# Lakes Sorell and Crescent Water Management Plan

**Department of Primary Industries Water and Environment**

***and***

**Inland Fisheries Service Tasmania**

**November 2005**

Tasmania
DEPARTMENT *of* PRIMARY INDUSTRIES, WATER *and* ENVIRONMENT

Natural Heritage Trust
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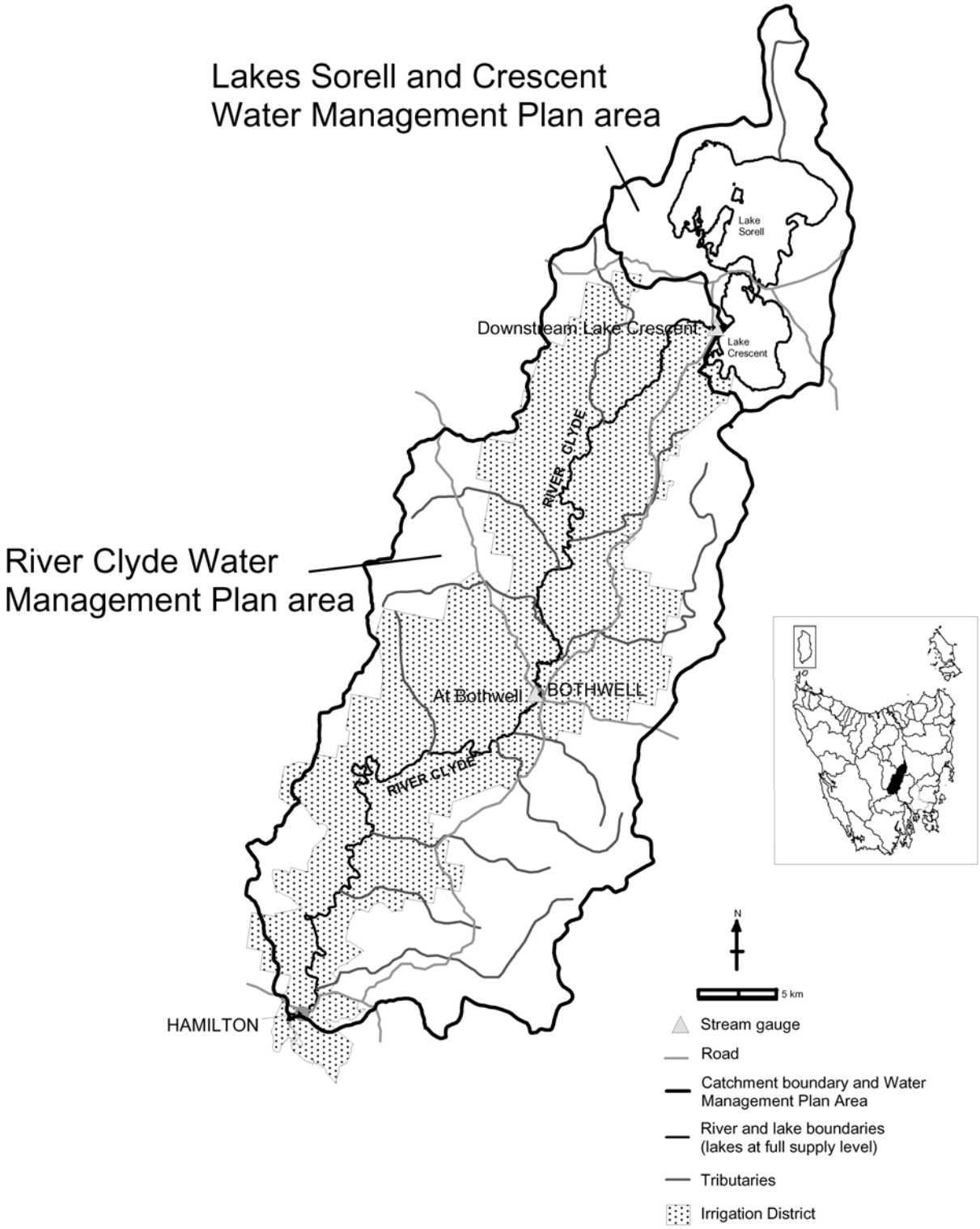


Figure 1: The Lakes Sorell and Crescent Water Management Plan area in the context of the River Clyde catchment.

# FOREWORD

This Plan, together with the River Clyde Water Management Plan, has been developed by a community Consultative Group comprising 14 members (with occasional assistance from their proxies) representing the following stakeholder groups:

| Stakeholder Group | Representative | Proxies |
|---|---|---|
| Irrigation Entity (Clyde Water Trust) | Richard Bowden | |
| Irrigators and landholders in the River Clyde catchment | Peter Bignell<br>Henry Edgell<br>Rob Parsons | Anthony Archer<br>Paul Ellis<br>Keith Rice (TFGA) |
| Southern Tasmanian Licensed Anglers Association | Trevor Sutton<br>Peter Wood | Terry Byard (*Regularly*) |
| Hydro Tasmania | Greg Carson | |
| DPIWE | Mike Temple-Smith (Chair)<br>Jenny Deakin (Project officer) | |
| Inland Fisheries Service | John Diggle | Danielle Heffer<br>Chris Wisniewski |
| Central Highlands Council | Deirdre Flint<br>Geoff Parsons | |
| Derwent NRM Committee | Jane Gudde | Oliver Ward |
| Interlaken Estate | Alan Jarvis | |

Three peak body stakeholder groups have also been kept informed throughout the process by receiving the minutes and papers of the meetings and by attending meetings with observer status when required. These were the Tasmanian Farmers and Graziers Association (I. Whyte), the Tasmanian Conservation Trust (C. Woodfield) and the Freshwater Anglers Council of Tasmania. The local shackowners group also received minutes and was kept informed through the Southern Tasmanian Licensed Anglers Association. Eight technical experts have attended meetings to present technical information and provide advice at various stages throughout the process. These include D. Fuller, R. Phillips and M. Read (DPIWE); S. Hardie, D. Heffer and A. Uytendaal (IFS); Dr. P. Davies (Freshwater Systems); and Dr. L. Koehnken (Technical Advice on Water). Their contribution to this process is gratefully acknowledged.

The Plan recognises the needs of each of the stakeholder groups and the needs of the environment and seeks to achieve a balance between them, particularly in the difficult times when demand exceeds supply. More than 10 person-years of specific scientific research, hydrological modelling and community consultation have gone into the development of this Plan, including 2.5 years of intensive negotiations within the Consultative Group. Being a compromise position, the Plan does not meet the full requirements of any of the Stakeholder Groups and not all Group members are necessarily in full agreement with every clause. The intensive negotiations conducted over more than 20 full day meetings have resulted in a number of trade-offs being made with each of the Stakeholder Groups having some wins and some losses. The Department considers that there is now confidence in the science behind the needs of the lakes' ecosystems, and that the community negotiated outcomes represent the best achievable balance of all the Plan's objectives.

Dr. Mike Temple-Smith, Chair of the Lakes Sorell and Crescent and River Clyde Consultative Group

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# PREFACE

Lakes Sorell and Crescent are two shallow freshwater lakes located in the Central Highlands at a height of approximately 800 m AHD. The lakes are individually regulated and together have provided an important source of supply for downstream uses in the Clyde Valley since the early 1800s. Today these uses include towns, stock and domestic supplies and irrigation. The lakes support a diverse range of flora and fauna in their complex in-lake ecosystems and adjacent associated wetlands. Specific ecological values of note include a number of rare or threatened species including the endemic native fish the golden galaxiid (*Galaxias auratus*); and a number of state, national and internationally recognised (Ramsar) wetlands. The wetlands are an important refuge for several listed migratory bird species during droughts and some, which are privately owned, are an integral part of local grazing enterprises. The lakes also support a premier trout fishery and a commercial eel fishery and have long been known as an important place of recreational value to the local community and the tourism sector. In 1995, the listed pest fish species European carp (*Cyprinus carpio*) was found in the lakes. An intensive carp management program was initiated to prevent the spread of the species throughout the State and to work towards its eradication. Recent years have seen the decline of the health of the lakes ecosystems. This is considered to be for the most part, a consequence of the severe reduction in water levels due to the extended drought, relatively high water abstraction levels to support the irrigation industry through the drought and the release of a large quantity of water in the mid 1990s for carp management purposes.

This water management plan has been prepared by the Department of Primary Industries, Water and Environment, the Inland Fisheries Service, and the Lakes Sorell and Crescent and River Clyde Water Management Plan Consultative Group. Funding for the development of the Plan was provided by the Department as in-kind support for the Natural Heritage Trust funded Lakes Sorell and Crescent Rehabilitation Project.

The purpose of the Plan is to provide a framework for managing the catchment's water resources in accordance with the objectives of the *Water Management Act 1999* and the *State Policy on Water Quality Management 1997*. The Plan is a statutory plan that affects everyone who uses water in, or from the catchment.

The Plan identifies the key water management and environmental objectives for the catchment. It outlines a number of water management strategies which are necessary to meet the objectives to ensure that the water in the catchment is managed sustainably for the long term. These strategies include provisions for water management responsibilities, water licensing and allocation, groundwater management, operating guidelines and rules, water availability and restriction management, monitoring and reporting, and water development.

The Plan also contains a number of assessments required under the *Water Management Act 1999* which pertain to the most appropriate Water Regime to meet the objectives of the Plan, including its capacity to meet those objectives; the capacity of the water resource to meet current and future demands; the effects of the Plan on water quality and on Water Users and their businesses; and the effects of the Plan on the River Clyde as it is a linked water resource.

This Plan has been developed in association with the River Clyde Water Management Plan as the flows in the River Clyde, particularly during the summer months, are dependent on the releases from the lakes. A decision has been taken by the Consultative Group, together with the Department, that as the environmental values of the lakes are significantly higher than those of the river, water from the lakes will not generally be used to support environmental values in the river, as this could potentially jeopardise the lakes' values. There may however be instances when artificial releases from the lakes may be considered where a net environmental benefit to the system as a whole can be achieved.

# PART 1 INTRODUCTION

## 1.1. Title and application

1.1.1. This Water Management Plan is titled the Lakes Sorell and Crescent Water Management Plan, hereafter referred to as the Plan.

1.1.2. The Plan is to be read as being subject to the *Water Management Act 1999*, hereafter referred to as the Act. The objectives of the Act are listed in Appendix 1.

1.1.3. Nothing in this Plan absolves any person from the need to obtain any licence, permit, approval or other requirement under the Act, or under any other applicable legislation.

## 1.2. Area to which the Plan applies

1.2.1. The Plan area is the Lakes Sorell and Crescent catchment downstream to and including the control structure at Lake Crescent (Figure 1).

1.2.2. The Plan applies to the following water resources:
(a) water in permanent and temporary watercourses including lakes and wetlands; and
(b) groundwater.

## 1.3. Commencement of the Plan

1.3.1. In accordance with Section 28 of the Act, the Minister adopted the Plan on the date specified in the certificate endorsed on the Plan.

1.3.2 In accordance with Section 29 of the Act, the Plan takes effect on the date of publication of notice of its adoption in the Gazette.

## 1.4. Interpretation

1.4.1. Words used in the Plan have their ordinary meanings as defined in the Macquarie Dictionary unless otherwise defined in the Plan or the Act. A reference in the Plan to any legislation is to be taken as a reference to such legislation as it may be amended from time to time.

1.4.2. In this Plan, unless the contrary definition appears –

**Act** means the *Water Management Act 1999* as amended from time to time or, if that Act is repealed, any Act enacted in substitution for that Act.

**Catchment** means the area within which water will naturally flow towards a watercourse and includes the watercourse.

**Consultative Group** means the Lakes Sorell and Crescent and River Clyde Water Management Plan Consultative Group. The Group comprises representatives of some of, or all of, but is not limited to, the following groups or organisations: Irrigation Entity (1), Bothwell irrigators (1), Hamilton irrigators (1), Derwent Catchment Natural Resource Management Committee (1), Central Highlands Council (2), Hydro Tasmania (1), Inland Fisheries Service (1), DPIWE Water

Resources Division (2), Southern Tasmanian Licensed Anglers Association (2) Interlaken Estate (1), Water Users from the river catchment (1).

