



**WORKING GROUP STARLIGHT RESERVES  
ASTRONOMY AND WORLD HERITAGE  
INITIATIVE**

# **A CASE STUDY FOR A STARLIGHT RESERVE**

## **LAKE TEKAPO, NEW ZEALAND**



Margaret Austin: Former Chair, National Commission for UNESCO NZ

John Hearnshaw: Professor of Astronomy, University of Canterbury

Graeme Murray: Director of Earth and Sky, Lake Tekapo

Photographs kindly supplied by Alan Gilmore, Fraser Gunn and Denis Callesen

# CASE STUDY for LAKE TEKAPO

## 1. Introduction



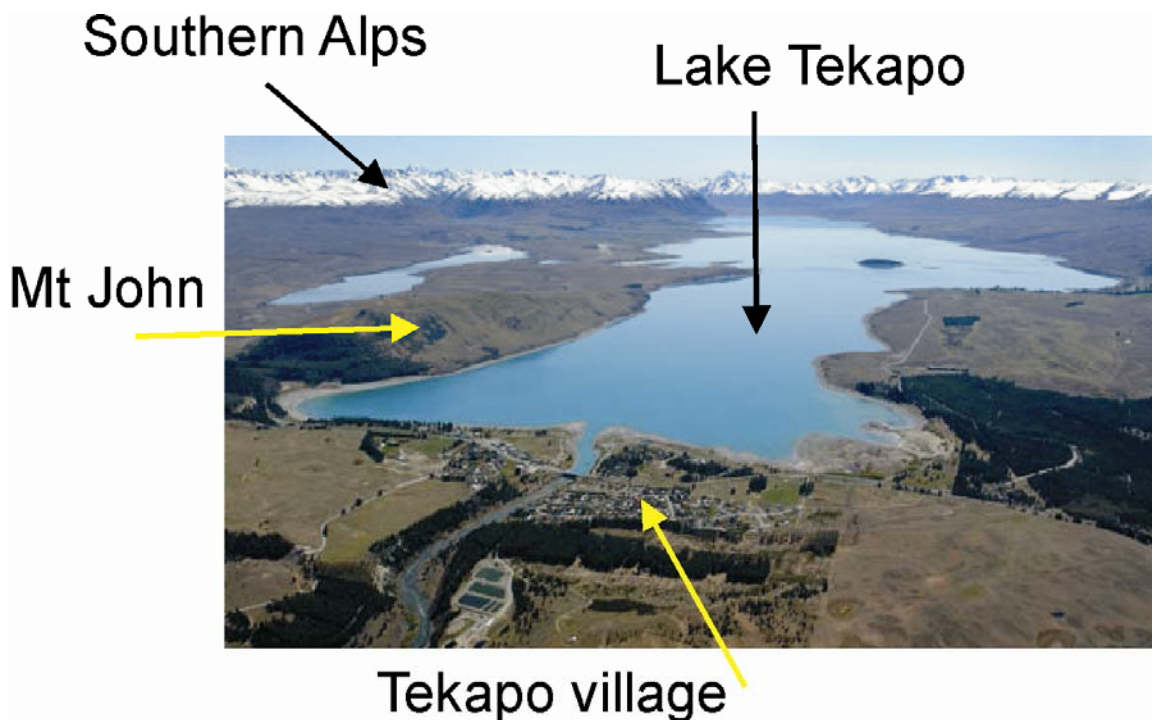
A: Lake Tekapo, B Aoraki Mt Cook National Park

Lake Tekapo is located in the Mackenzie Basin situated in the centre of the South Island of New Zealand. It is a major tourism location and through route between Christchurch, Mt Cook National Park and Queenstown. It is the site of the Mt John Observatory operated by the University of Canterbury, chosen in the 1963 for the clarity and darkness of the night sky. The proposal to establish a Starlight Reserve in the Mackenzie basin and including the Aoraki Mt Cook National Park is made in this Case Study. The proposal is supported by the following:

- Ministers and Members of Parliament in the New Zealand Government
- The Mackenzie District Council
- The Department of Conservation
- The Mackenzie Tourism and Development Trust
- Earth and Sky Ltd, Lake Tekapo
- The University of Canterbury
- The National Commission for UNESCO New Zealand
- The Royal Society of New Zealand
- ICOMOS New Zealand
- The Royal Astronomical Society of New Zealand

