Department of Planning and Environment

June 2022

Snowy Mountains Special Activation Precinct

Kosciuszko National Park Plan of Management – Carrying Capacity – Framework Development





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Snowy Mountains Special Activation Precinct Kosciuszko National Park Plan of Management – Carrying Capacity – Framework Development

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PS120074-WSP-ENV-REP-003 RevF_Carrying Capacity Framework

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Abbreviations and definitions

AEP	Annual Exceedance Probability. The probability that a design event (rainfall or flood) has of occurring in any 1-year period	
ACHMP	Aboriginal Cultural Heritage Management Plan	
Alpine DCP	A future Alpine Development Control Plan to be developed following the adoption of the Snowy Mountains SAP Master Plan.	
Alpine precincts	Snowy Mountains Specialist Activation Precinct areas located within the boundary of Kosciuszko National Park	
Alpine precincts – Alpine resort areas	Snowy Mountains Specialist Activation Precinct areas located within the boundary of Kosciuszko National Park and the location of the alpine resorts.	
Alpine precincts – Tourism opportunity areas (TOAs)	Snowy Mountains Specialist Activation Precinct areas which are located within the boundary of Kosciuszko National Park, and however outside of the alpine resort areas.	
Alpine Resorts	One of the four ski resorts located within Kosciuszko National Park, as outlined in the Kosciuszko National Park Plan of Management and the Precincts-Regional SEPP	
AMU	'Alpine Management Unit' as outlined in the Kosciuszko National Park Plan of Management	
ANZECC	Australia and New Zealand Environment and Conservation Council	
Alpine SEPP	State Environmental Planning Policy (Kosciuszko National Park—Alpine resorts) 2007 (now Chapter 4 of the Precincts-Regional SEPP).	
AUSRIVAS KNP	Australian River Assessment System for assessing water quality developed by the Co-operative Research Centre for Fresh Water Ecology for the streams and rivers in Kosciuszko National Park	
BC Act	Biodiversity Conservation Act 2016	
Bed limit	The maximum accommodation limit for the Snowy Mountains SAP alpine precincts, as set out in the Snowy Mountains SAP Master Plan and Chapter 10 of the KNP PoM	
Bed allocation	The allocation or beds available for use in the Snowy Mountains SAP alpine precincts as set out in Schedule 8 of the KNP PoM (which must always be less than or equal to the bed limit).	
CCF	Carrying Capacity Framework	
Charlotte Pass	Charlotte Pass Alpine Resort	
Cth	Commonwealth	
cVPP	Community based virtual power plant	
DPE	NSW Department of Planning and Environment	
DPIE	The former NSW Department of Planning, Industry and Environment	
EbD	Enquiry by Design workshops held in Jindabyne	
EIA	Environmental Impact Assessment	

EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environment Protection Biodiversity Conservation Act 1999
FFDI	Forest Fire Danger Index
KNP	Kosciuszko National Park
KNP PoM	Kosciuszko National Park Plan of Management
LALC	Local Aboriginal Land Council
LGA	Local Government Area
NPWS	NSW National Parks and Wildlife Service
NPW Act	National Parks and Wildlife Act 1974
MNES	Matters of National Environmental Significance
NARCLiM	NSW/ACT Regional Climate Modelling
OEH	Former NSW Office of Environment and Heritage
Operators	All commercial, service or infrastructure providers undertaking activities in the Snowy Mountains SAP Alpine Precincts which are located in Kosciuszko National Park
Perisher Range	Perisher Range Alpine Resort
POEO Act	Protection of the Environment Operations Act 1997
RGDC	Regional Growth NSW Development Corporation
Regional NSW	Department of Regional NSW
Precincts-Regional SEPP	State Environmental Planning Policy (Precincts – Regional) 2021
Selwyn	Selwyn Alpine Resort
SEPP	State Environmental Planning Policy
SIMP	Salt Impact Management Plan
Snowy Hydro Scheme	Snowy Mountains Hydro-Electric Scheme
Snowy Mountain SAP	Snowy Mountains Special Activation Precinct
Snowy Mountains SAP study area	The Snowy Mountains SAP area as defined in the Snowy Mountain SAP Master Plan
State Park Act	Kosciuszko State Park Act 1944
STP	Sewage Treatment Plant
TEC	Threatened Ecological Community
TfNSW	Transport for NSW
Thredbo	Thredbo Alpine Resort

Executive summary

Special Activation Precincts

Special Activation Precincts (SAPs) are dedicated areas in regional NSW identified by the NSW Government to become thriving hubs. The SAP program facilitates job creation and economic development in these areas through infrastructure investment, streamlining planning approvals and investor attraction.