**Critical Minimum Level** means the level below which serious environmental impacts are known to occur in each lake and the level below which water will not generally be available for allocation purposes.

**Cumec** means a measurement of flow. 1 cumec is equivalent to 86.4 ML per day, or 1000 litres per second.

**Department** or **DPIWE** means the Department of Primary Industries, Water and Environment.

**Director** means the Director of the Inland Fisheries Service (IFS).

**Environment** means components of the earth, including land, air and water; and any organic matter and inorganic matter and any living organism; and includes interacting natural ecosystems that include these components.

**Exceptional circumstance** means an unforeseen circumstance that arises unexpectedly at the end of an irrigation season, when all other potential sources of water have been exhausted, and when serious economic or social impacts could arise as a consequence of a small additional release of water not being made available. Such a circumstance is likely to be related to an unusual extended drought period that has not been adequately forecast.

**Full Supply Level** means the level at which the lakes begin to spill. These levels are 804.36 m AHD in Lake Sorell and 803.8 m AHD in Lake Crescent.

***Galaxias auratus*** or **golden galaxiid** or **galaxiid** means the native fish species that is endemic to Lakes Sorell and Crescent. This species is listed as 'rare' under the Tasmanian *Threatened Species Protection Act 1995* and is being considered for listing as 'vulnerable' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

**Hydro Tasmania** or **Hydro** means Hydro Electric Corporation.

**IFS** means the Inland Fisheries Service

**Interlaken Estate** means the Interlaken Estate Property (Property ID 7612624) which is located on the western side of Lakes Sorell and Crescent.

**Irrigation Entity** or **the Entity** means the Water Entity responsible for the administration of the River Clyde Irrigation District.

**Irrigation Right** means a right under the *Irrigation Clauses Act 1973* to be supplied with water for irrigation. Irrigation rights are issued by the Irrigation Entity and are granted from the Entity's bulk Water Allocation.

**Irrigation Season** means the annual period declared by the Irrigation Entity as the period during which water will be available for irrigation or for taking into storage. In the River Clyde catchment, this period is likely to be 12 months of the year.

**Macrophytes** means aquatic plants that are visible to the naked eye.

**ML** means megalitre or one million litres.

**Preferred Minimum Level** means the level below which significant environmental impacts are known to occur in each lake and the level below which the low surety portion of the allocation is restricted.

**Preferred Operating Range** means that part of each lake in which it is desirable to maintain lake level fluctuations for environmental, social and economic reasons.

**Protected Environmental Value** means the value or use for which it has been determined that a given area of the environment should be protected, as defined under the *State Policy on Water Quality Management 1997.*

**Release Period** means that part of the Irrigation Season when water is being released from Lake Crescent for town supply, stock and domestic and/or irrigation purposes. The Release Period does not include times when water is being released from the lakes as controlled spill.

**Season's Available Water** means that portion of the allocation which can be sustainably and reliably be made available for a given season. The Season's Available Water is determined at the beginning of the season and is based on the amount of water that is predicted to remain in the lakes at the end of the season using the Water Availability Model.

**Surety** means the actual or relative probability with which a Water Allocation is expected to be available in any year having regard to the natural variability of the supply of water.

**The lakes** means Lakes Sorell and Crescent.

**Turbidity** means the cloudiness in water caused by suspended material such as clay, silt, finely divided organic and inorganic matter, soluble coloured compounds and plankton and microscopic organisms. Standard units for measuring turbidity are NTU (Nephelometric Turbidity Units).

**Water Availability Model** means a spreadsheet modelling tool developed by the Department which is used to determine the Season's Available Water from Lakes Sorell and Crescent at the beginning of each Irrigation Season. The model predicts what the levels of the lakes are likely to be by the end of the season based on the actual monthly climatic yield changes in each of the lakes in the recent past. The outputs are an estimate of the maximum volume of water that can be extracted while still maintaining the lakes above the Preferred and Critical Minimum Levels. The model is updated each year with the new climatic data so that it reflects current climatic conditions.

**Water Entity** means a formal entity such as a Government Business Enterprise, a Council, a statutory authority, a body corporate, a trust, an electricity entity or a registered society, that can apply to the Minister to be responsible for the administration of a Water Management Plan. The definition can also include the Minister where he/she is responsible for administering a Plan.

**Water User** means any person who has a right to take water under the Act, or under the Irrigation Clauses Act 1973, or any amended versions of those Acts thereof, and any person who is affected by the level of water in the lakes for other commercial or non-commercial reasons.

**Water Manager** means the Water Entity or agency responsible for administering the Plan.

**Water Regime** means the pattern of fluctuations in water levels in the lakes resulting from, or governed by, a set of operating guidelines and operating rules for managing the lake levels; and a series of protocols for determining the Season's Available Water or managing any restrictions if and when they are required.

**Watercourse** means a river, creek or other natural stream of water (whether modified or not) flowing in a defined channel, or between banks, notwithstanding that the flow may be intermittent or seasonal or the banks not clearly or sharply defined, and includes – **(a)** a dam that collects water flowing in any such stream; **(b)** a lake through which water flows; **(c)** a channel into which the water of any such stream has been diverted; **(d)** part of any such stream; and **(da)** the floodplain of any such stream – but does not include – **(e)** a channel declared by the regulations to be excluded from this definition; or **(f)** a drain or drainage depression in the contours on the land which only serves to relieve upper land of excess water in times of major precipitation.

## 1.5. Aim and objectives of the Plan

1.5.1. The aim of the Plan is to establish and implement a sustainable, efficient and balanced management system for the water resources of Lakes Sorell and Crescent that recognises the needs of all Water Users and the environment.

1.5.2 The objectives of the Plan, including the environmental objectives, are to manage the lakes' Water Regime so as to –:

(a) ensure that water quality, principally turbidity, is maintained at levels necessary to facilitate growth of aquatic plants and maintain a healthy ecosystem in the lakes;
(b) maintain the health and population of the endemic native fish golden galaxiid (*Galaxias auratus*) which is a listed threatened species;
(c) provide a sustainable, secure and reliable supply of water for downstream purposes, including towns supplies, stock and domestic use and irrigation, and at all times to maximise the availability of that water;
(d) maintain a water level inundation regime necessary to sustain the wetland ecosystems of the lakes in a healthy condition, in particular the State, National and Internationally recognised (Ramsar) wetlands, some of which contain threatened species;
(e) minimise the risk, in mid to late summer, of inundation of those parts of Interlaken Estate that are adjacent to the lake and normally used for grazing purposes;
(f) enhance the aesthetic and recreational values of the lakes;
(g) maintain and enhance the trout and commercial eel fisheries;
(h) minimise the risk of uncontrolled spill occurring from the lakes which could lead to the spread of the pest fish European Carp (*Cyprinus carpio*) downstream; and
(i) increase community involvement in, and understanding of, the management of the lakes resources.

## 1.6. Review of the Plan

1.6.1 In accordance with Section 34(1) of the Act, a review of this Plan is to be undertaken 4 years after adoption of the Plan. The Secretary of the Department shall consult with the Consultative Group during the review of the Plan. The items that are to be reviewed include:

- Provision 2.1.1 (The Inland Fisheries Service as the Water Manager); and
- Provision 2.2.6 (Sustainable allocation of the lakes); and
- Provision 2.4.1 (Location of management level reference points); and
- Provision 2.4.5 (The trigger level for assessing the risk of uncontrolled spill); and
- Provision 2.6.4 (Allocation protocol for Surety 6 allocations); and
- Provision 2.6.5 (Allocation protocol for Surety 5 allocations); and
- the Water Availability Model; and
- Any other provision as may be agreed by the Consultative Group, the Water Manager and the Secretary of the Department.

1.6.2 The review of Provision 2.2.6 should take into consideration lake yield and climatic trends over the life of this Plan, and the final Irrigation Rights that are granted by the Irrigation Entity. Provision 2.2.6 may also be reviewed earlier if the sustainable yield of the catchment is increased or developed.

# PART 2 WATER MANAGEMENT PROVISIONS

## 2.1. Management responsibilities

2.1.1. The Director of the Inland Fisheries Service has management control of Lakes Sorell and Crescent under the *Inland Fisheries Act 1995* due to the presence of the pest fish European Carp (*Cyprinus carpio*). The Director will be responsible for administration of the Plan and will be known as the Water Manager.

2.1.2. In the event that the Director declares that carp have been completely eradicated, or that the Director wishes to relinquish his or her water management responsibilities, the Minister will become the Water Manager until such time as Provision 2.1.1 can be reviewed.

2.1.3. The Consultative Group will remain in place after the Plan has been adopted. The stakeholder membership of the Consultative Group may be amended by the Minister or the Water Manager as required to meet the needs of the Group. The Chair will be elected by the Group.

2.1.4. The Consultative Group may provide advice to the Water Manager on the implementation of the Plan and on local water management issues. The Group will meet at least annually and will seek advice from, and report back to, their organisations or constituencies on matters relating to implementation of the Plan.

2.1.5. The Water Manager will provide the Minister with a written annual report on the administration of the Plan in accordance with Section 45 of the Act. A copy of the draft report will be forwarded to each of the members of the Consultative Group. The Water Manager will make a representative available to meet with the Consultative Group in Bothwell as soon as practicable after the draft report has been prepared.

## 2.2. Water licensing and allocations

2.2.1. For the purposes of the Plan, water licensing will be undertaken in accordance with Part 6 of the Act and will be consistent with this Plan and with the *State Policy on Water Quality Management 1997*.

2.2.2. All water takes from the water resources covered by this Plan will be required to be measured.

2.2.3. Water may be taken for stock and domestic use without a licence in accordance with Part 5 of the Act. The quantities of water which may be taken for stock and domestic purposes must be in accordance with the *Water Management Act Regulations 1999*, as amended from time to time.

2.2.4. The existing Water Licence held by the Irrigation Entity will be varied to be consistent with this Plan in accordance with Part 6 of the Act.

2.2.5. The sureties of water allocations are listed below in descending order of priority, in accordance with the requirements of Section 94(1) of the Act. These sureties determine the order of priority of access to water resources during periods of restriction. For example, stock and domestic and essential town water supplies (Surety 1) have the highest priority during any restrictions.

Surety Level 1 Water for stock, domestic and fire fighting purposes all year round at the lakes; and water for town supplies, stock, domestic and fire fighting purposes in the Clyde Valley when necessary when there is insufficient water in the River Clyde;

Surety Level 2 Water provided to meet environmental needs of the lakes and the River Clyde, as set out in this management plan;

Surety Level 3 None present in this catchment (*Water licences replacing rights registered under Section 100D or Section 100H of the Water Act 1957*);

Surety Level 4 Special licence holders, i.e. Hydro Tasmania;
Surety Level 5 High security allocations for non-essential towns' supplies, irrigation and industrial use. (May also include water for Surety 1 purposes in the Clyde valley if there is insufficient water in the river to meet demands);
Surety Level 6 Low security allocations;
Temporary allocations.

This catchment is located within the Lower Derwent Hydro-Electric District and Hydro Tasmania has rights to access all unallocated water, and all excess water left in the Clyde catchment that flows into Lake Meadowbank after the requirements of other licensed users are met.

2.2.6. Under Schedule 5 of the Act, there are two licensed allocations in this catchment for direct takes of 5,000 ML at Surety 5 and 5,000 ML at Surety 6. As the catchment is now fully allocated at Surety levels 5 and 6, no new water allocations at those surety levels will be issued.

2.2.7. For the purposes of the Plan, transfers of licences or allocations will be permitted in accordance with Division 4 Part 6 of the Act and the Water Resources Policy 2003/2 *Guiding Principles for Water Trading in Tasmania*, as amended from time to time.

## 2.3. Groundwater management

2.3.1. A Groundwater Use Register will be established by the Water Manager within 2 years of the commencement of the Plan. The register will contain details including, but not limited to, well type; well depth and construction; well location; the purpose for which groundwater is used; quantity, timing and rates of groundwater abstraction; and groundwater quality.