## 2. Geographical boundaries of the area.

The location being advocated for the Starlight Reserve is envisaged to encompass Lake Tekapo and include the Mount John Observatory, the Lake and its tributary – the Godley Valley and the Mt Cook National Park within the Te Wahipounamu South West New Zealand World Heritage Park. This concept was initiated by the Mount Cook Mackenzie Tourism and Development Board and is now in the hands of the Council's Tourism and Development Trust. (see section 10 below)



The area to be protected can be divided into three regions:

- (a) The Core Zone proposed includes the whole of Mt John Observatory on Mt John which is a dark area and free of light and air pollution.
- (b) The Buffer Zone would take in Tekapo Village and a three kilometre area around the Village.
- (c) The External Zone proposed includes the region covered by the Lighting Ordinance in the Mackenzie District Plan (2004), which is included in the Resource Management Act (1991). It is proposed to extend the External Zone to encompass the whole of the Aoraki Mount Cook National Park which is within the Te Wahipounamu World Heritage Area. This is administered and managed by the Department of Conservation which has similar ordinances in place. (see Map in Section 10 below and also see section 11 for the Lighting Ordinance). This ordinance has been in force since 1981 under the Town and Country Planning Act. <http://www.mackenzie.govt.nz/Site/Internal/Environmental/Districtplan.aspx>



Mount Cook and the Village

### **Aoraki/Mount Cook**

The Aoraki/Mount Cook village is located in the Aoraki/Mount Cook National Park. The National Park was accorded World Heritage status in 1989 as part of the South West (Te Wahipounanu) World Heritage Area along with the Westland, Mt Aspiring and Fiordland National Parks.

Aoraki/Mount Cook was designated a part of the World Heritage Area because of its “Outstanding universal value”. It meets the three criteria for being “outstanding”

- it represents the major stages of the earth’s evolutionary history,
- it is a site that represents ongoing geological and biological processes and man’s interaction with those processes,
- it has superlative natural phenomena.

The Department of Conservation is the state agency responsible for the management of the Aoraki/Mount Cook National Park and does so in accordance with the National Parks Act 1983, the National Parks General Policy 2005, and the operative Aoraki/Mount Cook National Park Management Plan 2004. The Department is both the planning agency and the local body at Aoraki.

Since the early 1980s the value of “natural darkness” has been recognised as an important ‘natural value’ at Aoraki. The management plans, including the current plan, have had policies and methods that apply to the village’s design and use and the provision of services to protect natural dark. These provisions have been directed at preventing light contaminating the night sky.

The Department is currently in the process of reviewing the overarching Conservation Management Strategy (CMS) for Canterbury and the protection of natural darkness will be an important part of the strategy. That process will be completed over the next 18 months.

Through the CMS review process the Department will consult with Ngai Tahu and the public of Canterbury over seeking a higher level of status for this particular ‘natural value’ and will float the concept of a “Starlight Reserve”. If support is forthcoming, which the Department anticipates will be the case, then if and when the opportunity arises for the Department to make an application for an extension to the existing World Heritage status for Aoraki/Mount Cook National Park to include the value of natural darkness as a Starlight Reserve, we will be in a position to do so. (<http://www.doc.govt.nz/publications/about-doc/role/policies-and-plans/national-park-management-plans/aoraki-mount-cook-national-park-management-plan/>)



The Moon rising over the Alps and Sir Edmund Hillary

## **2a. Some basic information about Tekapo village:**

### ***Population.***

The resident population at the 2001 census was 303 and is now about 400. The population can often double due to the number of visitors to the area here and at Mt Cook.

### ***Position***

Lake Tekapo village's latitude, longitude and altitude is: S44°00.5' E170°28.7' and 720m above sea level. The designed flood level of the lake is 713m above sea level, but as a hydro lake it is often less than this.

### ***Length of the day in Tekapo.***

New Zealand is located half way between the equator and the South Pole. As a result there is a large difference in the length of the day between the summer and winter seasons.

## **2b. Climate**

### ***Rainfall***

On average Tekapo village experiences 78 rain days a year producing an annual rainfall of 600 mm (23.6"). This increases significantly towards the Southern Alps, above the head of the lake.

### ***Sunshine***

On average Tekapo experiences 2180 sunshine hours annually. This is almost 200 hr above the New Zealand average and has some of the clearest skies in New Zealand.

### ***Wind***

The average wind speed throughout the year is 7 km/h. The highest wind speed ever recorded in New Zealand of 250 km/h was recorded on top of Mt John.

### ***Temperature***

The highest temperature recorded in Tekapo is 33.3°C.

The lowest temperature recorded in Tekapo is -15.6°C.

On average Tekapo experiences 149 ground frosts a year.