On 15 November 2019, the NSW Government announced its commitment to investigating the Snowy Mountains SAP, to revitalise the Snowy Mountains into a year-round destination and Australia's Alpine Capital, with Jindabyne at its heart.

The planning framework for each SAP includes three key parts:



- Identifies the matters to be addressed as part of the Delivery Plan.
- infrastructure and services
- staging.
- Provides procedures for ongoing monitoring and reporting.

Master planning

The master planning process for all SAPs adopts an evidence-based approach to determine the best outcome for the precincts. It is designed to ultimately provide a clear pathway for ideal future development, in particular locations.

The process involves the engagement of a range of technical experts to investigate the study area and prepare technical studies (such as this report) to demonstrate their findings. Each of the technical studies are specifically designed and scoped for each SAP and tailored to the needs of the study area.

To achieve integrated and balanced planning outcomes, technical experts and other stakeholders collaborate at a series of design workshops held throughout the master planning process. At these workshops, opportunities and constraints are discussed and assessed to inform the design of the precinct. This includes the evaluation of matters such as environmental impacts and benefits, transport opportunities, infrastructure capabilities, stormwater, and economic viability, among others. These workshops are designed to offer technical experts and decision makers the opportunity to ensure the identified vision, aspirations and principals for the precinct are guiding the outcomes.

Snowy Mountains SAP

The Snowy Mountains region is one of Australia's most iconic natural environments. In addition to hosting some of Australia's premier alpine destinations, the Snowy Mountains is home to over 35,000 people and Australia's highest peak, Mount Kosciuszko. The traditional custodians of the Snowy Mountains are the Ngarigo people, in connection with the Walgalu, Ngunnawal and Bidhawal people.

Kosciuszko National Park (KNP) incorporates parts of the Snowy Mountains region. It is the central segment of the Australian Alps Bioregion containing the highest mountains in Australia and is the largest national park in NSW. KNP possesses exceptional diversity of alpine plant communities, containing threatened ecological communities (TECs) and habitats for several rare and threatened species. KNP also contains most of the alpine endemic species found on the Australian mainland (NSW National Parks & Wildlife Service, 2006).

The Snowy Mountains region plays a crucial role within the regional and state economy, with its local population swelling with an additional 1.4 million international and domestic visitors each year (Destination NSW, June 2020 report). The region's unique natural environment allows locals and visitors to participate in a diverse array of recreational activities year-round, however many visitors still experience the region through the peak winter season.

Priorities for the Snowy Mountains SAP are to capitalise on the unique cultural and environmental attributes which attract 1.4 million visitors annually to the region, revitalise the Snowy Mountains into a year-round destination, and reaffirm Australia's Alpine Capital (Destination NSW, June 2020 report). This revitalisation will focus on adventure and eco-tourism, improving regional transport connectivity, shifting towards carbon neutrality, increasing the lifestyle and wellbeing activities on offer, and supporting Jindabyne's growth as Australia's national centre for winter sports.

Kosciuszko National Park

The Snowy Mountains SAP study area encompasses a total of 72,211 hectares (ha) of land, with a series of 'sub precincts' identified within the area. Where the Snowy Mountains SAP differs from other SAP's across the state, is the inclusion of a national park within the study area, and specifically identifying existing alpine resort areas as the alpine precincts of the overall SAP.

This inclusion of KNP within the Snowy Mountains SAP master planning process requires an additional level of planning and management to ensure appropriate value protections are in place, and the planning and environmental management framework is consistent with the aims and objectives of existing legislation. As such the Snowy Mountains SAP Master Plan has been developed to facilitate expected growth in visitation in the region and KNP, while ensuring the same or improved protection for existing values, and where appropriate the consideration of additional values.

Following a process of community consultation, technical assessments and studies, a carrying capacity framework (CCF) has been selected as the most appropriate methodology to ensure a balanced approach to development and environmental, social and cultural value protections is implemented in the Snowy Mountains SAP alpine precincts, which are located in KNP.

Strategic need for a carrying capacity framework

KNP is a culmination of various factors which have influenced its establishment, expansion, and development over time, and today visitor management remains tied to its historical land uses, the presence of the ski industry and the legacy of the Snowy Hydro Scheme. All factors remain an influential presence in decision making and environmental management in areas of KNP.

