0 Prevent the introduction and colonisation of controlled fish, pest fish, noxious aquatic plants and diseases.

9.6.2.1 Prepare a pest fish risk management strategy for Great Lake.

9.6.2.2 Negotiate with Hydro Tasmania for an assessment on the impacts of Canadian pond weed and management options.

9.6.2.3 Prepare and contribute a submission to the compliance operational plan which outlines the compliance strategies and efforts required to prevent pest fish introductions at Great Lake.

9.6.2.4 Prepare a contact protocol for IFS staff that ensures important information is effectively delivered to anglers during lakeside interviews such as licence checks and creel surveys.

9.6.2.5 Ensure that the community complies with angling regulations, specifically in regard to bait fishing, and the translocation of biota.

9.6.2.6 Ensure that all trout stockings are conducted in accordance with the IFS Fish Translocation Policy and other relevant operational protocols.

9.6.2.7 Review and improve the *Inland Fisheries Act 1995* and *Inland Fisheries Regulations 1999* to achieve better outcomes in regard to preventing pest biota introductions.

9.6.3.0 Implement measures to prevent or retard the establishment of populations of pest fish and noxious aquatic plants.

9.6.3.1 Assess the need for a pest fish threat abatement plan (especially for redfin perch) at Great Lake.

9.6.3.2 Monitor regularly for the presence of redfin perch at Great Lake.

9.6.3.3 Investigate infrastructure options to prevent pest fish from moving from Great Lake and becoming established in waters downstream from the Miena Dam (eg Shannon Lagoon and Penstock Lagoon).

9.7 RESEARCH REQUIREMENTS

If pest fish become established in Great Lake, then opportunities will be presented to examine interactions and relationships between the native biota and pest fish. This research could contribute to the management of pest fish at Great Lake and could also provide information for their management in other waters.

- Encourage research into interactions with, and impacts of pest fish on native biota. Conduct research on the biology and control of pest species.
- Encourage research on the management of Canadian pondweed and its impacts on native biota.

9.8 RESPONSIBILITIES

The Inland Fisheries Service is responsible for the management of pest fish within inland waters of Tasmania including Great Lake.

DPIWE is responsible for development of noxious weed policies and the management of noxious weeds including aquatic species in the State.

Hydro Tasmania has obligations to contribute to the management of aquatic pest species if their operations, infrastructure or systems cause the colonisation or establishment of pest species in Great Lake.

10. ENVIRONMENT AND BIOTA

10.1 INTRODUCTION

The most significant environmental issues within Great Lake are closely allied with its biological values. Great Lake contains significant charophyte beds and several rare, threatened, highly restricted and endemic aquatic fish and invertebrates. The lake is considered to have a high conservation value because of its assemblage of locally endemic fauna and significant flora. This section covers management of the aquatic environment and biota other than native fish (see previous section).

AQUATIC INVERTEBRATE FAUNA

Great Lake is recognised for its high level of endemicity of it's aquatic invertebrate species. Much of the aquatic macroinvertebrate fauna is linked to the lake's algal beds (Inland Fisheries Commission 1987) which are critical in maintaining the overall productivity of the lake. The macrobenthos in Great Lake appears to be influenced by the original lake and the extensive fluctuations in water level. This has resulted in reduced abundance of benthic fauna at Great Lake compared to Arthurs Lake despite both lakes being limnologically similar (Fulton 1983a).

The Great Lake shrimp (*Paranaspides lacustris*) has a distribution restricted to Great Lake, Shannon Lagoon, Penstock Lagoon, Arthurs Lake and Woods Lake. In Great Lake this species is usually found in association with submerged aquatic vegetation (Fulton 1982b) principally with *Nitella* sp. and occurs in water depths ranging between 0.2 m and 10 m. Great Lake also has the highest diversity of phreatoicid isopods found anywhere in the world (B. Wilson, Australian Museum, *pers. comm.*). Another Tasmanian endemic species restricted to Great Lake is the freshwater limpet, *Ancylastrum cumingianus*.

Of the invertebrate species present, eight are listed under the Tasmanian *Threatened Species Protection Act 1995* as being either rare or vulnerable (Table 2).

Table 2. Rare and threatened invertebrates present in Great Lake listed under the Tasmanian *Threatened Species Protection Act 1995* (source DPIWE Website 2003).

Class	Order	Species	Conservation Status
Gastropoda	Neotaenioglossa	*Beddomeia tumida*	Vulnerable
Gastropoda	Basommatophora	*Glacidorbis pawpela*	Rare
Crustacea	Amphipoda	*Tasniphargus tyleri*	Rare
Crustacea	Isopoda	*Uramphisopus pearsoni*	Rare
Crustacea	Isopoda	*Onchotelson brevicaudatus*	Rare
Crustacea	Isopoda	*Onchotelson spatulatus*	Rare
Crustacea	Isopoda	*Mesocanthotelson setosus*	Rare
Crustacea	Isopoda	*Mesocanthotelson tasmaniae*	Rare

NATIVE AQUATIC PLANTS

Algal and macrophyte beds in Great Lake are generally restricted to sheltered bays and lee shores protected from the predominantly westerly winds. Large frequent fluctuations in lake level have restricted the development of charophyte beds to the zone below which lake level fluctuations occur.

Significant algal and aquatic macrophyte beds cover approximately 5 % of the lake bed, and generally are limited to between 15 m and 19 m below full supply level (1039.37 m AHD) (Inland Fisheries Commission 1987). Macrophyte beds situated below the drawdown zone are important habitats for numerous aquatic invertebrate species and the Great Lake paragalaxias (*Paragalaxias eleotroides*) (Fulton 1982a; Inland Fisheries Commission 1987).

WATER LEVEL

Great Lake is one of the two most valuable water storages in the Hydro Tasmania's hydro-electric generation network. Great Lake and Lake Gordon act as drought storages for the State's power generation system. Great Lake is operated to provide long-term storage in the generation system and to meet short-term generation demands. The upper Ouse River water diversion via Liawenee Canal and the Arthurs Lake pump are major sources of regulated water inflows for the storage. Lake Augusta discharges water to Great Lake via Liawenee Canal, which has a maximum capacity of approximately 18 cumecs, and Arthurs Lake water is pumped to Great Lake via the Pumphouse Bay pump, which has a maximum capacity of 4.7 cumecs.