Lake Tekapo experiences warm summers and very cold winters.

## **3. General description.**

Lake Tekapo lies in the centre of the South Island of New Zealand . This highland lake and settlement at 710 meters (2300 feet) is in the heart of the Mackenzie District and surrounded by a vast basin of golden tussock grass. The name Tekapo derives from Maori words Taka (sleeping mat) and Po (night). Finely ground rock in the glacial melted waters give Lake Tekapo a beautifully unique turquoise colour.

Lake Tekapo's geographical and central location is protected from rough coastal weather by the Southern Alps in the west and the Two Thumb Range to the east. This allows the highland location to enjoy some of New Zealand's highest sunshine hours and lowest average wind speeds. Rainfall is just 575 millimeters (23 inches) annually.

Summer or winter, snow-covered or golden yellow, the surrounding mountains and turquoise lake make a spectacular backdrop for the Church of the Good Shepherd. The unforgettable night sky reveals why Lake Tekapo has a reputation for clear air.

Lake Pukaki lies thirty km south west of Tekapo with Aoraki Mt Cook and Mt Cook Village at its headwaters. It services tourism and conservation in the Mt Cook National Park in Te Wahipounamu World Heritage Area.

The following article is from the Tekapo Tourism website (<http://www.tekapotourism.co.nz/history.htm>)

Approximately 250-300 million years ago the Southern Alps and the area surrounding Lake Tekapo were part of a seafloor valley. Movement of two large plates of the earth's crust has seen the once horizontal seabed, hardened to rock and pushed upwards to form the land it is today.

The last ice-age, 15,000 to 18,000 years ago, saw huge glaciers of ice longer than the length of the lake, depositing large volumes of rock at it's terminal, resulting in the damming of the valley and the formation of Lake Tekapo behind it.



**Glacier**

The glaciers have since retreated back to the valleys at the head of the lake, but are still clearly visible from the air and often accessible by four wheel drive vehicle.



**Godley Valley today**

In 1855 James Mackenzie, a Scottish shepherd turned sheep stealer discovered the basin that now bears his name when he, with the help of his dog Friday, drove flocks of sheep inland to avoid being discovered.

Authorities were finally able to capture Mackenzie, but struggled to take control of the sheep due to his highly intelligent dog. It is alleged Friday continued to drive the sheep without his master's control until finally being disabled by the authorities. A bronze memorial to working collie dogs, such as Friday, was commissioned in 1968 by local farmers and now stands on the shores of Lake Tekapo near the Church of the Good Shepherd.



**Collie dog statue**

In 1857 the first sheep farm in the Mackenzie was built by John and Barbara Hay on the shores of Lake Tekapo. When the lake is low the remains of the old Tekapo Station homestead can be seen on the eastern shores of the lake. A hotel was established in 1861 and a ferry was set up to cross the Tekapo River. Twenty years later construction began on the first bridge.

In the 1930s work began on Tekapo power station. Construction was delayed by the event of World War Two, but the station was eventually finished in 1951. The intake for

The Mackenzie Basin was free of humans until several hundred years ago with the arrival of the Maori in search of food.

The Moa (a large flightless bird now extinct) and other birds were hunted and eels fished for in the area.

The Maori called the area Takapo, meaning "*To leave in haste at night*". The current name, Tekapo is possibly a corruption of Takapo.

the power station is located on the south-western shores of the lake. Water travels through a tunnel under the hill to the west of the township, to the power station located part way down the Tekapo River.

The lake level controlled by gates constructed on the Tekapo River, was raised, the existing bridge demolished and the hotel re-sited to its current location.

Today Lake Tekapo is flourishing under the effects of tourism and continues to grow as more people discover the magic of the undisturbed beauty of the Mackenzie.

#### **4. Description of values and natural environment and the importance of dark sky for the area's habitat and wildlife.**

Lake Tekapo is an alpine village in the heart of the South Island high country. A ski resort in winter and aquatic playground in summer, Lake Tekapo sits at the edge of its 25-kilometre glacial lake namesake, completely surrounded by mountains, including along one flank, New Zealand's impressive Southern Alps.

The landscape is outstanding, sculpted by successive Ice Age glaciers, the remnants of which continue to discharge fine 'rock flour' giving the lake its intense turquoise hue. The sky is huge and of extraordinary clarity, making Lake Tekapo one of the world's best locations to probe the heavens from its observatory atop Mt John.