The existing visitor management framework allows for a focus on high visitation areas around alpine resorts, sets an upper limit on park development using a bed limit, and separates wider landscape level management from alpine resort operations (where appropriate to do so). While this framework has remained in operation for a number of years, and has generally resulted in positive environmental and social outcomes, it is not without its limitations. The framework is based on segmented, often overlapping roles and responsibilities, between NPWS, the Department of Planning and Environment (DPE) and resort operators and has historically limited the opportunity for development activities to respond to visitor growth over time, or reduced potential to complete renewal works on ageing infrastructure. This has placed pressure on infrastructure (roads, wastewater, parking), and in some instances resulted in negative impacts to amenity and visitor enjoyment, as well as some negative environmental impacts.

The Snowy Mountains SAP provides a unique opportunity to consider the regulatory and environmental management framework which underpins visitor management in high visitation areas of KNP (alpine precincts). It allows for the consideration of SAP aspirations in areas which have traditionally not been a significant focus of the existing management framework and provides for a long-term view on the interactions between visitation growth and the infrastructure to support that growth while minimising, protecting and enhancing environmental, social and cultural value impacts. To meet stakeholder, community, and visitor expectations, it requires a structured, collaborative, and creative approach such as the implementation of a CCF.

A CCF is a method for managing visitors in a protected area, taking into consideration what are appropriate levels of impact based on a series of selected values, and responding when those values are impacted. A CCF can build on and contribute directly to the SAP master planning process in identifying appropriate development in appropriate areas, and considering where hard capacity constraints exist (that is, where there is a physical maximum limit to capacity), providing solutions to those constraints where practicable and appropriate to do so. It can also consider soft capacity constraints, which are traditionally not managed well under traditional assessment methodologies.

To do this, the CCF needs to acknowledge the historical and modern day use of the park by the ski industry and the social and economic values this provides to the public and local community. It also needs to balance those interests with the protection, preservation and enhancement of heritage and environmental values. As such the CCF must consider the range of stakeholders and wide scope of interests and agendas, in developing and guiding appropriate outcomes.

Purpose of this report

This report outlines a six-stage CCF for incorporation into the Snowy Mountains SAP alpine precincts. The CCF facilitates the management of the expected growth in visitor numbers to 2061 while protecting, preserving and enhancing environmental, social, and cultural values that are present in alpine precincts.



Figure ES.1 Snow Mountains SAP Carrying Capacity Framework for Kosciuszko National Park

The CCF:

- retains a bed limit to provide certainty for stakeholders, however, allows for an uplift of this limit to an appropriate maximum level based on the constraints identified in the Snowy Mountains SAP Master Plan, technical papers and this CCF
- considers how the impacts of day visitation is managed and uses the Snowy Mountains SAP master planning process
 to determine infrastructure requirements to manage those day visitors based on growth projections
- considers on mountain alpine resort capacities and includes the requirement for alpine resort operators to develop
 individual ski slope master plans (in partnership with the NSW government). The aim of these would be to manage
 future on-mountain visitation in a manner which ensures visitor experience, amenity and environmental values are
 maintained and enhanced
- brings together a tiered approach to the protection of environmental, cultural and social values via appropriate planning, monitoring and response provisions. Specifically, it implements:
 - the Snowy Mountains SAP Master Plan to set strategic and high-level visions, aspirations and principles for development opportunities and constraints
 - a future Alpine Development Control Plan (Alpine DCP) which would provide detailed planning and design guidelines for future developments, as well as detailed strategies for cultural heritage protections, environmental protection and management, amenity controls, infrastructure and services and staging of future developments
 - the requirement of an ISO 14001 certified Environmental Management System (EMS) for alpine resorts to ensure ongoing operational management is appropriate and monitoring and response procedures are in place, and
 - provides alternative management approaches for smaller operators, utilising site specific, environmental management site plans (EMSPs) to protect important values in alpine precincts.
- forms part of the conditions of development approval within the Snowy Mountains SAP framework.

1 Introduction

1.1 Special Activation Precincts

Special Activation Precincts (SAPs) are dedicated areas in regional NSW identified by the NSW Government to become thriving hubs. The SAP program facilitates job creation and economic development in these areas through infrastructure investment, streamlining planning approvals and investor attraction. The SAP program adopts a collaborative and integrated whole-of-government approach, bringing together the local Council and a range of other relevant state and local agencies. SAPs are unique to regional NSW. By focusing on planning and investment, their goal is to stimulate economic development and create jobs in line with the competitive advantages and economic strengths of a region.