2.3.2. The Department may implement a groundwater licensing system.

## 2.4. Operating rules

2.4.1. The primary management levels for each lake include the Full Supply Level, the Preferred Minimum Level, the Critical Minimum Level and the Preferred Operating Range, expressed as their respective heights above the Australian height datum (AHD). The levels are listed in Table 1. The levels are to be measured on the gauge boards on the Lake Sorell outlet structure for Lake Sorell, and at Tea Tree Point for Lake Crescent.

Table 1. Primary management levels for Lakes Sorell and Crescent (All levels in m AHD)

| | **Full supply level** | **Preferred Minimum Level** | **Critical Minimum Level** | **Preferred Operating Range** |
|---|---|---|---|---|
| Lake Crescent | 803.8 m | 802.7 m | 802.2 m | 802.7–803.8 m |
| Lake Sorell | 804.36 m | 803.5 m | 803.2 m | 803.5–804.36 m |

2.4.2. The Water Manager will endeavour to operate the lakes within the Preferred Operating Range as far as possible in a way that is consistent with natural seasonal and climatic changes. The lakes should be manipulated synchronously but may be operated independently to achieve specific objectives if necessary, taking into account the need to maximise water availability.

2.4.3. The Water Manager will use the Water Availability Model (or updated versions thereof) in the management of the system and in the assessment of the likely Season's Available Water. The Water

Manager will restrict releases from the lakes below the Preferred and Critical Minimum Levels in accordance with Section 2.6.

2.4.4. The Water Availability Model will be updated annually by DPIWE, in association with the Water Manager and the Irrigation Entity. The model will be reviewed if the lakes are drawn down below the Critical Minimum Levels twice in a 20-year period as a result of inaccurate water availability predictions.

2.4.5. The Water Manager shall keep the gate control structures at the lakes in good working order and will use them to their maximum potential. If the lakes rise to within 100 mm of Full Supply Levels, the Water Manager shall assess the likelihood of uncontrolled spill occurring and, following consultation with the Irrigation Entity and Interlaken Estate, adopt management techniques as appropriate and practicable to reduce the risk of uncontrolled spill occurring, taking into account the need to maximise water availability.

2.4.6. In the event that a Full Supply Level occurs, or is about to occur, in either lake, the Water Manager shall open the relevant outlets between the lakes and/or the River Clyde to permit the outflow of an appropriate quantity of water to reduce the levels to at or below the Full Supply Level as soon as possible, having regard to the potential impacts of flooding downstream and the environmental objectives of the River Clyde Water Management Plan. For a Full Supply Level in Lake Crescent, the Water Manager will, with as much notice as possible, send a flood warning advisory notice by fax to those property owners adjacent to the River Clyde who have specified in writing to the Water Manager that they wish to be included on such a circulation list.

2.4.7. If water is being discharged under Provision 2.4.6., it will be made available to the Irrigation Entity for distribution amongst Irrigation Right Holders, subject to the following conditions:

(a) All takes must be consistent with the River Clyde Water Management Plan.
(b) The Water Manager and the Irrigation Entity must consult with the Water Manager of the River Clyde Water Management Plan to consider whether the releases from the lake could be used and/or timed to meet the environmental flood flow provisions for the river. If a specific controlled release for such a purpose is deemed appropriate and achievable, the water from the lake will not be available for extraction from the river until such time as the relevant environmental objective has been met.

2.4.8. No works to reduce the Full Supply Level, whether permanent or temporary, may be carried out except in an emergency[1] or by prior agreement with the Consultative Group.

## 2.5. Operating guidelines

2.5.1. In managing the system, the Water Manager should follow the environmental guidelines 2.5.2 to 2.5.7 as far as practicable. In the event that following these guidelines may seriously impact on the Season's Available Water, the Water Manager will first consult with the Consultative Group. The Water Manager should strive to implement these guidelines without releasing water out of Lake Crescent.

2.5.2. To facilitate a drying phase in the wetlands, to allow access to private grazing lands below Full Supply Level and to maintain consistency with natural seasonal changes, Lake Sorell should be allowed to drop to 803.9 m AHD by mid February each year. If necessary water may be transferred into Lake Crescent.

2.5.3. The wetlands of Lake Sorell should not be maintained fully inundated (lake level at or above 804.2 m AHD), or completely dry (lake level at or below 803.9 m AHD), for more than 5 consecutive years, respectively.

[1] An emergency may arise for human health and safety, dam safety or carp management reasons.

2.5.4. The wetlands of Lake Sorell should be allowed to become fully inundated (lake level at or above 804.2 m) at least once in every five years, to encourage aquatic plant growth and regeneration in the wetlands.

2.5.5. Lake Crescent should not be maintained above 803.3 m AHD, or below 803.0 m AHD, for more than 5 consecutive years respectively, in order to reduce the impacts of the wetlands being wet for too long, or dry for too long.

2.5.6. Lake Crescent should be allowed to reach 803.3 m AHD at least once in every five years to encourage aquatic plant growth and regeneration in the wetlands.

2.5.7. Sudden large changes in water levels inconsistent with natural and seasonal climatic changes should be avoided, particularly while the lake levels are within the important wetland inundation zones (i.e. 803.9–804.2 m AHD in Lake Sorell and 803.0–803.3 m AHD in Lake Crescent). Decreases in water levels of more than 600 mm should not occur in either lake between June and September to reduce the risk of de-watering *Galaxias auratus* eggs.

## 2.6. Water availability and restriction management

2.6.1. The Water Manager will provide the Irrigation Entity with the Season's Available Water in accordance with the Entity's water licence. The Water Manager shall inform the Irrigation Entity of any factor that may influence the Season's Available Water, and will provide the Entity with weekly updates of lake levels during the Release Period as required.

2.6.2. The Water Manager will make available to the Irrigation Entity an estimate of the likely Season's Available Water on September 1 of each year, and on the first working day of every month thereafter, or as required, until the end of the Release Period. The Water Manager will finalise the actual Season's Available Water a week before the likely start of the Release Period, or as soon as practicable after the lake levels begin to decline.

2.6.3. The Irrigation Entity will advise the Water Manager as to the timing and quantity of the releases required, and will provide such advice with reasonable advance warning.

2.6.4. The Season's Available Water from the Surety 6 allocation will be granted based on the amount of water predicted using the Water Availability Model to remain above the Preferred Minimum Levels at the end of the season. If the model shows that the lakes are unlikely to remain above the Preferred Minimum Levels, there will be no water available for that period from the Surety 6 allocation. The Season's Available Water may be granted in part, but only up to the amount that is predicted to remain above the Preferred Minimum Levels by the end of the season.

2.6.5. The Season's Available Water from the Surety 5 allocation will be granted based on the amount of water predicted using the Water Availability Model to remain above the Critical Minimum Levels at the end of the season. If the model shows that the lakes are unlikely to remain above the Critical Minimum Levels, there will be no water available for irrigation for that season from the Surety 5 allocation. The Season's Available Water may be granted in part, but only up to the amount that is predicted to remain above the Critical Minimum Levels by the end of the season.

2.6.6. In the event of an exceptional circumstance, the Minister may, having given due consideration to the environmental impacts described in Part 3 and the social and economic implications to be provided by the Irrigation Entity, direct the Water Manager that Lake Sorell may be drawn down below the Critical Minimum Level, subject to the following conditions:

(a) The Minister must be satisfied using the Water Availability Model, that the lake level is not likely to remain below the Critical Minimum Level for longer than two months, and that by 1 July the level will be higher than the Critical Minimum Level.

(b) Where the draw down is for the purposes of releasing water for irrigation, in the subsequent Irrigation Season the Critical Minimum Level will be temporarily increased by an amount equal to the decrease in level below 803.2 m AHD.
(c) Where the draw down is for the purposes of providing water for stock, domestic and town supplies in a season where no water was available for irrigation supplies, the Critical Minimum Level will be as specified in Table 1.
(d) The lake may not be drawn down below the Critical Minimum Level for irrigation purposes more often than once in every 20 years.
(e) The lake may not be drawn down below 803.0 m AHD.

2.6.7. In the event of an exceptional circumstance, the Minister may, having given due consideration to the environmental impacts described in Part 3 and the social and economic implications to be provided by the Irrigation Entity, direct the Water Manager that Lake Crescent may be drawn down below the Critical Minimum Level, subject to the following conditions:
(a) The Minister must be satisfied using the Water Availability Model, that the lake level is not likely to remain below the Critical Minimum Level for a period longer than 3 months, and that by 1 June the level will be higher than the Critical Minimum Level.
(b) Where the draw down is for the purposes of releasing water for irrigation, in the subsequent Irrigation Season the Critical Minimum Level will be temporarily increased by an amount equal to the decrease in level below 802.2 m AHD.
(c) Where the draw down is for the purposes of providing water for stock, domestic and town supplies in a season where no water was available for irrigation supplies, the Critical Minimum Level will be as specified in Table 1.
(d) The lake may not be drawn down below the Critical Minimum Level for irrigation purposes for the next 4 years.

2.6.8. Temporary water allocations may be issued in accordance with Section 90 of the Act, once the following conditions have been met:
(a) The Water Manager must be satisfied using the Water Availability Model, that the lake levels are likely to remain above the Preferred Minimum Levels in each lake at the end of the season; and
(b) Applications for temporary allocations from the lakes for water use may only be made to the Department by the Irrigation Entity or by riparian landowners at the lakes.
(c) Temporary allocations may be granted during the Release Period, or during a period of controlled spill under Provision 2.4.6.

2.6.9. Where irrigation restrictions are in place and Surety 1 water only is being released from the lakes, the Water Manager will inform Central Highlands Council that water restrictions should be put in place to restrict the use of water to essential town supplies only.

## 2.7. Monitoring and reporting

*There are three components to the monitoring and reporting program: environmental, hydrological and water management. In each of the following tables, the Parameter lists the data to be collected or the assessments to be carried out; the Purpose (where present) refers to the objective of the monitoring program; the Sampling or Reporting Period is the frequency and/or timing of the monitoring to be carried out; and the Responsibility is the agency or agencies that will either collect the data or carry out the relevant assessment. The agency with the primary responsibility for the monitoring or reporting is highlighted in bold; two or more agencies in bold means there is joint responsibility*[2].

2.7.1. Hydrological monitoring program

The aim of the hydrological monitoring program is to assist the Water Manager to manage the water resources on a day to day basis in accordance with the requirements of the Water Regime and the other

[2] Joint responsibility may occur where the Irrigation Entity is responsible for reporting on actions of Irrigation Right holders and the Water Manager is responsible for reporting on actions of Water Licence holders.

provisions of the Plan. The program will help the Water Manager understand the availability and reliability of the water resources over the longer term. The hydrological monitoring program summarised in Table 2 will be carried out:

Table 2. Hydrological monitoring program

| **Parameter** | **Sampling** | **Responsibility** |
|---|---|---|
| Lake level monitoring *(both lakes)* | At least weekly during the Release Period, otherwise monthly | **Water Manager**/IFS |
| Flow monitoring<br>• *Sorell outflow*<br>• *Crescent releases (stream gauge on Clyde)* | Regularly as appropriate<br>Continuous | **Water Manager**/IFS<br>**DPIWE**/Water Manager |
| Rainfall at Interlaken | Daily | **Bureau of Meteorology**/Hydro Tasmania/other agency as appropriate |
| Yield changes and water availability using the Water Availability Model | At least monthly during the Release Period | **Water Manager**/DPIWE/ Irrigation Entity |

2.7.2. Environmental monitoring program

The aim of the environmental monitoring program is to monitor the effects of the Plan's provisions on the ongoing ecological health of the lakes. The environmental parameters listed in Table 3 have been selected for this monitoring program as they are of specific relevance to the Water Regime detailed in this plan.