The capacity of Great Lake is 3 178 720 ML at full supply level. The operating range of the lake is 21.34 m, varying between the normal minimum operating level of 1018.03 m (AHD) and full supply level of 1039.37 m (AHD) (Hydro Tasmania 2003b). Level fluctuations are relatively slow, varying over a period of years (rather than months or days as for some of Hydro Tasmania's smaller storages), but levels may vary up to 5 m in some years.

The management of water levels in Great Lake is determined by catchment water inflows and electricity generation demand. There is no lake level agreement constraining the lake level operating range, in contrast to several other lakes managed by Hydro Tasmania.

WATER QUALITY

Over the last decade, water quality data has been collected regularly for Great Lake. The Inland Fisheries Service Biological Consultancy (IFSBC), as part of its consultancy work for Hydro Tasmania, has routinely sampled Great Lake during bi-monthly lake surveys conducted in 1991/1992, 1994/1995, 1997/1998 and 2000/2001. Great Lake is an oligotrophic (low productivity) water body, having very low nutrient, turbidity and chlorophyll-a levels. Water temperatures range between 3°C - 17°C (Table 3.). Conductivity levels are very low, generally in the vicinity of 16 µS/cm. Wind events occasionally disturb shoreline sediments, causing short-term increases in turbidity and nutrients around exposed shallow margins. However, re-suspended materials settle rapidly when wave action eases. In general, water quality parameters consistently fall within the ranges recommended in the ANZECC (2000) guidelines. Further detail on the lake's water quality is contained in other IFSBC reports (Sanger (1993); Blühdorn *et al*. (1995); Blühdorn *et al*. (1998); Andrews *et al.* (*in prep.*)).

Table 3 provides a summary of water quality data for surface water samples from Great Lake.

Table 3. Summary of water quality parameters for Great Lake (source IFSBC).

1991-1998	Temperature (°C)	DO (mg/l)	Conductivity (µS/cm)	pH	Turbidity (NTU)	TKN (mg/l)	Nitrate (mg/l)
Maximum	16.4	11.7	22.0	7.1	1.9	0.19	0.017
Median	9.8	9.7	16.7	6.9	1.0	0.12	0.002
Minimum	2.4	8.3	14.4	6.3	0.5	0.07	0.001

DO = dissolved oxygen, TKN = Total Kjeldahl Nitrogen

There are no systematic problems with water quality in Great Lake apart from localised areas of increased turbidity caused by wind resuspension of sediments and low lake levels.

10.2 PAST MANAGEMENT

AQUATIC INVERTEBRATE FAUNA

There has been no management of aquatic invertebrate communities or individual invertebrate species at Great Lake. Most activity in this area has been research conducted on invertebrate communities or on specific species of these communities. Notable studies have been the quantitative surveys of the benthic community at Great Lake (Fulton 1983a; 1983b), life cycle of the Great Lake shrimp (Fulton 1982a) and surveys of phreatoicid isopods undertaken by the Australian Museum. During the recent assessment of the Basslink proposal research was conducted on aspects of the aquatic environment and biota of Great Lake by Hydro Tasmania.

Surveys of the aquatic macroinvertebrate community were conducted in conjunction with research into the charophyte beds of Great Lake (Hydro Tasmania 2003a). Results indicated that fauna assemblages are significantly more diverse in the charophyte beds than in rocky bed habitat. Many invertebrate taxa were also specifically identified as being more abundant in charophyte beds than rocky habitat. The charophyte beds provide a more complex and diverse range of micro-habitats for fauna than other benthic habitats. The beds are confirmed as having ecological and bio-conservation significance (Hydro Tasmania 2003a).

NATIVE AQUATIC PLANTS

Recent underwater surveys in Great Lake were conducted by Hydro Tasmania to establish the extent and colonisation rates of the weed beds, and to examine the impacts of water level fluctuations (Davies 2001; A. Uytendaal, Inland Fisheries Service, *pers. comm.*).

The algal communities of Great Lake have been identified as extremely important components of the lake's ecology (Inland Fisheries Commission 1987). However, despite this recognition, no formal measures have been implemented to ensure their protection.

WATER LEVEL

Hydro Tasmania has managed Great Lake water resources primarily for hydro-electric power generation demand. Water level management at Great Lake has not been constrained due to environmental considerations or specific issues.

WATER QUALITY

Water quality problems have not occurred at Great Lake and consequently Hydro Tasmania has not been needed to manage the water of Great Lake to overcome any specific water quality issue. Water quality parameters are regularly monitored by Hydro Tasmania.

10.3 PRESENT MANAGEMENT

AQUATIC INVERTEBRATE FAUNA

Hydro Tasmania has proposed more research on the aquatic invertebrate fauna associated with the charophyte beds (Hydro Tasmania 2003a, b). This is focussed at determining the critical minimum levels of charophyte habitat required to support associated threatened fauna.

NATIVE AQUATIC PLANTS

Past surveys and present research is expected to provide greater knowledge about the aquatic plants of Great Lake and this should lead to greater protection in the future. Hydro Tasmania has recognised the need for additional research into the charophyte beds.

Recent research has further defined the distribution of the charophyte beds, and compared the densities of fauna inhabiting rocky substrates with the charophyte beds, and examined the relationship between charophyte bed dynamics and lake levels (Hydro Tasmania 2003a). These surveys demonstrated that the charophyte beds were significant habitat for a range of aquatic macroinvertebrates including the threatened fish such as the Shannon paragalaxias (*Paragalaxia dissimilis*). Also the beds contained a more diverse and abundant macroinvertebrate fauna than other benthic habitats.

The surveys also indicated that the charophyte beds can migrate vertically in response to water level changes (Hydro Tasmania 2003a) although more work is being conducted to thoroughly assess this response within a water management context.

Hydro Tasmania has identified a number of activities that require more research before management responses are investigated and implemented. These include additional research on charophyte-water level relationships, charophyte ecology (in particular propagation), lake bathymetry (which will provide information on charophyte habitat availability and wind-turbidity relationships) and habitat utilisation by aquatic fauna (Hydro Tasmania 2003a).