This striking landform of solid rock, Mt John, overlooking the village, has stood firm against the onslaught of glacial action over thousands of years and now shelters a camping ground, ice-skating rink and a launching bay for boats to enjoy family fun, fishing and waterskiing as well as providing 360° views of the uplands, lakes and mountains from its summit. The weather patterns are stable with record sunshine hours.

The Mackenzie Country's flora is characterized by open grasslands consisting mainly of golden tussocks (*Chionochloa* sp.) dotted with scattered exotic trees. The surrounding mountain slopes are characterized by native beech forests and tussock grasslands with an abundance of native flora such as *Celmisias* (mountain daisies) and *Ranunculus* species (buttercups) as well as the threatened *Carmichaelias* (native brooms).

The nature of the climate is harsh, ranging from hot dry summers, to cold frosty winters. At times, Tekapo experiences the hot, dry nor-westerly winds as well as the stormy cold southerlies and heavy winter frosts, so that the vegetation of the Mackenzie has to be hardy and drought resistant. Despite the climatic extremes, it should be noted that the area has some of the highest sunshine hours in New Zealand, and one of the lowest yearly average rainfalls.

The fauna before the arrival of the Maori and the first settlers was populated by a rich variety of bird life (as was all of New Zealand). The hunting for food and the introduction of exotic mammals such as cats, stoats, ferrets and weasels, have drastically reduced their numbers and variety. Nevertheless, a number of rare and protected birds such as kea, the New Zealand falcon, rock wrens, black stilt, wrybills, banded dotterel, bellbirds, fantails, tomtits and black-fronted terns can be observed.

The introduced deer, thar and chamois, have also found a home here and are hunted recreationally and their population numbers managed. Rabbits and possums are considered pests of the first degree and are controlled vigorously. The rivers, canals, tarns and streams are stocked with trout and salmon, providing great sport for fishermen with many world class and record fish being caught. In summer Russell Lupins flower in abundance having been introduced when an early run holder's wife spread a few seeds to add "colour" to the surroundings.

## **5. Night Sky quality**

Since the existence of the University of Canterbury Mount John Observatory on the summit of Mount John, the local area has been subject to light restrictions as part of the Mackenzie District Council's district plan for Lake Tekapo. These restrictions have existed to protect the sky around the observatory from unnecessary light pollution. Local developers have complied with the Regulations through the installation of specialised street lighting on new sub-divisions. (See Mackenzie District Council Ordinance 1981 – section 11)

Seven years ago the Mackenzie District Council initiated an extensive series of public meetings and debate to establish the Tekapo District's blueprint for the Town's future that included Town planners, Government advisors and other experts. The result was a major policy document called the 'Tekapo Vision' that has a cornerstone statement – "That we protect the dark sky".



The Milky Way above MOA telescope at Mt John

Subsequently people began to think about the concept for a type of “Park in the Sky”. To ensure Tekapo’s significant asset was not lost through light pollution, not only for the sake of Mt John but for future generations. It was a simple concept which quickly caught on locally, nationally and internationally as people recognised how many parts of the world have already lost their Starry night Sky.



Astro-photography at Lake Tekapo - Earth and Sky

As part of its contribution to the 2009 International Year of Astronomy, Tekapo and the Mt John Observatory in conjunction with the Mackenzie District Council, the Mt Cook Mackenzie Tourism and Development Trust and the University of Canterbury are presenting this preliminary “Case Study” with a view to being accepted as an exemplar for the Thematic Study for presentation to the World Heritage Committee of UNESCO. It is believed that international recognition would have significant benefits not only for the Mackenzie Country but for New Zealand as a whole and its “Pure NZ” image.

## 6. Cultural Values

Maori were the first to venture into the Mackenzie Country about 1000 years ago where they hunted moas, birds and eels before returning to the coast for food and trade. It was the custom for tamariki (children) to sit at the feet of the grandmothers to be told of the tides of the universe, the journeys of the regular night visitors (the constellations), the names of the Stars in and across the 36 houses into which they divided the night sky.

They told of the great glowing fireball Halley's Comet "Tehana Rerenga o lo" which returned every 75 – 76 turns of the Earth around the sun and linked this with three generations of ancestral descent and important past events. They taught that the star group Orion "Te Kupenga a Te Ao" was central to all weather and safe travel in their new World and that the arrival of Matariki (Pleiades) low in the eastern sky in early June signaled the beginning of their new year and the counting of the full moons recommenced to set the times for planting and for the making of safe journeys across the mountains or the seas.