Table 3. Environmental monitoring program

| **Parameter** | **Purpose** | **Sampling** | **Responsibility** |
|---|---|---|---|
| *Galaxias auratus*<br>• Recruitment (eggs and larvae) | Assess the effects of the lake level regime on the *Galaxias auratus* population, with specific reference to the Critical Minimum Level in Lake Crescent | Annually as required if the risks to the galaxiid population are determined by IFS to be high | Water Manager/**IFS** |
| Water quality<br>• Turbidity (colloidal and total) | Assess the effects of the lake level regime on water quality, with specific reference to the Preferred Minimum Levels in both lakes and the Critical Minimum Level in Lake Sorell. | Monthly, or seasonally as required | Water Manager/**IFS while carp are present** |
| Wetlands<br>• Abundance and diversity of species | Assess the effects of the frequency of wetland inundation regime on the abundance and diversity of plant species, with specific reference to the wetlands provisions in Sections 2.5.2 to 2.5.7 | Once every 5 years as required. | Water Manager/**DPIWE** |

The following additional parameters should be considered in any future or ongoing technical studies at the lakes, particularly when the lakes are full, to gain a better understanding of the ecosystem health: a full suite of water quality parameters; in-lake macrophytes; lakeside vegetation; trout population and condition; abundance and diversity of macroinvertebrates.

2.7.3. Water management and related issues

The aims of the water management reporting program are to assist the Water Manager in the management of the resource; to ensure compliance with the provisions of the Plan; to assess the effects of the Plan on the community; and to establish where improvements leading to more effective management of the resource could be made. The program is summarised in Table 4:

Table 4. Water management monitoring program

| **Parameter** | **Reporting period** | **Responsibility** |
|---|---|---|
| Water usage | Annually | **Water Manager**/Irrigation Entity |
| Allocation restrictions | Annually | **Water Manager**/Irrigation Entity |
| Temporary allocations | Annually | **Water Manager**/Irrigation Entity |
| Water transfers | Annually | **DPIWE**/Irrigation Entity |
| Dam applications | Annually | **Assessment Committee for Dam Construction** |
| Financial statements as per S.45 of the Act | Annually | **Water Manager**/Irrigation Entity |
| Determine whether the Operating Rules and Guidelines have been met, including a discussion on why they were not met if appropriate. | Annually | **Water Manager**/**Irrigation Entity** |
| Groundwater register update | With review of the Plan | **Water Manager** |
| Discussion on the ecological and socio-economic impacts of exercising the exceptional circumstances rules in Provisions 2.6.6 and 2.6.7, should that occur. | In the annual report subsequent to the exceptional circumstances rules being exercised. | **Water Manager**/Irrigation Entity |
| Requests for releases from the Irrigation Entity and steps taken to meet those requests. Discussion on why requests could not be met if appropriate. | Annually | **Water Manager**/Irrigation Entity |

2.7.4. The results of the annual monitoring programs, together with a discussion of the results, will be included in the annual report provided by the Water Manager to the Minister under Section 45 of the Act.

## 2.8. Water development

2.8.1. Water development proposals will be subject to the standard appropriate approvals processes and must be consistent with the Act. Applicants must show that development proposals will not adversely affect the environmental provisions or the existing rights of Water Users.

# PART 3 STATUTORY REQUIREMENTS AND ASSESSMENTS

## 3.1. Statement of the objectives of the Plan, including the environmental objectives – Section 14(2)(a)

The objectives of the Plan, including the environmental objectives, are to manage the lakes' Water Regime so as to –:

(a) ensure that water quality, principally turbidity, is maintained at levels necessary to facilitate growth of aquatic plants and maintain a healthy ecosystem in the lakes;
(b) maintain the health and population of the endemic native fish golden galaxiid (*Galaxias auratus*) which is a listed threatened species;
(c) provide a sustainable, secure and reliable supply of water for downstream purposes, including towns supplies, stock and domestic use and irrigation, and at all times to maximise the availability of that water;
(d) maintain a water level inundation regime necessary to sustain the wetland ecosystems around the edges of the lakes in a healthy condition, in particular the State, National and Internationally recognised (Ramsar) wetlands, some of which contain threatened species;
(e) minimise the risk, in mid to late summer, of inundation of those parts of Interlaken Estate that are adjacent to the lake and normally used for grazing purposes;
(f) enhance the aesthetic and recreational values of the lakes;
(g) maintain and enhance the trout and commercial eel fisheries;
(h) minimise the risk of uncontrolled spill occurring from the lakes which could lead to the spread of the pest fish European Carp (*Cyprinus carpio*) downstream; and
(i) increase community involvement in, and understanding of, the management of the lakes resources.

## 3.2. Description of the Water Regime that best gives affect to the environmental objectives and other relevant objectives of the Plan – Section 14(2)(b)

The social, economic and environmental objectives of this Plan are complex, interdependent and sometimes conflicting. The demands on the lakes system have exceeded its capacity in recent years which has lead to difficulties in prioritising water use. The Water Regime provided for in this Plan is therefore a compromise position that takes all the values and demands into consideration and strives to achieve a sustainable balanced outcome.

This compromise position has not been reached lightly: there has been more than 10 person years of specific scientific research, hydrological modelling and community consultation for the development of this plan, including 2 years of intensive negotiations amongst the Consultative Group (Deakin, 2005). The result is that there is now confidence in the science behind the water needs of the lakes' ecosystems, and the community negotiated outcomes represent the best achievable balance of all the Plan's objectives. A full explanation of the scientific basis for the environmental water requirements in the lakes is described in a suite of technical reports completed by the Inland Fisheries Service in 2003 (Hardie, 2003a,b; Heffer, 2003a,b and Uytendaal, 2003a,b).

For the purposes of this Plan, the Water Regime comprises a set of operating rules which must be observed in managing the lake levels, a set of operating guidelines which should be followed, and a series of protocols for determining the Season's Available Water and managing restrictions if and when they are required. There are two primary management levels in each lake on which the Water Regime is based: the Preferred Minimum Level and the Critical Minimum Level. These levels have been determined from the scientific research as the levels at which different degrees of environmental impacts begin to occur (Hardie,

2003a and Uytendaal, 2003a,b). The height above sea level of these management levels in each of the lakes is described in Provision 2.4.1.

The basic principles underpinning the Water Regime are that lake level manipulation should be consistent with natural seasonal changes whilst recognising the social and economic needs, and that if demand exceeds supply, restrictions for both the environment and the Water Users should be introduced gradually, simultaneously and in a sustainable way. While it is preferable to manipulate the lakes synchronously there is scope to operate them independently if necessary to achieve specific objectives.

This Plan has been developed in association with the River Clyde Water Management Plan as the flows in the River Clyde, particularly during the summer months, are dependent on the releases from the lakes. A decision has been taken by the Consultative Group, together with the Department, that as the environmental values of the lakes are significantly higher than those of the river, water from the lakes will not generally be used to support environmental values in the river, as this could potentially jeopardise the lakes' values. There may however be instances when artificial releases from the lakes may be considered where a net environmental benefit to the system as a whole can be achieved.

### Objective (a): ensure that water quality, principally turbidity, is maintained at levels necessary to facilitate growth of aquatic plants and maintain a healthy ecosystem in the lakes

The scientific research has shown that the Preferred Minimum Levels are the levels below which water quality impacts begin to occur in the lakes. At these levels, the lakes become shallow enough for the wind action to cause turbulence of the lake bed sediments which significantly increases the turbidity in the water column and destabilises the lake bed (Uytendaal, 2003a). The environmental consequences of this are a decrease in water clarity leading to reduced access to light for plant growth, decreased quality of available habitat and degraded water quality, all of which can cause significant stress to the lakes ecosystem, particularly the fish and invertebrates. The research has shown that while the impacts of the increases in turbidity due to the turbulence events are significant, the system can recover if the lakes are not maintained below the Preferred Minimum Levels for extended periods (Uytendaal 2003a,b). Once the lake levels return up above the relevant levels, the turbidity decreases and the water quality greatly improves.

The Plan recognises that while water quality impacts do occur when the lakes drop below the Preferred Minimum Levels, there is still a need to provide water to support the irrigation industries downstream. The Plan invokes initial limited restrictions on the allocation at this stage to actively begin to reduce the risk of the lakes reaching the Critical Minimum Levels.

Considerably more serious impacts to water quality, and consequently the ecosystem values, occur in Lake Sorell when the lake falls below 803.2 m AHD, the Critical Minimum Level (Uytendaal 2003a). At this level, very fine grained sediment (colloidal material) is eroded from the lake bed and brought into suspension. This sediment is different to the sediment described above in that it is such a fine-grained material that it does not settle out despite subsequent increases in lake level. It is newly eroded material from the lake bed rather than sediment which has been recycled with consecutive wind events. The only potential for recovery from these impacts is for the sediment to be physically removed by flushing it out of the system or by diluting it to acceptable concentrations. With the flow control structures in place at the mouth of Interlaken Canal, and the limited storage capacity in the lakes, these are not viable options. Other engineering options such as flocculation have been considered but have been found to be impractical. The studies have shown that with the current rates of release, it may take as long as 20 years to flush this colloidal material from Lake Sorell, by which time the aquatic plant life and associated ecosystems will be restricted to the extreme edges of the lake. The lake bed could then take decades from that point to recover to the stage where it has a good cover of aquatic plant life, and a range of diverse habitats throughout.

Maintaining Lake Sorell above the Critical Minimum Level, is a very high environmental priority and therefore the Plan provides that no releases will generally be made for irrigation purposes below this level. The Plan accepts however that once in every 20 years or so, extreme social or economic circumstances

may arise that necessitate drawing water from below this level. The Plan includes enough flexibility for the Minister to consider, on a case by case basis and subject to a number of conditions, whether breaching this level is warranted in light of the environmental, social and economic consequences. The conditions are designed to ensure that the lake is not maintained at unsustainable levels for extended periods and that every chance for improvement in water quality is provided for in subsequent years if a breach occurs.

Excluding recent years which have been affected by unusually severe drought and carp management activities, Lake Sorell has only been drawn into this environmentally critical zone once since 1970, during the 1982–1983 drought (Appendix 2a). The sediment in Lake Crescent appears to be generally more coarse than in Sorell so there is no equivalent critical colloidal water quality management level recommended for that lake.

### Objective (b): maintain the health and population of the endemic native fish golden galaxiid (*Galaxias auratus*) which is a listed threatened species

The water quality provisions as described above are also the primary basic requirements for sustaining the golden galaxiid population in the lakes (Hardie 2003a). Good water quality leads to a healthy diverse range of habitats and sustainable food sources.

An additional highly significant factor in Lake Crescent however, is that the available spawning habitat for the galaxiid is limited when the lake is at low levels. The scientific studies in Lake Crescent have identified a Critical Minimum Level below which the last remaining suitable habitat for the fish to spawn, the rocky shore, becomes dewatered (Hardie 2003a). When the habitat is not available the fish will not spawn and with an average life cycle of just 3 to 4 years, successive or even single seasons without spawning could have severe ramifications for the health and survival of the species. Spawning time for the galaxiid is typically July and August so the timing of the dewatering is an important factor.

The Plan recognises the specific elements of the risks to the golden galaxiid by identifying the spawning period as the critical time during which this level must not be breached and by ensuring that the level does not return into the critical zone for a period of 4 years to coincide with the average life cycle of the fish. There is also provision for temporarily raising the Critical Minimum Level in the subsequent year to ensure that the lake is not maintained at unsustainable levels for an extended period, and that conditions are improved as quickly as possible. There appears to be adequate habitat available to the galaxiids in Lake Sorell at all lake levels so there is no equivalent galaxiid management level in that lake (Hardie 2003a).

An additional environmental guideline for the protection of the galaxiids which is applicable to both lakes provides that sudden large changes in water levels should be avoided so that fish do not become stranded in the wetlands and that their eggs are not dewatered at critical times (Hardie 2003a).

### Objective (c): provide a sustainable, secure and reliable supply of water for downstream purposes, including towns supplies, stock and domestic use and irrigation, and at all times maximise the availability of that water.

The Plan recognises the need for the lakes to continue to be managed as a source of supply for downstream users. The users' needs will be sustainably balanced with the environmental needs by applying restrictions to each in a gradual way in the event that water availability is low. This is achieved by using different lake management levels in the allocation protocol to determine the availability of different portions of the allocation.

The allocation is spilt into two equal portions with high and low surety, respectively. At the start of the Irrigation Season, a Water Availability Model is used to estimate what the levels of the lakes will be at the end of the Release Period, under different climatic scenarios. The quantity of water predicted to remain above the Preferred Minimum Levels is used to determine the amount of the low surety allocation that should be made available. The quantity of water predicted to remain above the Critical Minimum Levels is

used to determine the amount of the high surety allocation. The allocation of water in both cases is on a sliding scale depending on the amount of water available, rather than an 'all or nothing' outcome.