In the Northern Hemisphere, charophyte beds have been demonstrated to be important to freshwater macroinvertebrate communities (Forteath 1977) and in underpinning biodiversity. In fact, Forteath (1977) forewarned that the near extinction of charophyte beds at Loch Strathbeg would result in a radical change to the freshwater macroinvertebrate community. The subsequent eutrophication of the lake led to the realisation of this warning (N. Forteath, Inland Fisheries

Advisory Council, *pers. comm.*). This research would indicate that these beds are just as critical in maintaining biodiversity in Great Lake. Consequently, any threatening processes (eg water level management) should be carefully assessed to ensure that the charophyte beds are protected from negative impacts.

WATER LEVEL

The management of water in Great Lake remains generally unchanged from previous years, except that there is heightened concern over the threats that low water level and rates of water level fluctuations pose to aquatic plant communities and fauna habitats. Hydro Tasmania is examining these issues in more detail and has proposed further research (Hydro Electric Corporation 1999; Hydro Tasmania 2003b).

Basslink is a scheme that will connect Tasmania to the national electricity grid via an undersea cable across Bass Strait. Basslink is projected to result in changes to the operation of Great Lake and Lake Gordon. The lake level of Great Lake is expected to be reduced by 1 m from modelled historical levels and the long term variability is predicted to be reduced. It is also predicted that the historical seasonal variability will be maintained. An examination of the environmental issues and an assessment of the impacts associated with Basslink has been completed by Hydro Tasmania (Hydro Consulting 2000).

A model (TEMSIM – Tasmanian Electricity Market Simulation) was developed to examine the Tasmanian generating system operating according to the National Electricity Market. TEMSIM permitted the modelling of the behaviour of power stations and storages under various Basslink cable capacities. The model indicated that there would be no significant changes to the operation of Great Lake under the various modelled scenarios. Hydro Tasmania concluded that there were no significant environmental issues at Great Lake related to Basslink that could not be appropriately addressed (Hydro Consulting 2000).

WATER QUALITY

There are no systemic water quality problems in Great Lake. Predicted changes to lake levels because of Basslink are not expected to affect the water quality of Great Lake. Regular water quality monitoring at Great Lake may continue under the Hydro Tasmania's Waterway Health Management Program.

There is the potential for localised turbidity problems if lake levels become too low. This situation has arisen at the Poatina intake (J. Diggle, Inland Fisheries Service, *pers. comm.*)

10.4 ISSUES

There are several important issues that relate to the health of the aquatic environment and biota of Great Lake.

- Impacts of water level management on threatened species, algal beds, invertebrate communities, fish and the recreational fishery.
- Maintenance of fish habitat.
- Water quality at extremely low lake levels.

Impact of water level management is the most critical issue because minimum water level and rate of water level change may impact on water quality, charophyte beds, invertebrate communities, fish and the recreational fishery.

More research is required to fully understand these interrelationships and interactions.

10.5 GOAL FOR FUTURE MANAGEMENT

The following goal will focus and guide planning, management and advocacy activities relating to the aquatic environment and biota of Great Lake.

GOAL

Contribute to the protection and conservation of the aquatic environment and biodiversity in Great Lake.

10.6 OBJECTIVES AND ACTIONS

There are several specific objectives listed below that relate to this goal and the issues identified earlier. Protection of aquatic habitats is essential to maintain biodiversity and the management of key resources (eg water and salmonids) must recognise the environmental values such as key aquatic habitats, threatened species and biodiversity. Actions in other sections also contribute to the achievement of the goal and objectives in this section.

10.6.1.0 To assist in the protection of aquatic biota and habitats in Great Lake.

10.6.1.1 Determine the impacts of water level management on lake ecology with a focus on threatened species and other important or key biota and habitats (eg charophyte beds).

10.6.1.2 Negotiate, develop and implement with DPIWE and Hydro Tasmania, formal water resource management prescriptions that protect important habitats and biota.

10.6.1.3 Establish and maintain relationships with stakeholders with interests in aquatic biota and the aquatic environment at Great Lake.

10.6.2.0 Increase general awareness about aquatic environmental issues and their management in Great Lake.

10.6.2.1 Prepare and implement a strategy to increase awareness about aquatic biota and the environment of Great Lake amongst stakeholders, resource managers and the wider community.

10.6.2.2 Seek funding for interpretation signs and information booths that provide information about environmental issues and aquatic biota.

10.6.2.3 Provide strong advocacy for aquatic biota and aquatic environments at Great Lake.

10.6.3.0 Strategically build and enhance our knowledge about aquatic biota and their environment.

10.6.3.1 Submit a list of research projects to organisations relating to the impacts of water resource management on aquatic biota and environments.

10.6.3.2 Promote research on Great Lake aquatic biota and the environment.

10.6.3.3 Encourage water quality monitoring at Great Lake.

10.6.3.4 Investigate the feasibility of monitoring key indicators of aquatic ecological health at Great Lake.

10.6.3.5 Liaise with Hydro Tasmania in relation to the South Esk - Great Lake Water Management Review.

10.6.3.6 Negotiate with Hydro Tasmania for access to environmental information and data that will assist with the management and protection of biota and aquatic habitats.

10.7 RESEARCH REQUIREMENTS

Some research is required to contribute to the fulfilment of the environmental goal and objectives. The Service will encourage, promote, facilitate and contribute to, or conduct research into some of the areas identified below. Hydro Tasmania is undertaking research into key areas such as the charophyte beds of Great Lake.

- Research on the life history and habitat requirements of aquatic invertebrate fauna (eg *Ancylastrum*, *Paranaspides* and other crustacea).
- Research on the impacts of water level management on aquatic invertebrates, aquatic macrophytes, native fish and fisheries.
- Facilitate studies on the distribution, habitat requirements and status of threatened invertebrates and native fish.
- Facilitate an assessment of the effects of water level fluctuations on aquatic habitats and biota.

10.8 RESPONSIBILITIES

The IFS is responsible for the management of native aquatic fauna at Great Lake. This also includes threatened fish and invertebrates. The Threatened Species Unit (DPIWE) is responsible for ensuring management of threatened species consistent with the Tasmanian *Threatened Species Protection Act 1995* by the primary management agencies.