Pacific peoples navigated by the stars, judged distance by the stars, understood which birds inhabited the islands and planted their crops by them. Astro-navigation allowed Maori to make long sea voyages and settle in Aotearoa NZ. They developed a rich mythology based on Rangi – the sky father; Papa – the earth mother; Te Ra – the sun; Te Marama – the Moon and Nga Whetu – the stars all of which gave life its meaning even to this day.

Astronomy was pivotal to European discovery of New Zealand. Captain James Cook first came to New Zealand in 1769 after observing the Transit of Venus in Hawaii for no other reason than to find it, map it, and later to make extensive astronomical observations for determining latitude and longitude. He came three times in all bringing explorers, astronomers, botanists and warriors.

The founding father of New Zealand Science, James Hector standardised New Zealand time at 11 hours 30 minutes ahead of Greenwich Mean Time and established the Dominion Observatory in the capital, Wellington. A number of early amateur astronomers distinguished themselves. Gifford interpreted the lunar landscape, Grigg pioneered astronomical photography; McIntosh observed meteor showers and orbits, Bateson variable stars, Jones co-discovered supernova 1987A in the Large Magellanic Cloud and a comet in 1946. Today the Royal Astronomical Society of New Zealand has 26 Affiliated Societies and more than 600 active members. Professional Astronomers have included the New Zealander Sir William Pickering – the father of rocket science and space exploration including the mariner probes to Venus and Beatrice Tinsley, known in the US as the Queen of the Cosmos. Current academics of note include Professor John Hearnshaw at Canterbury University and Professor Phillip Yock at Auckland University both with international reputations.

European settlement and farming in the area introduced some colourful characters including the Scotsman James McKenzie whose capture in 1855, for being "in the company of a thousand stolen sheep" as he rustled them with his dog Friday, through a remote alpine pass into "a plain of immense extent" resulted in his deeds being immortalized and his name, albeit with a spelling change, applied to these highlands ever since.

## 7. Observatories and their scientific importance.

### (a) Mt John Observatory



Mount John is a *roche moutonnee*, an asymmetrical rock shaped by the movement of ancient glaciers. The large mass of bedrock attains an altitude of 1031 metres above sea level, rising approximately 300 metres above Lake Tekapo below.

On the summit of Mount John is the University of Canterbury's astronomical observatory. During the day its domes can be seen from the Tekapo township. The mountain was chosen as the best observatory site in New Zealand because of its high number of clear nights throughout the year, the stability and transparency of the atmosphere and the uniquely dark skies in the Mackenzie Basin, devoid of city light pollution. It is internationally recognised as one of the best-situated observatories for viewing the southern night skies. For example, the Magellanic Clouds (satellite galaxies to our own Milky Way) can be seen continuously throughout the year.

In addition, it is arguably one of the most beautifully placed observatories in the world, with the magnificent surroundings of glacial lakes and moraine, and the Southern Alps.

### (b) Cowan's Hill Observatory, Tekapo



Cowan's Hill Observatory, Tekapo, has a 40 – cm telescope operated by Earth and Sky Ltd for public outreach in astronomy.

### **A brief history of Mt John (Alan Gilmore)**

In 1960 the University of Pennsylvania received a grant from the U.S. National Science Foundation to survey New Zealand to find the best site for an astronomical observatory. Pennsylvania wanted to establish a southern station and New Zealand was much further south than the established observatories in Australia, South America and South Africa. So from here more of the southern sky was continuously visible throughout the year.



**Comet passing through Mt John's night sky**

Among the criteria for an observatory site were: a large number of clear nights, a dark sky not polluted by artificial light from any nearby town or city, a site reasonably close to power and water supplies and main roads and not too far from a major city.

The site survey began in 1961. It was organized by Mr Frank Bateson, a New Zealand amateur astronomer internationally respected as the Director of the Variable Star Section of the Royal Astronomical Society of N.Z. From geographical and weather information Bateson selected potential sites in the Bay of Plenty, Nelson, Marlborough, the Mackenzie Country and Central Otago. Between 1961 and 1963, with much help from local authorities and individuals, various sites were occupied so sky conditions could be continuously monitored.

By 1963 it was clear that Mt John provided the best conditions, all things considered. The University of Pennsylvania made an agreement with the University of Canterbury to jointly develop the site, thus providing a city base in Christchurch. The observatory was officially opened on 10 July 1965.