The Plan recognises and supports the current water licence and allocation of 10,000 ML, although the conditions on the licence will be varied to be consistent with this plan. The original conditions were that Lake Sorell must remain above its Critical Minimum Level at all times and that Lake Crescent must remain above its Preferred Minimum Level at all times. The effect of the variation will be to increase the security of the allocation by providing access to water below the Preferred Minimum Level in Lake Crescent, and by allowing releases of water from below the Critical Minimum Levels in both lakes under exceptional circumstances.

The Plan also recognises that there may be times when the economic and social benefits of taking more than the 10,000 ML allocation are high and that this water should be made available if it can be released without compromising the environmental values. The Plan therefore provides that an additional temporary allocation may be granted provided that the risk to the environmental values in subsequent years is assessed to be low. The risk is deemed to be low if it is predicted using the predictive model that the lake levels will still remain above the Preferred Minimum Levels in each lake at the end of the Release Period after the temporary allocation has been released.

The Water Availability Model will be used to determine the Season's Available Water at the beginning of the season in an open and transparent way. Typically, a large proportion of the inflows to the lakes occur in early to mid-spring so the Season's Available Water will not be finalised until a week before the likely start of the Release Period or as soon as practicable after the lake levels begin to drop. The Plan requires that the Water Manager will inform the Irrigation Entity of the likely Season's Available Water on a monthly basis from 1 September onwards in order that irrigators may plan their water use for the season. Once the Season's Available Water has been formally granted, the Plan provides that it must then be honoured if required by the Irrigation Entity even if the Critical Minimum Levels are eventually breached. This will ensure reliability and security for the irrigation supplies for the season.

Taking a more pro-active management approach to allocating the water with predictive modelling and gradual restrictions provides a more reliable allocation overall that is secure once the Season's Available Water has been granted. It also reduces the risks to the environment. In order to maintain transparency and confidence in the allocation protocol, the Plan provides that the Water Manager must consult with the Irrigation Entity in determining the appropriate Season's Available Water. The Season's Available Water is to be based on the needs of the Entity and the need to observe the environmental levels. The Entity is then responsible for determining an appropriate release regime for the given allocation and for managing the needs of all downstream Water Users within the constraints of that allocation.

The plan provides an opportunity for the irrigators to secure some additional water from the lakes from below the Critical Minimum Levels at the end of an irrigation season to provide emergency drought relief water to finish off crops or keep stock alive during an exceptional extended drought period that has not been adequately forecast. The opportunities are however limited by a number of conditions that represent a compromise position between minimising the risks to the environmental values while still providing some water for emergency purposes. The final decision is left to the Minister's discretion because the environmental consequences of drawing the lakes into those critical zones, and the potential economic consequences of not making some additional water available under exceptional circumstances, are both so serious. These provisions are not intended to be used to provide the irrigators with additional water that can be factored into the Season's Available Water or relied upon from year to year, but recognise the importance to the irrigators of having emergency water available. This represents a balanced compromise position. Where absolutely necessary, water must always be made available for stock, domestic and town supplies as they have a higher priority than the environmental needs.

### Objective (d): maintain a water level inundation regime necessary to sustain the wetland ecosystems of the lakes in a healthy condition, in particular the State, National and Internationally recognised (Ramsar) wetlands, some of which contain threatened species

The environmental studies have identified that the specific Water Regime needed to sustain the wetlands is somewhat more flexible than that for the water quality or the galaxiids and this is reflected in the Plan through the inclusion of the wetlands provisions as operating guidelines rather than operating rules.

The wetlands need to be inundated with at least 300 mm of water in spring to enable good plant growth, but they then need to dry out as summer progresses to enable the plants to flower, set seed and complete their reproductive cycle (Heffer, 2003a). The recommendation from the study was that while the seeds could remain viable for a limited number of years, the wetlands should not be maintained completely wet or completely dry for a period longer than five years respectively. While all of the wetlands have their own small catchment areas which can occasionally provide sufficient water if rainfall conditions are adequate, the wetlands need to be fully inundated by the lakes water at least once every five years.

Modelling has shown that these requirements will largely be met by those parts of the Water Regime already described with the additional operational guidelines for support.

### Objective (e): minimise the risk, in mid to late summer, of inundation of those parts of Interlaken Estate that are adjacent to the lake and normally used for grazing purposes

The particular property to which this objective relates, Interlaken Estate, includes three separate privately owned wetlands adjacent to Lake Sorell, two of which have inundation regimes which are highly dependent on the lake levels. Mid to late summer is the critical time for gaining access to the property for grazing.

The needs of this grazing enterprise are very similar to the needs of the other wetlands around the lakes. There needs to be good plant growth in spring, followed by a drying out period towards the end of the summer to ensure that the plants have set seed for the following year and that access for stock grazing is possible.

These needs will largely be met by the Water Regime already described. The Plan also provides that if absolutely necessary water may be released from Lake Sorell into Lake Crescent to reduce the water level of Sorell below the level of the wetlands (803.9 m) to allow drainage to occur. Water may not however be completely lost from the system by being released from Lake Crescent.

### Objective (f): enhance the aesthetic and recreational values of the lakes

The water related aesthetic and recreational values of the lakes include angling, duck shooting, camping, boating, bird watching and spending time enjoying the natural physical and biological beauty of the area. There are a number of shacks in the area, principally around Lake Crescent, which are used on a permanent and temporary basis. While these sorts of values are difficult to quantify and compare against the economic and environmental values, they are nonetheless important as they contribute to the tourism economy and to the quality of life for all Tasmanians.

All of these values are dependent upon there being good water quality, a healthy lakes ecosystem, thriving wetlands to provide diversity of habitat for a range of wildlife and improve the angler experience, and adequate water levels to enable boating access to the lakes via the dedicated boat ramps. This objective will be adequately met if the provisions for the other objectives are observed and no specific additional provisions are required.

### Objective (g): maintain and enhance the trout and commercial eel fisheries

The primary needs of the trout and eel fisheries are a healthy lakes ecosystem, healthy wetlands that are regularly inundated, and good water quality. The eel fishery benefits with rising water levels in October/November and water in the wetlands to provide habitat. This objective will be adequately met if the provisions for the other objectives are observed. There are no specific additional provisions required.

### Objective (h) minimise the risk of uncontrolled spill occurring from the lakes which could lead to the spread of the pest fish European Carp (Cyprinus carpio) downstream

There is one specific carp management strategy included in the Plan which is to minimise the risk of uncontrolled spill occurring that could lead to the downstream spread of this pest fish. Previous carp management strategies, which included releasing water from the lakes to keep water out of the wetlands, are no longer a high priority because of the adoption of improved technology and different management techniques by the carp management team. The capacity of the outlet structures on both lakes has also recently been significantly increased which means larger volumes of water can be released at short notice if necessary (approximately 10–12 cumecs from Lake Sorell and 8 cumecs from Lake Crescent). The increased release capacity allows the Water Manager to delay the decision to implement controlled release strategies until the lakes reach levels within 100 mm of full supply. The 100 mm level is a trigger level at which the Water Manager must assess the likelihood of spill occurring and take appropriate management actions as necessary. Appropriate management actions might range from a timely controlled release to a temporary increase in the Full Supply Level using engineering means, and will vary depending on the timing of the trigger, the rate of rise of the lakes and the seasonal forecast.

As each potential spill scenario will be different, the Plan provides that appropriate actions will be assessed on a case by case basis. Consultation with the Irrigation Entity, Interlaken Estate and affected downstream users who wish to be kept informed will be required. The Plan also requires that the Water Manager will maintain the control structures in good working order such that they can be used to their maximum capacity when required.

### Objective (i) increase community involvement in, and understanding of, the management of the lakes resources.

Lakes Sorell and Crescent are in demand from a number of different Water Users, many of whom have conflicting values for the system and differing views on how it should be managed. The development stages of this Plan have involved extensive consultation with the community, culminating in lengthy and intensive negotiations within the Consultative Group to develop the final content of the Plan (Deakin, 2005). These negotiations have required that the Consultative Group fully understand the technical detail of the scientific studies, the hydrological modelling, and the values and needs of the other stakeholder groups. The Consultative Group members were responsible for taking this information back to the groups they represent.

The Plan provides for ongoing involvement of the local community in the decision making processes, particularly in relation to the water availability and the restriction management protocol, the movement of water between the lakes and the appropriate management actions if the risk of spill from Lake Crescent is high. Other relevant provisions include retaining the Consultative Group in an advisory capacity to the Water Manager, requiring formal input by the Irrigation Entity to determining the Season's Available Water, and implementing a protocol for informing the downstream community in the event of spill.

The Plan itself and its future review processes will play a major role in the dissemination of the relevant technical scientific information to the community as the basis for water management actions and decisions. Further information will continue to be available on the Department's website.

## 3.3. Assessment of the ability of the Water Regime to achieve the environmental objectives and other relevant objectives of the Plan – Section 14(2)(c)

The net climatic yield to Lakes Sorell and Crescent is highly variable (Appendix 2a). Over the long term, the natural rainfall, runoff and groundwater inputs to Lakes Sorell and Crescent balance the natural evaporative losses from the lakes. In recent years however, there have been a number of consecutive seasons when evaporation and releases for downstream purposes exceeded the inputs resulting in an overall net loss to the system. While the releases for downstream purposes are relatively small in comparison to the evaporation, in dry years they can have a significant effect on the lakes water balance, particularly as the dry years are also typically the times when the demand for water is highest.

This sensitivity in the lakes' water balance means that there will inevitably be years, both wet and dry, when the demands on the system will not be able to be met in full, irrespective of the Plan's requirements. The Plan provides that during these times the needs of the environment and the Water Users are balanced and restricted together such that the pressures on the ecology of the system are not unduly artificially increased, and the economies of the water dependent businesses can be sustained.

Long term and short term hydrological modelling carried out as part of the development of this Plan has shown that the Water Regime will meet the primary environmental objectives of the Plan with a relatively high degree of reliability. The results of the different modelling exercises together with an explanation of the basis behind them and their limitations is presented in Appendices 2b and 2c.

The long term modelling shows that the Water Regime has a very high (>95%) probability of preventing the Critical Minimum Levels from being breached in each lake. This will have a significantly positive effect on the colloidal water quality in Lake Sorell and consequently the lake's ecosystem, and will ensure the continuity of the galaxiid population in Lake Crescent. The short term modelling shows that a reliability of almost 100% can be achieved for these Critical Minimum Levels.

The long term modelling also shows there is a high probability (>88%) that both lakes will be maintained higher than their Preferred Minimum Levels at all times (94% of the time from the short term modelling).

Modelling the wetlands' water requirements is more difficult because with their inherent level of flexibility their needs are less definitive than the water quality and the galaxiid requirements. Nonetheless, the modelling shows that there is a high probability that the lakes will be operated within their Preferred Operating Ranges which increases the probability that appropriate wetting and drying cycles will be maintained in the wetlands and that access to private grazing property will be ensured.

The long term modelling shows that the reliability of the supply for allocation purposes is very high at almost 100%, and that if and when it does fail, the amount by which it fails is very small in comparison to the total allocation. The shorter term modelling, which is more useful for describing the dry season scenarios of recent years, shows that the actual releases over the 34 years from 1970 to 2003 would have been met in full in 30 of those years had the new operating regime been in place over that period. There would have been just two years when the allocation was restricted to the high surety portion only and four years when there would have been more water available than was actually released.

The frequency of uncontrolled spill events is not certain over the longer term because the full capacity of the outlet gates has not been tested and it is difficult to incorporate the consequences of the management actions that would be adopted if the risk of spill was high. During the current climate, it is considered that adopting appropriate management actions at the 100 mm trigger level will maintain a low risk of uncontrolled spill occurring. This aspect of the Plan has been highlighted for consideration at the first review when further information in relation to how the lakes behave at high levels is available.

It is considered that the Water Regime in this Plan will meet all of the objectives of the Plan with a high level of reliability.