As the major generator of hydro-electric power in the State, Hydro Tasmania manages water resources under licence from DPIWE which administers the *Water Management Act 1999*. The Act requires that ecological considerations are taken into account in the management of water resources. Hydro Tasmania is identifying environmental issues through a review of its water management activities in the South Esk – Great Lake catchment.

11. INFRASTRUCTURE

11.1 INTRODUCTION

The establishment of most angling-related infrastructure at Great Lake followed the development of hydro-electric generation infrastructure and the success of the recreational trout fishery. Consequently, there is a strong historical influence in its provision, which developed as the fishery flourished and the associated community expanded.

There are many types of infrastructure directly related to angling, such as access roads/tracks around the shores of Great Lake, boat ramps and associated car parking, and two public convenience facilities based at the Parks and Wildlife Service Field Station (Liawenee) and the Great Lake shop (Miena).

Responsibility for this infrastructure is vested in various agencies such as the Central Highlands Council, Parks and Wildlife Service, and Hydro Tasmania, although at times this responsibility is ill-defined. Issues of public liability present a problem for infrastructure owners and managers and this will be a significant consideration in determining the nature, quality and number of facilities provided to the public in the future.

The Inland Fisheries Service has fisheries management and accommodation infrastructure at its Liawenee Field Station. A compliance officer is permanently based at the station. This field station is used to host the annual Liawenee Open Weekend, as a resource for internal and external research projects, as a venue for workshops and meetings, and to enable the collection and monitoring of spawning trout in Liawenee Canal.

11.2 PAST MANAGEMENT

The first fisheries management infrastructure established at Great Lake was a hatchery which was operational in 1910. Since then, three other hatcheries were built around the lake with the largest, the Miena hatchery, being established on the Shannon River in 1934.

The Miena hatchery received ova from trout collected in Liawenee Canal and it is possible that a trapping structure may have been constructed to assist in the collection of ova in the 1930s and after. Since then, Liawenee became the focus of fisheries management infrastructure with accommodation, fish traps and spawning channel development.

Over the years boat ramps have been improved, particularly since the establishment of MAST (Marine and Safety Tasmania) which has funded boating related infrastructure.

11.3 PRESENT MANAGEMENT

Although Great Lake is one of the State's most popular inland fisheries, the provision of publicly funded infrastructure is generally limited.

ACCESS

Much of Great Lake is accessible by vehicle with 4WD tracks linking the lake shores to 2WD standard roads. These tracks receive limited maintenance and public use is at the users discretion. Access to the lake is gained over freehold, Hydro Tasmania or Crown land. Presently there are no access issues although Hydro Tasmania reserves the right to prohibit access in the vicinity of its infrastructure where public safety is an issue. Access is limited along the eastern shore in the vicinity of Mother Lord Plains and Cramps Bay.

ACCOMMODATION/CAMPING

The Great Lake Caravan Park provides the only formal camping facility at Great Lake. Informal camping occurs around the lake shores and is generally dispersed apart from some small aggregations of caravans (eg Boundary Bay) at popular fishing locations. There may be a need for additional formal camping facilities (public or commercial) to complement informal camping.

Commercial accommodation around the lake is primarily provided by two hotels and shack rentals.

The recent upgrade of the ferry services across Bass Strait is expected to place more pressure on existing facilities and informal camping arrangements. Demand for more accommodation and a variety of types of accommodation is likely to increase.

DAY FACILITIES

Day facilities, including public conveniences, are provided only at the information centre at the PWS Field Station (Liawenee) and at the Great Lake Store (Miena). The lack of public conveniences around Great Lake creates problems with human faecal waste and diminishes the experience of interstate and local visitors to the area. The development of a northern public amenities shelter may be advantageous in the area of Brandums Bay fire station.

PARKING FACILITIES

Most car parks at Great Lake are associated with boat ramps. Specific car parking facilities for anglers are not required unless developed in conjunction with other infrastructure such as camping or day use facilities.

SIGNAGE

The Service does not currently provide specific signage about the Great Lake fishery. Some signage has been provided by other agencies and has focused on scenic and other attributes of Great Lake. There is a significant need for signage located at key locations to assist with the provision of visitor information and important fishery management messages.

BOAT RAMPS

There are several public boat ramps situated around the lake. Many were developed over the years from IFS initiatives prior to the establishment of MAST. MAST has maintained and upgraded facilities at the request of recreational boat owners through the recreational boating facilities fund with input and advice from the Service. All boat ramps are surfaced with gravel and are presently in

reasonable condition although regular maintenance is required. The ramps are located in the following areas: Cramps Bay, Tods Corner, Swan Bay, Haddens Bay, Brandums Bay, Breona and Pine Creek. Low water levels can render the boat ramps unsuitable because of their restricted length.

There are many other informal boat launching sites although their suitability to launch boats is lake level dependent.

INLAND FISHERIES SERVICE FACILITIES

The IFS has a number of facilities located at the Liawenee Field Station adjacent to, and in, the canal. These structures include; buildings, fish traps, associated sheds and diversion barriers/screens, canals and channels, access roads and fencing.

11.4 ISSUES

The provision of signage that displays fishery and tourist information is a significant issue that needs to be addressed. The lack of this type of information will retard progress and achievement of many objectives and goals. Also, the enhancement of community awareness about issues (eg pest fish) through signage, is often more cost effective than addressing the problem on the ground.

Other issues identified below relate to provision and/or maintenance of public conveniences, boat ramps and camping areas.

- Lack of tourism information and fishery information signage.
- Inadequate number of public conveniences.
- Regular maintenance of boat ramps.
- Lack of formal camping areas although it is important to maintain free-range camping.
- Lack of access along the eastern shore in the vicinity of Mother Lord Plains and Cramps Bay.

The management solutions to these issues are identified in later sections.

11.5 GOAL FOR FUTURE MANAGEMENT

The goal below has two main aims, one of which focuses on maintaining and improving infrastructure to support fisheries management functions and the other to improve the experience of visitors and anglers to Great Lake.