The observatory's early instruments were astronomical cameras, provided by Pennsylvania, and telescopes lent by Bateson. They were housed in buildings largely constructed by volunteer labour from the South Canterbury district. In 1970 the 60cm (24inch) Optical Craftsmen (the 'OC') telescope was installed. Five years later a second 60cm telescope made by Boller and Chivens (the 'B&C') was erected. During these years some of the original University of Pennsylvania staff moved to the University of Florida so it too

became part of the consortium. However, from about 1975 the contribution and interest of the U.S. partners waned as their senior staff retired. The Observatory now operates entirely as a field station of the University of Canterbury's Department of Physics and Astronomy.



**Southern Cross and Pointers**

In 1969 the U.S. Air Force built a satellite tracking station on Mt John south of the university observatory. The USAF also funded the sealed road up the mountain and a water supply from Lake Tekapo. Prior to this the Observatory had depended on rainwater or tanker supplies brought up a rough track. The tracking station employed a large staff for following the positions of US and Soviet satellites.

The USAF tracking station closed in 1982 as new imaging technology made it redundant and the building passed to the New Zealand government. Canterbury University now leases the building and has modified it, adding a large dome to the north end to house its one-metre telescope. The 'One Metre building', as it is generally called, accommodates visiting staff and observers. It also houses an upper atmosphere experiment that measures wind and air temperature 100 km above the ground, part of an international study.

The One-Metre McLellan reflector was built in the University of Canterbury's workshops and was installed at Mt John in February 1986. It is used for a wide variety of astronomical research, most of it in stellar astrophysics: the study of stars and their evolution. In 2001 a large 'fibre fed' spectrograph made at Canterbury was installed, greatly enhancing the telescope's capabilities.

Since 1996 a consortium of New Zealand and Japanese researchers have run a joint programme on the B&C telescope. It is called the MOA project from Microlensing Observations in Astrophysics and involves Auckland, Massey, Victoria and Canterbury universities on the NZ side, and Nagoya University in Japan. Following a grant from the Japanese government a 1.8-metre telescope was installed at Mt John in 2004. It will continue the microlensing work, watching many millions of stars for changes in brightness.

In 2003 the MOA team discovered a Jupiter-size planet orbiting a star several thousand light-years away.



**Orion Nebula**

As services to the local community the Observatory hosts Vodafone cell-phone antennae and a FM repeater for National Radio. On a pillar near the summit is a GPS station run by the Institute of Geological and Nuclear Sciences and the Survey Department of Otago University. It is the base station for measuring bending of the South Island around the Alpine Fault. A webcam gives hourly updates of the region's weather.

Earth & Sky, a Tekapo company, now runs daytime tours of the Observatory. They installed a 40-cm telescope for public viewing in the '16-inch' dome early in 2007.

Since Mt John was established, the village of Lake Tekapo has grown, so increasing night sky brightness has become a concern. Mackenzie District Council ordinances require that all outside lights be full cut-off so that no light shines upward into the sky. The new subdivision developers are installing observatory-friendly, low-pressure sodium lighting.

## **8. Territorial jurisdiction (land ownership and administration)**

Most of the land in the Mackenzie Basin is crown land (i.e. Government owned) but leased to farmers or available for recreational use. Two blocks near Tekapo have recently become freehold (in private ownership). These are Mt John Station, which includes all of Mt John *except* the summit and road, which are crown land leased by the University of Canterbury for the purposes of operating Mt John Observatory, and also part Richmond Station, which is across Lake Tekapo on the east side and northern end of the lake.

## **9. Environmental protection system.**

The Department of Conservation manages significant areas of public conservation land surrounding the Tekapo township and the Tekapo lake and river. This land is characterised by a natural cover of indigenous grasses and shrublands over a topography of hill country, mountain lands and riverbeds. The land is managed for its natural flora and fauna values, including the protection of rare and threatened species such as the black stilt, robust grasshopper and the Chionochloa grasslands. As public conservation land it is open for public use and enjoyment such as walking, mountain biking and nature studies.

Within the Tekapo skyline area there are no commercial buildings or structures on public conservation land and therefore no threat to the preservation of natural darkness.

The Conservation Act 1977, the Conservation General Policy 2005 and the revision of the Canterbury Conservation Management Strategy (CMS) all support the preservation of natural darkness. The sympathetic management of these public conservation lands will support the case for a Starlight Reserve based on the Tekapo township.

If at some time in the future there were to be an application for a building on the land managed by the Department within the Tekapo skyline, or an application to establish some other potentially harmful light source, then the provisions of the Conservation legislation, the Canterbury CMS and the requirements of the Mackenzie District Council would be applied to protect the night sky.