## 3.4. Assessment of the likely detrimental effects of the Plan on the quality of water – Section 14(2)(d)

The water quality in both lakes has been particularly poor since 1999. Turbidity levels for example, have reached levels up to 10 times higher than the long term average which has been attributed to the substantially lower water levels than at any other time over the previous 30 years (Uytendaal, 2003a). The lakes have also had less winter yields in general over recent years which has resulted in limited opportunity for recovery.

The scientific research carried out for this Plan has identified that water quality is perhaps the key variable that influences the overall health of the lakes' ecosystems (Uytendaal, 2003b). As water quality is highly sensitive to the lake level operating regime, maintaining a regime that supports good water quality is a primary objective of the Plan.

This Plan will significantly improve and protect the water quality values by managing the lake levels within the Preferred Operating Range, through a forward planning water allocation process based on a considered assessment of the water availability in the context of those water quality values.

The Plan recognises the different water quality consequences of the lakes falling below the Preferred Minimum Levels and the Critical Minimum Levels, and has used these to stagger the high surety and low surety allocation restrictions such that the environment and the Water Users share the available resources. The Plan provides for a minimum level in Lake Sorell of 803.2 m AHD to prevent the serious environmental impacts of the suspended colloidal material occurring. While towns, stock and domestic supplies must still be released below that level in an emergency, there are a number of provisions in the Plan that will prevent this from being a regular occurrence.

The Protected Environmental Values that have been determined by the community as minimum water quality standards for the lakes catchment are as follows:

A. Protection of aquatic ecosystems
   (i) Pristine or nearly pristine ecosystems; and
   (ii) Modified (not pristine)
      (a) from which edible fish are harvested

B. Recreational water quality and aesthetics
   (ii) Secondary contact water quality; and
   (iii) Aesthetic water quality

C. Agricultural water uses
   (i) Irrigation; and
   (ii) Stock watering

D. Industrial water supply (i.e. hydro electricity)

While Water Quality Objectives have not yet been developed for this catchment to ensure that these values are protected, the objectives of this Plan are consistent with these values and would be expected to achieve the appropriate water quality objectives that are assigned in the future. Further information on the Protected Environmental Values and the water quality objectives is available on the Department's website and in the *State Policy on Water Quality Management 1997*.

## 3.5. Assessment of the capacity of the relevant resource to meet the likely demands for water by existing and future users – Section 15(a)

This Plan recognises that the Irrigation Entity has traditionally had access to all the available water from Lakes Sorell and Crescent. The system is fully allocated in that the current (as well as future) demands from the lakes essentially comprise all the water that can be made available on a sustainable basis.

The current licensed allocation from lakes Sorell and Crescent is 10,000 ML which has been shown to have a relatively high reliability over both the long and short term. The historical demands from the system before the allocation was licensed, ranged from less than 5,000 ML to almost 18,000 ML. This Plan recognises these higher historical demands by making temporary allocations available in addition to the licensed allocation, once the associated environmental risks have been assessed to be low.

The capacity of the system to provide these temporary allocations on a regular basis however, is low. Modelling has shown that regularly releasing significantly more than the licensed allocation of 10,000 ML reduces the reliability of the allocation over the long term and appreciably increases the risk to the environmental values. In the three years leading up to the 1982-1983 drought for instance (Appendix 2c), the allocations of 16,350 ML, 9,300 ML and 17,560 ML, together with the release of 13,000 ML during the drought year itself, caused Lake Sorell to drop significantly below its Critical Minimum Level. If an average release of approximately 11,500 ML had been maintained throughout this period, Lake Sorell could have been maintained above its Critical Minimum Level.

These sorts of relatively large releases which were traditionally relied upon in successive drought years are not sustainable in the current climate because the likelihood of the inflows to the lakes in subsequent years being insufficient to recover the water balance is too high. The available information suggests that the long term sustainable yield from the lakes is approximately 10,000 ML. Temporary allocations should be restricted to no more than a further 2,000 ML, in no more than three consecutive years. The sustainable yield may be adjusted in future years if the climate conditions improve.

## 3.6. Likely effects of the Plan on existing and future users, including any effect on businesses carried on by those users – Section 15(b)

In the context of the objectives of the Plan, the Water Users include non-consumptive users with non-commercial needs (e.g. anglers and people following recreational pursuits), non-consumptive users with commercial needs (e.g. eel fishers and Interlaken Estate) and consumptive users with commercial needs (e.g. the Irrigation Entity and irrigators).

### Non-commercial non-consumptive users

The Plan will benefit the non-consumptive, non-commercial users by improving the ecosystem health of the lakes, in particular water quality, which will improve the trout fishery and the aesthetic appearance of the lakes. Access to the boat ramps will be improved with generally higher water levels and the wetlands will be more regularly inundated which will encourage bird life to return and diversify the angler and recreational experience.

While the businesses of these Water Users will not be directly affected, an improved trout fishery will bring substantial economic benefits to the State. Freshwater angling generates expenditure on both direct fishing costs and other related infrastructure such as holiday shacks and camping facilities. In addition, movement of angler visitors (both tourists and Tasmanians) through the region provides significant income for the township of Bothwell. In 1991/92 the Inland Fisheries Commission undertook a study on the value of freshwater angling in Tasmania. The overall expenditure by anglers in Tasmania was $28 million, of which a significant proportion could be attributed to the Sorell/Crescent fishery as it was the second most

popular fishing destination in the State. It is estimated by the IFS that the current annual value of recreational freshwater angling is in the region of $40 million.

### Commercial non-consumptive users

The eel fishers will benefit from the Plan with the improved ecosystem health and the increased likelihood that the wetlands will be regularly inundated. Interlaken Estate will also benefit from the improved wetlands inundation regime which will provide better growth and reproduction of the aquatic plants and secure access to these areas during the grazing season. The requirement of the Plan to release water in the event that full supply is reached, and to consider appropriate management actions if the lakes come within 100 mm of full supply, will minimise the risks of the property being flooded at critical times, and for extended periods, as it has been in the past.

### Commercial consumptive users

The impacts of the Plan on the current water entitlements holders, i.e. the Irrigation Entity, are predominantly positive. The current water licence is subject to the condition that the lakes must remain above 803.2 m AHD in Sorell and 802.7 m AHD in Crescent **at all times**. The Plan will increase the Entity's access to water by relaxing the 802.7 m restriction level in Lake Crescent and by permitting the lakes to be drawn down below their Critical Minimum Levels if necessary for stock, domestic and town supplies. While it is difficult to quantify the potential increases to the allocation, this measure may provide access to an additional 5800 ML every 20 years, based on the events during the 1982–83 drought. The water licence will be amended to reflect this change when the Plan is adopted. The Plan also provides for additional temporary allocations to be made on a sustainable basis to increase the availability of water when it is needed.

Nothwithstanding the positive impact on the current level of entitlements, it is recognised that the environmental provisions in the Plan may at times provide less water than has traditionally been used by effectively raising the minimum levels of the lakes, thereby reducing the potential available water. The modelling has shown that the extent of this impact during the period 1970 to 2003, had the Water Regime been in place, would have been a net change to the total water used over the whole period of approximately –2800 ML. The maximum loss in any one year would have been –8790 ML and the maximum gain 5330 ML (Appendix 2b). These figures are only estimates as in reality the lakes would probably have been operated differently given the current level of knowledge of the system. Irrigation practices have also changed in the last 5 years with improved infrastructure and technology and the move towards higher value cropping which uses less water than pasture.

Perhaps a more realistic estimate of the maximum loss under the historical management regime is 3000 ML in a year of severe drought, plus a further 1500 ML in the following year, to give a total of 4,500 ML, once every 20 years. This is based on spreading the 10,000 ML allocation out evenly over a 6 month irrigation period, including two months of loss in the first year of a drought (since this was the period of restriction during the 1982-83 drought), plus half that loss again in the following year. The 20-year return period is based on the historical frequency of extreme low levels.

A comprehensive survey of the agricultural enterprises based around irrigation in the Clyde Valley was conducted by the Department's economists. Using a standardised approach based on a methodology used in other states (ACIL Consulting, 2002), the economic consequences of potential changes to the allocation in the River Clyde catchment were estimated (Bowman, 2004). The approach considered the economic returns of water per hectare for each of the different enterprises in the Clyde Valley, including maintaining stock. The methodology divides up any losses or gains to the available water as a consequence of the Plan on the basis that half the loss (or gain) is borne by the enterprises with the lowest return per hectare, and half the loss (or gain) is borne by all existing enterprises proportional to current average use. The assessment was conducted for an average year and for 2002-2003 as an example of a dry year. The results indicated that a 1000 ML reduction or gain in water availability would have corresponded to a direct

potential economic loss or gain of the order of $300,000 in 2002-2003 and $560,000 in an average year. Doubling these dollar figures gives an estimate of the potential loss or gain to the region (Bowman, 2004).

As the allocation will not be permanently reduced by the Plan and the amount of water that has been traditionally taken from the lakes has been so variable depending on water availability and cropping requirements, it is difficult to be definitive about what the economic impacts of the Plan will be. It does seem likely however that the positive impacts of the Plan relative to the current water entitlements will outweigh the negative impacts of the Plan relative to the historical water usage, and that on a long-term average basis the irrigators will be better off with the plan in place. On a shorter term basis however, a negative impact may be felt at the end of a period of successive drought years when there are natural shortages of water and the demand is high. The Plan seeks to reduce the likelihood of these situations arising however, by more pro-actively managing the water resources in good times as well as in bad so that water is preserved in the lakes in preparation for the extended drought periods. The modelling has shown that this approach can significantly minimise the impacts to irrigators.

In the event of an unforseen circumstance, the plan provides that the irrigators can secure some additional water from the lakes from below the Critical Minimum Levels for emergency drought relief purposes to finish off crops or keep stock alive, under a limited number of conditions and at the Minister's discretion. Analysis has shown that a maximum of 2800 ML from Sorell and 500 ML from Crescent extra could be provided from the lakes under those conditions if necessary, depending on the time of year and the lake levels at the time. Water would not however, become available until late in the season (April) after the period when the typical irrigation allocation would normally be used. This is considered appropriate given the intended purpose of the extra water which is for emergency use only.

The Plan also provides security of supply to consumptive Water Users by ensuring that the Water Manager must consult with the Irrigation Entity in determining the Season's Available Water, and that the Entity has the power to decide the timing and rates of releases throughout the season. After an allocation decision has been made at the beginning of the season, it must be honoured for that season if requested by the Entity, irrespective of unexpected environmental outcomes. The predictive planned approach to allocating water will provide better opportunities for properly managing the available resource and sharing it in a sustainable way with the needs of the environment. The Plan also provides that the lakes may be operated independently if necessary to achieve specific objectives and that water development options can be considered if the opportunity arises.

This Plan should be read in association with the River Clyde Plan which provides additional access to water for consumptive Water Users from the River Clyde. The Department has also recently issued the Irrigation Entity with a supplementary licence and allocation from Lake Meadowbank which will help the Entity manage the current and future demands. In addition, the State and Federal governments have recently funded new control structures at the outlets of each of the lakes through the carp management and lakes rehabilitation project programs. This has greatly increased the capacity to release large volumes of water quickly and means that controlled release strategies to minimise the risk of spill can be delayed much longer now than they could in the past, resulting in increased security of supply.

### All users

The Plan benefits all Water Users by providing transparency, accountability and community involvement in the water management process in the following ways:

- The Consultative Group will remain in place and will provide advice to the Water Manager on the implementation of the Plan and in relation to the annual report.
- The Water Availability Model will be made available to interested Water Users, the Department and the Water Manager.
- In the event of a perceived risk of spill, the Water Manager will consult with the Irrigation Entity, the Water Manager of the River Clyde Water Management Plan, as well as Interlaken Estate, before taking any management actions.

- If a controlled release is necessary, the Plan provides that downstream property owners will be informed and that the released water will be made available to downstream users to be taken into storage if storage capacity is available.

## 3.7. Impacts of the Plan on a linked water resource – Section 17

The water resources of Lakes Sorell and Crescent contribute to the water resources of the River Clyde and under Section 17 of the Act, the requirements of the river as the downstream resource must also be considered in the lakes plan. The River is the subject of a separate water management plan developed in conjunction with this Plan and this issue is further addressed in that plan.