GOAL

To ensure that adequate infrastructure and facilitates are developed and maintained to support the recreational fishery and to make sure that all visitors and anglers to the Great Lake are suitably provided for so that they may have an enjoyable and rewarding experience.

11.6 OBJECTIVES AND ACTIONS

The provision of infrastructure is important for a variety of reasons ranging from public health and the amenity to fisheries management. Generally, the development and maintenance of infrastructure is expensive but the benefits can be significant. A number of organisations are responsible for the provision of

various types of infrastructure and it is important to establish clear relationships with these organisations to achieve the goals for infrastructure at Great Lake.

The objectives below relate to four main areas of infrastructure development and maintenance; (i) information and interpretation, (ii) development of facilities, (iii) access, and (iv) fisheries management infrastructure used by the Service.

The provision of signage and information booths at key points around Great Lake is considered important to improve community awareness and education about fishery related issues at Great Lake. Information booths are similarly important to provide a venue for the provision of information.

The Service will strongly advocate for development, maintenance and improvements to access, boat ramps, parking areas, amenities and camping facilities. The Service will also seek to improve fisheries management infrastructure to support objectives for the recreational trout fishery defined in this plan.

11.6.1.0 Ensure the community is well informed about the fishery and natural history of Great Lake through the provision of interpretative infrastructure.

11.6.1.1 Prepare and implement a signage strategy to increase community awareness about the fishery, natural history values and other issues.

11.6.1.2 Initiate discussions about the development of information booths at key locations at Great Lake (eg Breona, Brandums Bay and Miena Dam).

11.6.1.3 Review infrastructure requirements for the improvement of public viewing of spawning fish and fish stripping during the IFS Open Weekend.

11.6.2.0 Increase and enhance the facilities used by anglers and visiting tourists.

11.6.2.1 Using the Caravan and Holiday Parks Strategy as a platform, initiate discussions with DTPHA, TSRTA, Hydro Tasmania and the Central Highlands Council about the development, improvement, management and maintenance of formal camping grounds at Great Lake, particularly at places such as Sandbanks, whilst ensuring on-going informal camping.

11.6.2.2 Initiate discussions with DTPHA, TSRTA, Hydro Tasmania and the Central Highlands Council about the development of public amenities at Brandums Bay and at other locations around Great Lake.

11.6.2.3 Review the provision of boat ramps at Great Lake to ensure that there is adequate access for anglers using boats.

11.6.2.4 Initiate discussions with MAST about the provision of MAST funded safety beacons at boat ramps.

11.6.3.0 Improve and maintain access to the shores of Great Lake for angling purposes.

11.6.3.1 Advocate the maintenance of angler access to the shores of Great Lake.

11.6.3.2 Advocate for improved access to remote areas along the eastern shore in the vicinity of Mother Lord Plains and Cramps Bay.

11.6.3.3 Liaise with the Central Highlands Council to ensure vehicular access roads and tracks are maintained to a reasonable standard.

11.6.4.0 Develop and maintain fisheries management infrastructure.

11.6.4.1 Prepare and implement an asset management plan for the Service's Liawenee Field Station which includes accommodation, laboratory, workshop, fish traps and spawning channels.

11.6.4.2 Ensure that fisheries management infrastructure is not compromised by alterations to water level management regimes.

11.6.4.3 Undertake maintenance and improvements to the lower fish trap on Liawenee Canal.

11.6.4.4 Review rainbow trout trapping and recruitment infrastructure requirements.

11.7 RESPONSIBILITIES

The Inland Fisheries Service is responsible for fisheries management and building infrastructure it owns at Liawenee.

MAST contributes to the establishment and maintenance of boating related infrastructure, such as boat ramps.

Responsibilities for other infrastructure and land lie with land managers and land owners (eg DTPHA, Hydro Tasmania and Central Highlands Council).

12. IMPLEMENTATION, EVALUATION, REVIEW AND AMENDMENTS

12.1 IMPLEMENTATION OF THE PLAN

A schedule of implementation of actions in this and other plans will be developed on an annual basis and included in IFS operational plans.

To ensure that proper and sufficient progress of the plan is achieved, the Services will prepare an annual report reviewing the implementation of the plan and evaluation of management actions.

It is intended that the plan remain as a guide for fisheries management for ten years.

12.2 EVALUATION OF THE PLAN

The evaluation of the plan will be undertaken at two levels – project or action level and plan level. Individual actions will be monitored and progress towards completion evaluated and reported on regularly. This monitoring will provide the basis for higher level evaluation of the plan which will occur annually and be reported to the Inland Fisheries Advisory Council (IFAC), the Minister and be presented in annual reports.

12.3 REVIEW OF THE PLAN

The plan will have a life of ten years but a review will occur at five years.

12.4 AMENDMENTS TO THE PLAN

Any person seeking to amend the plan should make a written submission to the Director of Inland Fisheries. Submissions should clearly state the nature of the amendment, the reasons for the amendment, and if submitted on behalf of an organisation, contain a statement of support by that organisation. Submissions should also provide evidence that the proposed amendment embraces the goals and objectives of the fishery management plan and does not contravene the management requirements of other organisations.

The Director of Inland Fisheries may seek advice from IFAC and other relevant bodies about any submission. Any submission sent to the Director will be open to public scrutiny if an application is made to view the submission. The Director of Inland Fisheries will determine whether to accept or reject the proposed amendment.

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14. FURTHER INFORMATION AND ACKNOWLEDGEMENTS

FURTHER INFORMATION

Further information can be obtained from the Inland Fisheries Service.

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ACKNOWLEDGEMENTS

The Inland Fisheries Service would like to acknowledge the following persons who contributed to a focus group that outlined the vision for the Great Lake fishery and that identified issues that the plan needed to address.

- Terry Byard, Bob Campbell, Leanne Datlin, Richard Dax, David French, Bruce Heathcote, Barry Hickman, Peter Richards, and Jason Roach.

Also, the following staff from the IFS that contributed to the plan.

- Rob Freeman, Mark Nelson, Phillip Potter and other staff that contributed comments and ideas.

Appreciation is also extended to the Inland Fisheries Advisory Council that provided input into, and critical and constructive review of the plan.