## **10. Tourism Activity and its Relation with the Starlight Initiative**

Statement from Lesley O'Hara, Chair of the Mackenzie Tourism & Development Board. endorsing the Lake Tekapo, New Zealand bid for Starlight Reserve status.

“New Zealand has a long history of commitment to both conservation and tourism, with visitors flocking from all over the world to see the pink and white terraces in the late 1800's and establishing the world's first national tourist office in 1901. This commitment is even more firmly entrenched in 2009, with tourism being the number one foreign exchange earner in New Zealand and employing one in every ten of our workforce.

The Mackenzie District, with its magnificent scenery and large portion of land held by the conservation estate, is an integral part of the tourism product in New Zealand.

We will put all our efforts into ensuring that the Starlight Reserve is protected, but also and most importantly, shared with the people of the world. We know how special and lucky we are to have this magnificent attraction above us, and we will nurture it for future generations to enjoy.”

The Mackenzie Tourism and Development Trust is responsible for Lake Tekapo and Aoraki Mt Cook and their associated environs and are acclaimed tourist destinations with spectacular alpine landscapes and clean air. Currently it is estimated that approximately 1.4 million visitors pass through Tekapo and Aoraki Mt Cook annually on route to such places

as the Southern Lakes, Fiordland, Haast Pass, the West Coast and if traveling north, Christchurch.

A Company, Earth & Sky was established at Mt John, Lake Tekapo four years ago to capitalize on the fast developing tourism interest in the alpine landscape, recreational activities and Astronomy. Visitors are enthusiastic to learn more about the area's unique Milky Way in the dark sky. It is believed that this has the potential to contribute to better understanding and appreciation of this important part of our natural heritage and to contribute to their cultural and spiritual wellbeing.

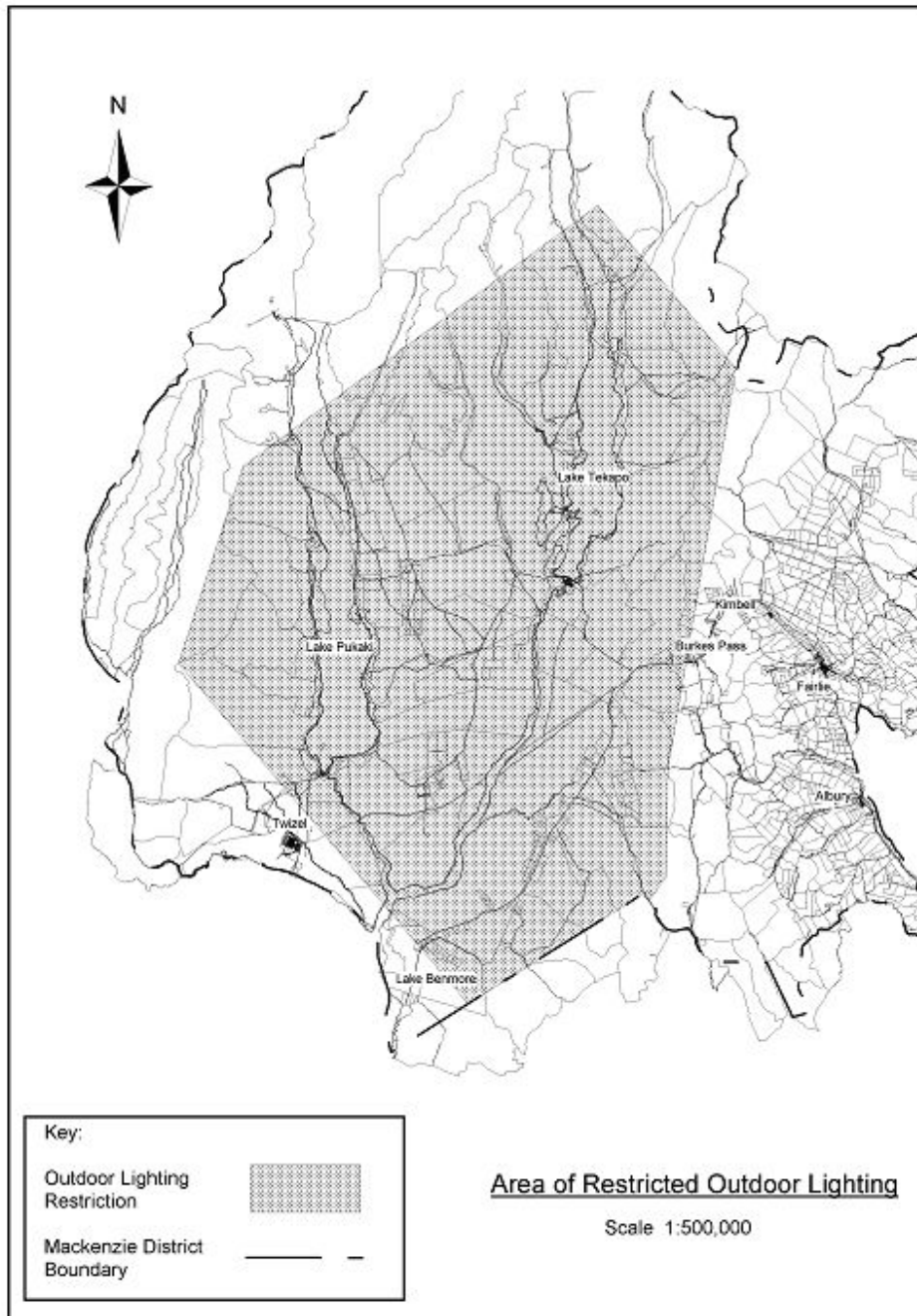
Mt John is considered to be one of the most beautiful, easily accessible Observatories in the world and is therefore an ideal location to combine scientific research, education and astro-tourism. Recognition as a Starlight Reserve would give this location enhanced status worldwide.