The principal effect of the lakes plan on the River Clyde is to continue the historical pattern of an inversed flow regime of high flows in summer and low flows in winter with occasional spill events. By the time the river reaches Bothwell, the flow regime has reverted to a normal seasonal pattern and the effects of the lakes on the river flow are significantly reduced. This is because the river catchment is a number of times bigger than the lakes catchment and there are several relatively large unregulated tributaries along its course between the lakes and Bothwell which greatly influence the flow.

The upper reaches of the river are most impacted by the lakes plan. The control gate structure downstream of Lake Crescent has been in place for approximately 170 years and the ecology of the upper part of the river system has, to a certain extent adapted to the inverse flow regime. Recent changes have occurred however, in that the newly installed control gates for the carp management program can now be completely closed in comparison to the old wooden structure which leaked a very small but continuous flow. Hazelwood Lagoon and its catchment, which has been in various states of connection with the river in the past, has now also been rehabilitated and retains its own catchment water which at times in the past would have contributed to the River Clyde. Although these are not changes that have been effected by the Plan, they may result in less water in the upper reaches of the river during extreme low flows than there was previously. A special study would be required to determine the effects of these changes on the ecology of the upper reaches of the river.

Apart from the effects of the inverse flow regime, the water quality in the lakes also impacts on the water quality in the river, particularly during the drought years when the flow in the river is almost entirely derived from the lakes. This Plan will improve the lakes water quality through the proposed Water Regime and is expected to have a positive effect on the water quality in the river.

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# APPENDIX 1
# OBJECTIVES OF THE WATER MANAGEMENT ACT 1999

The purpose of the Plan is to provide a framework for managing the water resources of the Lakes Sorell and Crescent catchment in accordance with the objectives of the Act.

The objectives of the Act are to provide for the use and management of the freshwater resources of Tasmania having regard to the need to:

(a) promote sustainable use and facilitate economic development of water resources; and

(b) recognise and foster the significant social and economic benefits resulting from the sustainable use and development of water resources for the generation of hydro-electricity and for the supply of water for human consumption and commercial activities dependent on water; and

(c) maintain ecological processes and genetic diversity for aquatic ecosystems; and

(d) provide for the fair, orderly and efficient allocation of water resources to meet the community's needs; and

(e) increase the community's understanding of aquatic ecosystems and the need to use and manage water in a sustainable and cost-efficient manner; and

(f) encourage community involvement in water resource management.

It is the obligation of the Minister, the Secretary, a Water Entity and any other person on whom a function is imposed or a power is conferred under the Act to perform the function or exercise the power in such a manner as to further the objectives of the Act and of the Resource Management and Planning System of Tasmania.

# APPENDIX 2
# TECHNICAL INFORMATION

## Appendix 2a: Assessment of the lakes water balance

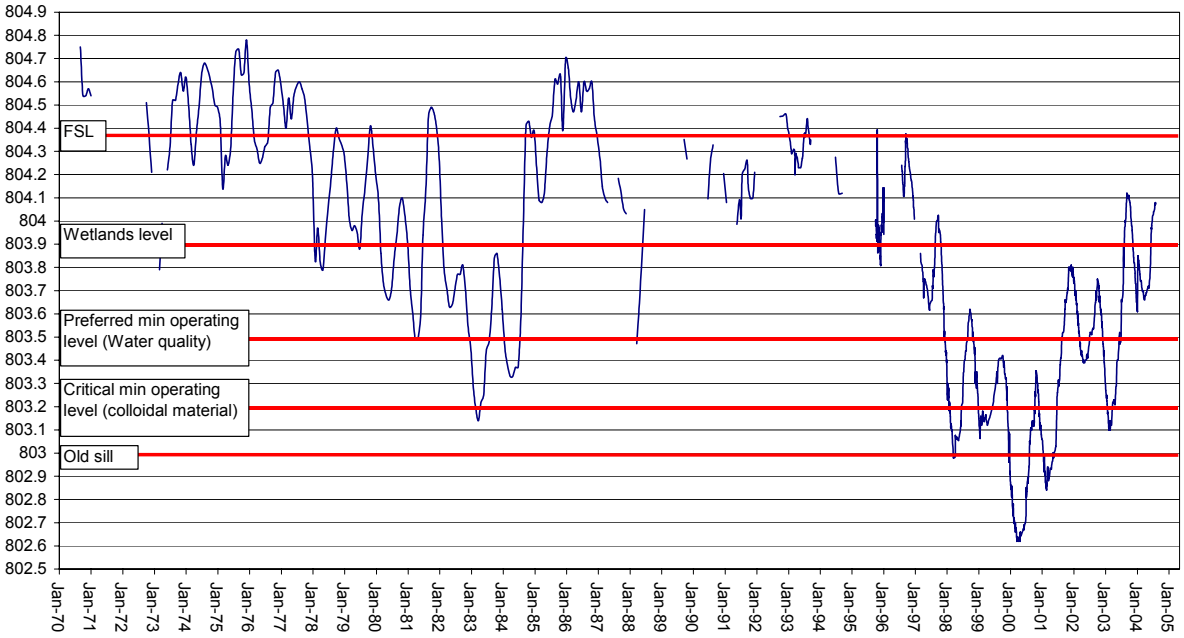


Figure 2: The water level history of Lake Sorell from September 1970 to September 2004. Levels measured in metres AHD.

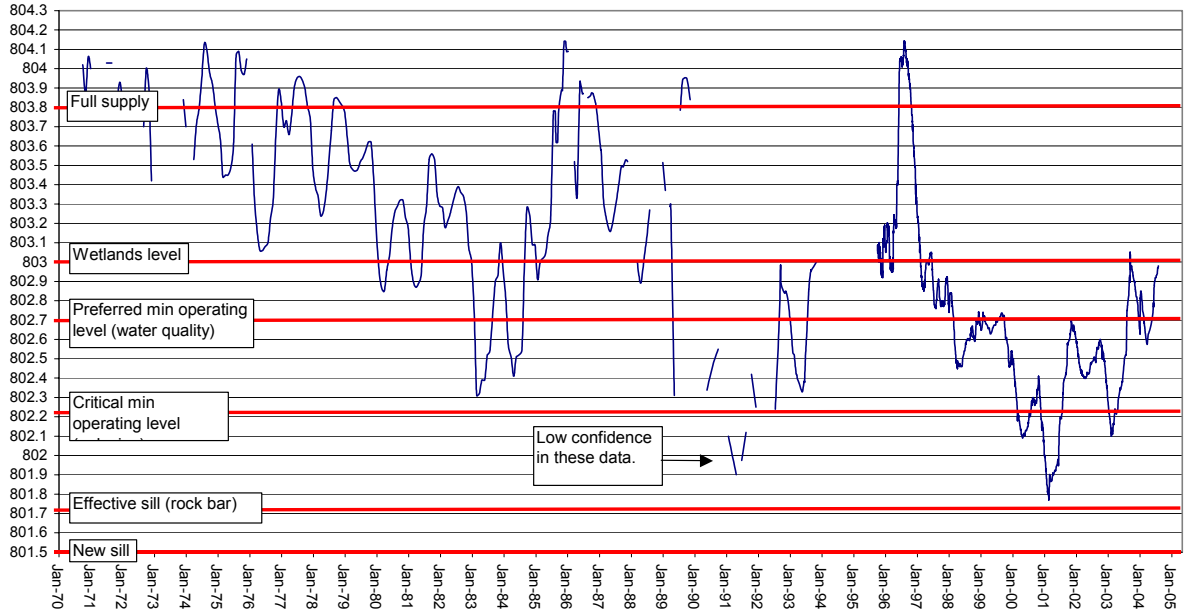


Figure 3: The water level history of Lake Crescent from September 1970 to September 2004. Levels measured in metres AHD

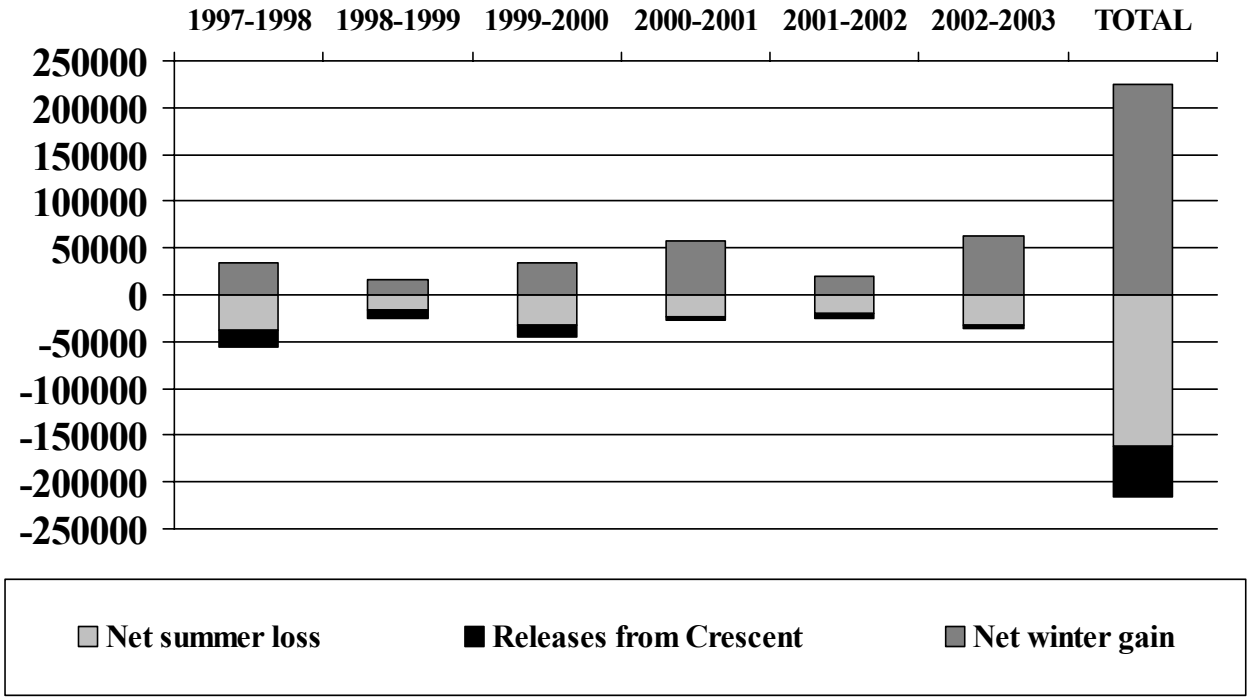


Figure 4: Net annual losses and gains in megalitres from the lakes system between 1997/98 and 2002/03

This graph shows the net climatic losses and gains from the lakes, together with the releases from the lakes, for the six years from 1997/98 to 2002/03. In two of the six years (1997/98 and 1998/99), the net climatic loss to the system during the summer was greater than the climatic gains in the following winter. In a further two years (1999/00 and 2001/02), the net climatic losses in summer were marginally smaller than the winter gains but when the artificial releases from the system were added, the net losses to the system were greater than the net gains over the 12-month periods. The winters of 2001 and 2003 were relatively wet which resulted in net gains to the system in those years.

Over the whole 6-year period therefore, the net yield change at the lakes has been a small gain of 9200 ML. It is worth noting that the allocation was severely restricted in 3 of those years. It is also worth noting that in the 5 years up to 2001/02, the lakes were operating at a deficit with an overall net loss to the system of 16,800 ML.

This shows that the lakes' net climatic inflows and outflows are for the most part in balance over the long term. While the releases for allocation purposes are relatively small in terms of the evaporation for instance, they can severely impact on the overall water balance in dry years.

# Appendix 2b: Long term modelling exercise to determine the effects of the Water Regime on water availability

A long term modelling exercise was carried out to determine the effects of the Water Regime on the environmental needs and on water availability. The model is a water balance model based on 34 years of hydrological data from Lakes Sorell and Crescent, Lagoon of Islands and Arthurs Lake between 1961 and 1994. These data were then used to generate 100 different 34-year yield sequences to give a total of 3400 years of generated data. The outputs of the modelling are probabilities of the lake levels remaining above the various water management levels (Figures 5 and 6) and the probabilities of different components of the allocation being available (Figure 7).