Lastly, the Service would like to thank those members and organisations of the wider community that provided comment on the draft.

15. GLOSSARY

Term	***Definition***
Algae	*Non-vascular photosynthetic plants with unicellular or multicellular structures that are found in moist ground or water. Microscopic forms are known as phytoplankton.*
Biodiversity	*The number and variety of species in a community.*
Biota	*Flora (plants) and fauna (animals)*
Charophyte	*Some algae belonging to the genera* Chara *and* Nitella*.*
Cumec	*1 cubic metre per second (m^3/s).*
Endemic	*Organism having a distribution limited to a particular geographic region or part of a region.*
Fishery	*Generic description of the general area, but more specifically to mean, all elements of the freshwater fish fauna including native and introduced species.*
Freshwater fish	*The definition of freshwater fish under the Inland Fisheries Act 1995, includes all freshwater fauna which spends a portion of their life history in freshwater and includes, fish and aquatic invertebrates (crustaceans, insects and molluscs) and includes the spawn, fry or young of such an animal.*
Galaxiid	*Fish that are members of the Family Galaxiidae.*
Habitat	*The environment in which an animal lives. It includes basic life requirements such as food, shelter and spawning areas.*
Littoral	*The zone between high and low water marks.*
Macroinvertebrate	*Macroscopic (visible to the naked eye) invertebrate.*
Macrophytes	*Aquatic plants.*
Mudeye	*Larvae of dragonflies (Order Odonata).*
Native	*Occurs naturally in a specified region or locality.*

Oligotrophic	*A lake that is deficient in organic nutrients. Unproductive waters.*
Pest fish	*An undesirable fish species, whether native or introduced, that exists outside its natural distribution where it may have a significant detrimental impact on existing native species or desirable introduced species.*
pH	*A measure of the acidity or alkalinity (in this case of water). 7 is neutral, greater than 7 is alkaline, less than 7 is acidic.*
Rare	*A category of threat defined under the* Threatened Species Protection Act 1995 *as "A taxon of native flora or fauna may be listed as rare if it has a small population in Tasmania that is not endangered or vulnerable but is at risk."*
Salmonid	*Fish that are members of the Family Salmonidae.*
Turbidity	*Is the measure of the capacity of light to pass through water and generally reflects the amount of suspended material in the water. Measured in nephelometric turbidity units (NTU).*
Vulnerable	*A category of threat defined under the* Threatened Species Protection Act 1995 *as "a taxon of native flora or fauna may be listed as 'vulnerable' if it is likely to become an endangered taxon while the factors causing it to be vulnerable continue operating."*

16. APPENDIX 1. SUMMARY OF ACTIONS AND IMPLEMENTATION SCHEDULE

A. Recreational Fisheries Management			Timeframe		
GOAL	***To provide a reliable, well-utilised and accessible recreational fishery based on a multi-species trout fishery, offering a quality angling experience for all anglers.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
6.7.1.0	***Maintenance of the brown trout population and enhancement of the wild rainbow trout population.***				
6.7.1.1	Prepare and implement a strategy to enhance the rainbow trout population and which includes specific measures to evaluate the strategy.	IFS			
6.7.1.2	Develop a plan to monitor, evaluate and report on the performance of fishery management strategies (eg reviewing Liawenee spawning channels) and the fishery's general performance.	IFS			
6.7.1.3	Develop policy and implement measures to ensure the protection of the stock of wild rainbow trout and to prevent the risk of genetic contamination with domesticated rainbow trout.	IFS			
6.7.2.0	***Application of meaningful angling regulations and focused compliance activities that serve to promote fishery objectives.***				
6.7.2.1-6.7.2.7	Prepare and implement a suite of regulations.	IFS			
6.7.2.8	Ensure the annual IFS compliance plan contains specific priorities and activities for Great Lake.	IFS			

A. Recreational Fisheries Management (continued)			Timeframe		
GOAL	***To provide a reliable, well-utilised and accessible recreational fishery based on a multi-species trout fishery, providing a quality angling experience for all anglers.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
6.7.3.0	***Strategically build and enhance our knowledge about the recreational fishery.***				
6.7.3.1	Submit a list of research projects to research organisations in relation to the recreational fishery.	IFS			
6.7.3.2	Actively promote research on the recreational fishery at Great Lake.	IFS			
6.7.3.3	Seek funding for the implementation of priority research projects.	IFS			
6.7.4.0	***Increase the popularity of Great Lake as an angling and tourism destination.***				
6.7.4.1	Liaise with Tourism Tasmania, Central Highlands Council, FACT, TGALT and TSRTA about promotional and interpretative initiatives for the recreational fishery at Great Lake.	IFS			
6.7.4.2	Facilitate the preparation of a promotional strategy (including interpretation infrastructure) with Tourism Tasmania, Central Highlands Council, FACT, TGALT and TSRTA to promote the Great Lake fishery.	IFS, CHC, FACT, TGALT, TSRTA, DTPHA			

B. Native Fish Management			Timeframe		
GOAL	***Protect and conserve the native fish fauna and fish habitats of Great Lake.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
7.6.1.0	***Ensure the protection of native fish and important fish habitat at Great Lake.***				
7.6.1.1	Implement the relevant sections of the Tasmanian Galaxiidae Recovery Plan - 2003-2007 (if the plan and conservation listings for the Shannon and Great Lake paragalaxiids are accepted by the Commonwealth).	IFS, DPIWE			
7.6.1.2	Ensure all natural resource management is consistent with the Tasmanian Galaxiidae Recovery Plan, the Tasmania Threatened Species Strategy and other relevant legislation.	IFS, DPIWE, HT			
7.6.1.3	Negotiate a water level management agreement with Hydro Tasmania to protect important habitats of threatened fish and invertebrates.	IFS, HT			
7.6.1.4	Develop and implement a plan to assess the impact of recreational fishery management on native fish populations.	IFS			
7.6.1.5	Implement the monitoring program for threatened galaxiids in Great Lake as prescribed in the Tasmanian Galaxiidae Recovery Plan 2003-2007 (draft).	IFS			
7.6.1.6	Liaise with Hydro Tasmania in relation to the translocation of non-endemic Great Lake paragalaxiids into Great Lake.				
7.6.1.7	Develop a contingency plan for native fish to address the possibility of redfin perch and other introductions of undesirable fish.				