## **11. Sky quality protection measures.**

The International Dark Sky Association (IDA) uses the Bortle scale for measuring sky darkness. The sky on Mt John is typically 2 on the Bortle scale; The central village's present sky is about 5 or 4, depending on location. The new village subdivisions would be 4 or 3, given that the new street lighting strictly complies with the Lighting Ordinance. (see [http://en.wikipedia.org/wiki/Bortle\\_Dark-Sky\\_Scale](http://en.wikipedia.org/wiki/Bortle_Dark-Sky_Scale) )

The region covered by the Lighting Ordinance in the Mackenzie District Plan (2004), which is included in the RMA (1991). It is defined by straight lines between designated trig points, and includes the whole of lake Tekapo and most of the Mackenzie Basin, to about 40 km south, but it excludes Twizel, Burkes Pass and Fairlie. See also District Plan website at <http://www.mackenzie.govt.nz/Site/Internal/Environmental/Districtplan.aspx> ( refer to section 11 for the Lighting Ordinance). This ordinance has been in force since 1981, and was previously under the Town and Country Planning Act.

The map below is from the Mackenzie District Plan and shows the area where the Lighting Ordinance is in force. It extends some 50 km south of the Tekapo village and some 30 km to the west, and includes all of neighbouring Lake Pukaki, but not the townships of Burkes Pass, Twizel or Fairlie. None of these places has a direct line-of-sight to Tekapo village or to Mt John. A review to be undertaken is expected to result in the inclusion of the Aoraki Mt Cook National Park being incorporated in the ordinances.



## 12. Conclusion

This proposal is guided by the “Declaration in Defence of the Night Sky and the Right to Starlight’ La Palma 2007 which defines the sky as a common and universal heritage and an integral part of the environment perceived by humankind. We are convinced as stated in the Declaration that “interest in astronomy has had profound implications for science, philosophy, culture and our conception of the universe and that contemplation of the night skies should be considered an inalienable right of humankind”. We believe that Lake Tekapo and its surroundings provide the best place in New Zealand to achieve the goals of the Declaration and its vision.

Community, Local and National Government support for this Project is augmented by public interest within New Zealand and from overseas. The light control ordinances are well established and accepted by the local and farming communities. The Research infrastructure is already in place and collaboration among the research astronomers has resulted in international recognition of their findings and along with opportunities for astronomy students from the University. Astrotourism is already attracting large numbers of visitors to Mt John and Mt Cook to provide for the growing national and international interest in Astronomy as part of outreach education. Educational opportunities for school age children have the potential to contribute to the New Zealand science curriculum which includes Investigation of the Planet Earth and Beyond from Years 1 – 13.

Of particular significance is the emphasis by Maori on understanding of the Stars to guide navigation, seasonal plantings, food gathering and journeys. The Mackenzie Basin, Lake Tekapo and Mt Cook area is in a unique conservation landscape with a rich flora and of great significance to all New Zealanders.

Margaret Austin [austinme@xtra.co.nz](mailto:austinme@xtra.co.nz)

John Hearnshaw [john.hearnshaw@canterbury.ac.nz](mailto:john.hearnshaw@canterbury.ac.nz)

Graeme Murray [murrayfamily84@xtra.co.nz](mailto:murrayfamily84@xtra.co.nz)