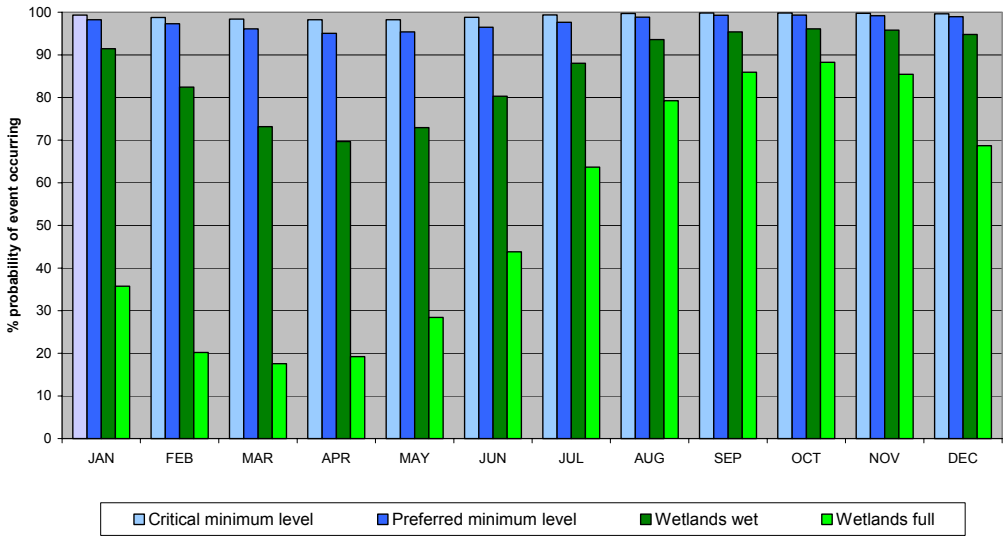


Figure 5: Probability of Lake Sorell remaining above each of its relevant management levels

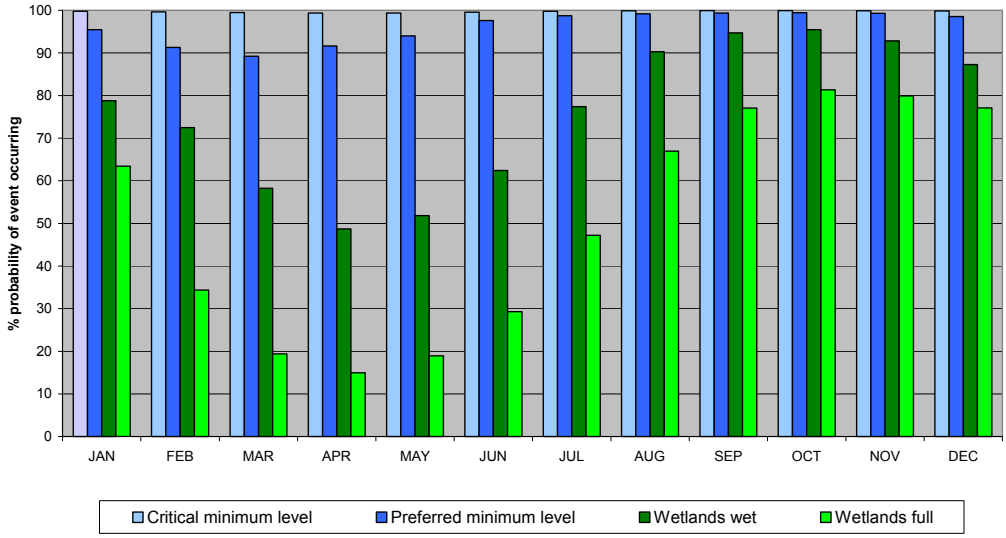


Figure 6: Probability of Lake Crescent remaining above each of its relevant management levels

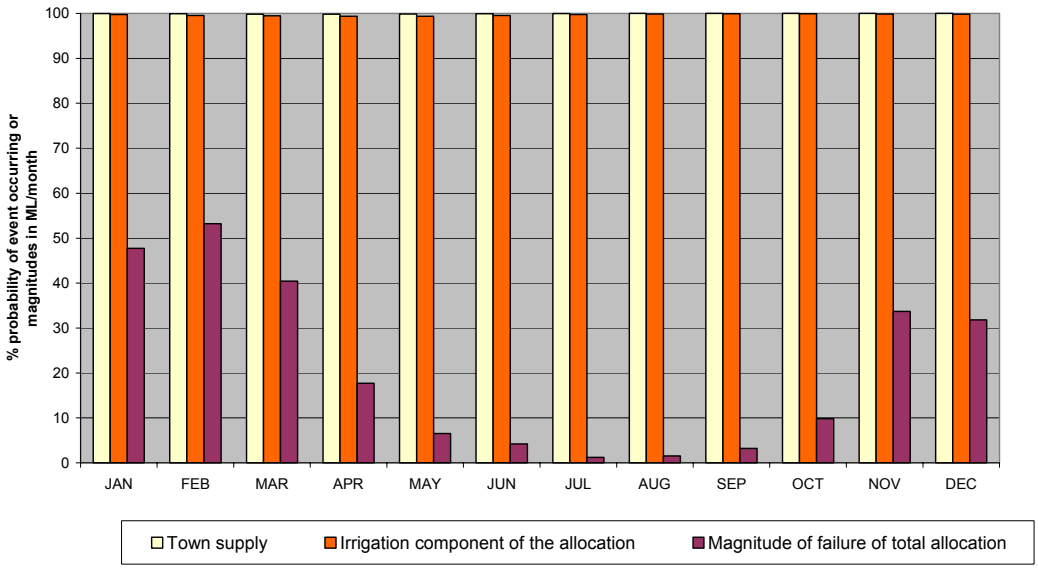


Figure 7: Probability of the town supply and the irrigation allocation being available in full from the lakes, together with the magnitude of the failure of the allocation in ML (on the same axis) if a failure were to occur. For the purposes of the exercise, the total allocation is divided into 2,500 ML for towns supply and 7,500 ML for the irrigation component. In reality the towns component will be variable and is unlikely to be as much as this in most years.

The results indicate that the probability of the lakes remaining above their Critical Minimum Levels is >95% in both lakes. The lakes are estimated to remain above their Preferred Minimum Levels 96% of the time in Lake Sorell and 88% of the time in Lake Crescent. The cycle of inundation in the wetlands mirrors natural climatic processes with the probability of them being full in late summer and full during winter, being low and high, respectively.

This model provides an indication of the ability of the Water Regime to meet the plans objectives over the long term but it is not clear how representative the period used to generate the 'long term' is of the current climate. There are some indications from the rainfall record that the climate experienced at the lakes over the last eight years has been considerably drier than average. Several of the driest periods on record have occurred in the last 5 years.

If the long term model is not representative of current climatic conditions, it will be biased towards showing higher inflows to the lakes occurring than there actually are at present. If this is the case, the probabilities as shown in the above graphs will be slightly higher than the actual probabilities of the events occurring.

A more conservative estimate, with considerably better confidence levels for a dry season scenario, is achieved using the short term modelling which is based on recent actual climatic conditions rather than relying on the generated data (Appendix 2c). It uses the actual recent historical yield changes rather than yield changes determined from the generated data based on a more distant time period. While the long term model is statistically likely to incorporate extreme drought events such as have occurred in the recent decade, it is less likely to have such a high number of severe events occurring consecutively as have they done in reality.

# Appendix 2c: Short term modelling exercise to determine the effects of the Water Regime on water availability

In order to determine the likely effects of the Water Regime on the allocation, a short term modelling exercise was carried out on the historical lakes operating regime over the 34 years between 1970 and 2003, without any statistically generated data added in. The lakes were subjected to the new Water Regime each year instead of the historical operating regime, the lake levels were adjusted accordingly and the impacts of the different regimes on the environmental management levels and the allocation were compared.

| Season commencing | Actual allocation | Allocation under new rules without the carp release | Difference |
|---|---|---|---|
| **1970 to 1978** | not known | same as actual | 0 |
| **1979** | 16350 | 16350 | 0 |
| **1980** | 9300 | 9300 | 0 |
| **1981** | 17560 | 17560 | 0 |
| **1982** | 12956 | 7395 | -5561 |
| **1983** | 9596 | 6811 | -2785 |
| **1984** | 6760 | 6760 | 0 |
| **1985** | | | |
| **1986** | 10970 | 10970 | 0 |
| **1987** | 13250 | 13250 | 0 |
| **1988** | 6390 | 6390 | 0 |
| **1989** | 7660 | 7660 | 0 |
| **1990** | 10440 | 10440 | 0 |
| **1991** | 5530 | 5530 | 0 |
| **1992** | 7980 | 7980 | 0 |
| **1993** | 7430 | 7430 | 0 |
| **1994** | | | |
| **1995** | | | |
| **1996** | | | |
| **1997** | 16660 | 16660 | 0 |
| **1998** | 8220 | 8220 | 0 |
| **1999** | 13787 | 5000 | -8787 |
| **2000** | 4367 | 5000 | 633 |
| **2001** | 4784 | 10000 | 5216 |
| **2002** | 4670 | 10000 | 5330 |
| **2003** | 6839 | 10000 | 3161 |
| **TOTAL** | 201499 | 198706 | -2793 |
| **AVERAGE** | 9595 | 9462 | -133 |
| **MEDIAN** | 8220 | 8220 | 0 |
| | | | |
| Years in which the Water Regime would have restricted actual use | | | |
| Years in which the Water Regime would have delivered more than the actual restricted use | | | |

Figure 8: Changes in allocation as a results of the short term modelling exercise

Several assumptions were made for the purposes of the modelling exercise:

- Temporary allocations were granted in addition to the licensed allocation, if the water was available, so that the proposed Season's Available Water equalled the historical water usage even if it was more than the current licensed 10,000 ML allocation.
- During the pre-carp years when there were no restrictions on the historical water use, the proposed Season's Available Water was made equal to the historical water use if it was less than 10,000 ML, as it was assumed that the lesser amount was all that was required that year.
- Water use was heavily restricted in the drought years of 2001–2003. It was assumed that the full 10,000 ML would have been used during that period if it had been available.
- Any water savings made by implementing water restrictions were stored in the respective lakes for later use.

- The 22,000 ML that was released for carp management purposes in 1996/97 was put back into the respective lakes. This was a once-off occurrence that will not affect the management of the system in future.
- Although there are no data to determine the historical water use for the years 1970 to 1978, it can be assumed from the water level graphs of each lake which remained above the critical levels that the lakes were sustainably managed over that time. The proposed Season's Available Water was therefore considered to have been the same as the actual water use.

The effects of managing the lakes between 1979 and 2003 in accordance with this Plan (had the Plan been in place) are shown in the table and are described as follows:

- The new Water Regime would have delivered 2800 ML less over 34 years than the historical management regime, or an average of 133 ML less per year. The median water availability would have been the same.
- There would have been no restrictions at all on the historical water use in 30 of the 34 seasons, which is 88% of the time. Of the 4 restricted years, one would have had more water available than was actually available that year despite being in restriction (2000). There would also have been 3 further years when more water would have been available than was actually released (2001–2003).
- Lake Sorell would have remained above the Critical Minimum Level, in comparison to the six times the level has actually been breached. Lake Crescent would have dropped below its Critical Minimum Level once, instead of three times, but the period below the Critical Minimum Level would have been brief enough that the level would have recovered again before the spawning season began.

This exercise shows that the lakes can be sustainably managed within the new Water Regime but that in 12 years out of 100, some changes to the way in which water has historically been used from the lakes will be necessary. The traditional practice of releasing large amounts of more than 12,000 ML in successive years (for example between 1979 and 1982) is not sustainable in the current climate because it impacts on the environmental values, as well as on the security of the supply for downstream purposes in subsequent years. The large releases in 1997 and 1999 for instance would have played a major role in the restricted availability in the following three years. In contrast however, the 13,250 ML released in 1987 was tolerable because it was followed by two relatively low usage years.