B. Native Fish Management (continued)			Timeframe		
GOAL	***Protect and conserve the native fish fauna and fish habitats of Great Lake.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
7.6.1.8	Prepare an evaluation of stocking short-finned eels into Great Lake for environmental purposes.	IFS			
7.6.2.0	***Obtain resources for the management, research and protection of native fish and their habitats at Great Lake.***				
7.6.2.1	Seek external funds to support the management, protection and research into threatened native fish and their habitats at Great Lake.	IFS			
7.6.3.0	***Strategically build and enhance our knowledge about native fish and their environment.***				
7.6.3.1	Submit a list of research projects to research organisations.	IFS			
7.6.3.2	Promote research on Great Lake native fish and their habitat requirements.	IFS			
7.6.3.3	Liaise with Hydro Tasmania in relation to the findings of the Great Lake technical studies program and Environmental Management Program which forms part of the Hydro Tasmania South Esk – Great Lake Water Management Review.	IFS, HT			

B. Native Fish Management (continued)			Timeframe		
GOAL	***Protect and conserve the native fish fauna and fish habitats of Great Lake.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
7.6.4.0	***Increase community awareness about the issues which affect native fish in Great Lake.***				
7.6.4.1	Prepare and implement a strategy to increase the awareness about the native fish fauna and threatened fish of Great Lake amongst stakeholders, resource managers and the wider community.	IFS			
7.6.5.0	***Ensure all natural resource managers and relevant stakeholders consider native fish issues in the management of resources.***				
7.6.5.1	Provide advocacy for the conservation of native fish and the aquatic environment at Great Lake.	IFS			
7.6.5.2	Establish and maintain partnerships with stakeholders with interests in native fish at Great Lake.	IFS			

C. Commercial Fisheries Management			Timeframe		
GOAL	***To prevent commercial fishery activities impacting on the recreational fishery and natural values of Great Lake.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
8.7.1.0	***To prevent the licensing, development and establishment of commercial fishery activities in Great Lake.***				
8.7.1.1	Review existing policies on commercial fishery activities to ensure consistency with this plan.	IFS			
8.7.1.2	Review and establish administrative protocols and procedures to ensure policy on commercial fishery activities are implemented.	IFS			

D. Pest Fish and Noxious Aquatic Plants Management			Timeframe		
GOAL	***To maintain an aquatic environment free of pest fish and to reduce the risks of further introductions of aquatic plants.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
9.6.1.0	***Ensure the community is fully informed and aware of the environmental risks associated with controlled and pest fish, noxious aquatic plants and diseases.***				
9.6.1.1	Prepare and implement a community awareness and education strategy about controlled and pest fish, fish translocations and the transfer of aquatic plants in the wider context.	IFS			
9.6.1.2	Ensure that compliance staff is fully informed about pest biota, fish translocations and the risk these present to the aquatic environment.	IFS			
9.6.1.3	Develop a program to highlight and reinforce bait-fishing regulations with a particular focus on interstate anglers.	IFS			
9.6.2.0	***Prevent the introduction and colonisation of controlled fish, pest fish, noxious aquatic plants and diseases.***				
9.6.2.1	Prepare a pest fish risk management strategy for Great Lake.	IFS			
9.6.2.2	Negotiate with Hydro Tasmania for an assessment on the impacts of Canadian pond weed and management options.	IFS			
9.6.2.3	Prepare and contribute a submission to the compliance operational plan that outlines the compliance strategies and efforts required to prevent pest fish introductions at Great Lake.	IFS			

D. Pest Fish and Noxious Aquatic Plants Management (continued)			Timeframe		
GOAL	***To maintain an aquatic environment free of pest fish and to reduce the risks of further introductions of aquatic plants.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
9.6.2.4	Prepare a contact protocol for IFS staff that ensures important information is effectively delivered to anglers during lakeside interviews such as licence checks and creel surveys.	IFS	■		
9.6.2.5	Ensure that the community complies with angling regulations, specifically in regard to bait fishing, and the translocation of biota.	IFS			■
9.6.2.6	Ensure that all trout stockings are conducted in accordance with the IFS Fish Translocation Policy and other relevant operational protocols.	IFS			■
9.6.2.7	Review and improve the *Inland Fisheries Act 1995* and *Inland Fisheries Regulations 1999* to achieve better outcomes in regard to preventing pest biota introductions.	IFS			■
9.6.3.0	***Implement measures to prevent or retard the establishment of populations of pest fish and noxious aquatic plants.***				
9.6.3.1	Assess the need for a pest fish threat abatement plan (especially redfin perch) at Great Lake.	IFS		■	
9.6.3.2	Monitor regularly for the presence of redfin perch at Great Lake.	IFS			■
9.6.3.3	Investigate infrastructure options to prevent pest fish from moving from Great Lake and becoming established in waters downstream from the Miena Dam (eg Shannon Lagoon and Penstock Lagoon).	HT		■	

E. Environment and Biota			Timeframe		
GOAL	***Contribute to the protection and conservation of the aquatic environment and biodiversity in Great Lake.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
10.6.1.0	***To assist in the protection of aquatic biota and habitats in Great Lake.***				
10.6.1.1	Determine the impacts of water level management on lake ecology with a focus on threatened species and other important or key biota and habitats (eg charophyte weedbeds).	IFS, HT			
10.6.1.2	Negotiate, develop and implement with DPIWE and Hydro Tasmania, formal water resource management prescriptions that protect important habitats and biota.	IFS, DPIWE, HT			
10.6.1.3	Establish and maintain relationships with stakeholders with interests in aquatic biota and the aquatic environment at Great Lake.	IFS			
10.6.2.0	***Increase general awareness about aquatic environmental issues and their management in Great Lake.***				
10.6.2.1	Prepare and implement a strategy to increase the awareness about aquatic biota and the environment of Great Lake amongst stakeholders, resource managers and the wider community.	IFS			
10.6.2.2	Seek funding for interpretation signs and information booths that provide information about environmental issues and aquatic biota.	IFS			
10.6.2.3	Provide strong advocacy for aquatic biota and aquatic environments at Great Lake.	IFS			

E. Environment and Biota (continued)			Timeframe		
GOAL	***Contribute to the protection and conservation of the aquatic environments and biodiversity in Great Lake.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
10.6.3.0	***Strategically build and enhance our knowledge about aquatic biota and their environment.***				
10.6.3.1	Submit a list of research projects to research organisations relating to the impacts of water resource management on aquatic biota and environments.	IFS			
10.6.3.2	Promote research on Great Lake aquatic biota and the environment.	IFS			
10.6.3.3	Encourage water quality monitoring at Great Lake.	IFS			
10.6.3.4	Investigate the feasibility of monitoring key indicators of aquatic ecological health at Great Lake.	IFS, DPIWE, HT			
10.6.3.5	Liaise with Hydro Tasmania in relation to the South Esk - Great Lake Water Management Review.	IFS			
10.6.3.6	Negotiate with Hydro Tasmania for access to environmental information and data that will assist with the management and protection of biota and aquatic habitats.	IFS, HT			

F. Infrastructure			Timeframe		
GOAL	***To ensure that adequate infrastructure and facilitates are developed and maintained to support the recreational fishery and to make sure that all visitors and anglers to the Great Lake are suitably provided for so that they may have an enjoyable and rewarding experience.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
11.6.1.0	***Ensure the community is well informed about the fishery and natural history of Great Lake through the provision of interpretative infrastructure.***				
11.6.1.1	Prepare and implement a signage strategy to increase community awareness about the fishery, natural history values and other issues.	IFS			
11.6.1.2	Initiate discussions about the development of information booths at key locations at Great Lake (eg Breona, Brandums Bay and Miena Dam).	IFS, CHC, DTPHA, TSRTA			
11.6.1.3	Review infrastructure requirements for the improvement of public viewing of spawning fish and fish stripping during the IFS Open Weekend.	IFS			
11.6.2.0	***Increase and enhance the facilities used by anglers and visiting tourists.***				
11.6.2.1	Using the Caravan and Holiday Parks Strategy as a platform, initiate discussions with DTPHA, TSRTA, Hydro Tasmania and the Central Highlands Council about the development, improvement, management and maintenance of formal camping grounds at Great Lake, particularly at places such as Sandbanks, whilst ensuring on-going informal camping.	IFS, CHC, HT, DTPHA, TSRTA			

F. Infrastructure (continued)			Timeframe		
GOAL	***To ensure that adequate infrastructure and facilitates are developed and maintained to support the recreational fishery and to make sure that all visitors and anglers to the Great Lake are suitably provided for so that they may have an enjoyable and rewarding experience.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
11.6.2.2	Initiate discussions with DTPHA, TSRTA, Hydro Tasmania and the Central Highlands Council about the development of public amenities at Brandums Bay and at other locations around Great Lake.	IFS, CHC, HT, DTPHA, TSRTA			
11.6.2.3	Review the provision of boat ramps at Great Lake to ensure that there is adequate access for anglers using boats.	IFS, MAST, HT			
11.6.2.4	Initiate discussions with MAST about the provision of MAST funded safety beacons at boat ramps.	IFS, MAST			
11.6.3.0	***Improve and maintain access to the shores of Great Lake for angling purposes.***				
11.6.3.1	Advocate the maintenance of angler access to the shores of Great Lake.	IFS			
11.6.3.2	Advocate for improved access along the eastern shore in the vicinity of Mother Lord Plains and Cramps Bay.	IFS			
11.6.3.3	Liaise with the Central Highlands Council to ensure vehicular access roads/tracks are maintained to a reasonable standard.	IFS, CHC			

F. Infrastructure (continued)			Timeframe		
GOAL	***To ensure that adequate infrastructure and facilitates are developed and maintained to support the recreational fishery and to make sure that all visitors and anglers to the Great Lake are suitably provided for so that they may have an enjoyable and rewarding experience.***	Responsibility	Short Term (1-2 years)	Medium term (1-5 years)	Long Term (1-10 years)
11.6.4.0	***Develop and maintain fisheries management infrastructure.***				
11.6.4.1	Prepare and implement an asset management plan for the Service's Liawenee Field Station which includes accommodation, laboratory, workshop, fish traps and spawning channels.	IFS			
11.6.4.2	Ensure that fisheries management infrastructure is not compromised by alterations to water level management regimes.	IFS			
11.6.4.3	Undertake maintenance and improvements to the lower fish trap on Liawenee Canal.	IFS			
11.6.4.4	Review rainbow trout trapping and recruitment infrastructure requirements.	IFS			

APPENDIX 2. SUMMARY OF POLICIES

Recreational Fisheries Management	
1	*Forage fish will not be introduced into Great Lake to enhance food resources for trout.*
2	*All trout fish stockings will be conducted in accordance with the IFS Fish Translocation Policy and other relevant policies.*
3	*Domestic rainbow trout are not to be introduced into Great Lake.*
Commercial Fisheries Management	
1	*Commercial eel and mudeye harvesting will be prohibited in Great Lake.*
2	*Private fishery and commercial fish hatchery developments will be prohibited at Great Lake.*
3	*Cage culture of all fish will be prohibited at Great Lake.*

APPENDIX 3. SUMMARY OF RECREATIONAL ANGLING REGULATIONS

Recreational Fisheries Management	
1	All inflowing waters (including water within a 50m radius of the inflowing stream mouth) will remain closed to angling. Liawenee Canal will remain closed all year.
2	All legal methods of angling will be permitted in the waters of Great Lake except Tods Corner and Canal Bay which will remain as artificial lures only.
3	Canal Bay will remain closed in the period April to November inclusive to protect spawning brown and rainbow trout.
4	The present boundary defining the prohibition of fishing in Canal Bay will be moved to increase the area of protection of spawning fish. The white post at Clarks Point near Canal Bay, which presently marks the southern Canal Bay boundary point, will be moved southwards 100 m.
5	The daily bag limit for salmonids (ie trout) will be 12 fish although only three may be rainbow trout.
6	The minimum size for brown trout will be 300 mm.
7	The minimum size for rainbow trout will be 400 mm.

Inland Fisheries
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