On 15 November 2019, the NSW Government announced its commitment to investigating the Snowy Mountains SAP, to revitalise the Snowy Mountains into a year-round destination and Australia's Alpine Capital, with Jindabyne at its heart.

The Snowy Mountains SAP is being delivered through the \$4.2-billion Snowy Hydro Legacy Fund.

Different components of each SAP are led by different teams within the NSW Government:

- The Department of Regional NSW (Regional NSW) assesses potential locations for inclusion in the program and considers government investment for essential infrastructure to service the SAPs.
- The NSW Department of Planning and Environment (DPE) is responsible for the planning of SAPs. The
 Department leads the master planning process, including community and stakeholder engagement, the technical
 studies required to inform the preparation of a master plan and development of the simplified planning framework
 for each Precinct.
- The Regional Growth NSW Development Corporation (RGDC) is responsible for delivering and implementing SAPs. This includes attracting investment, providing support to businesses, developing infrastructure, and creating strategic partnerships to foster education, training and collaboration opportunities.

The five core pillars of the SAPs are:



Figure 1.1 SAP core pillars

The planning framework for each Special Activation Precinct includes three key parts:



State Environmental Planning Policy (Precincts-Regional) 2021

- identifies each Special Activation Precinct
- provides land use controls for each precinct
- identifies Exempt and Complying Development pathways for certain development.



Special Activation Precinct Master Plans

- identifies the vision, aspirations and principles for the precinct
- provides more detailed land use controls where required
- identifies Performance Criteria at a precinct-scale for amenity, environmental performance and infrastructure provision
- identifies the matters to be addressed as part of the Delivery Plan.



Special Activation Precinct Delivery Plans / Development Control Plans

- identifies site-level development controls
- provides detailed strategies and plans for:
 - Aboriginal cultural heritage
 - environmental protection and management
 - protection of amenity
 - infrastructure and services
 - staging
 - provides procedures for ongoing monitoring and reporting.

1.2 Master planning

The master planning process for the SAPs adopts an evidence-based approach to determine the best outcome for the precincts. It is designed to ultimately provide a clear pathway for ideal future development, in particular locations.

The process involves the engagement of a range of technical experts to investigate the study area and prepare technical studies (such as this report) to demonstrate their findings. Each of the technical studies are specifically designed and scoped for each SAP and tailored to the needs of the study area.

To achieve integrated and balanced planning outcomes, technical experts and other stakeholders collaborate at a series of design workshops held throughout the master planning process. At these workshops, opportunities and constraints are discussed and assessed to inform the design of the precinct. This includes the evaluation of matters such as environmental impacts and benefits, transport opportunities, infrastructure capabilities, stormwater, and economic viability, among others. These workshops are designed to offer technical experts and decision makers the opportunity to ensure the identified vision, aspirations and principals for the precinct are guiding the outcomes. The technical reports ultimately inform the development of planning controls and guide the development of each SAP.

This planning process is facilitated with community, stakeholder and industry consultation, providing an opportunity for community members, landowners and land managers to contribute and help shape the vision for each SAP.

1.3 Snowy Mountains

The Snowy Mountains, located in the southeast of NSW, is one of Australia's most iconic natural environments. In addition to hosting some of Australia's premier alpine destinations, the Snowy Mountains is home to over 35,000 people and Australia's highest peak, Mount Kosciuszko. The traditional custodians of the Snowy Mountains are the Ngarigo people, in connection with the Walgalu, Ngunnawal and Bidhawal people.

This region forms the northern part of the Australian Alps, which extend south into Victoria, and is predominantly accessed from Canberra which is located approximately 150 kilometres to the north. To the south and west of this region is the sparsely populated high country. The township of Jindabyne situated on Lake Jindabyne provides a hub for the region, with the regional catchment supporting opportunities for tourism and facilities.

KNP is located in the Snowy Mountains. It is the central segment of the Australian Alps Bioregion and is the largest national park in NSW. KNP possesses exceptional diversity of alpine plant communities, containing threatened ecological communities (TECs) and habitats for several rare and threatened species. KNP also contains most of the alpine endemic species found on the Australian mainland (NSW National Parks & Wildlife Service, 2006).

Today, the Snowy Mountains region plays a crucial role within the regional and state economy, with its local population swelling with an additional 1.4 million international and domestic visitors each year (Destination NSW, June 2020 report). The region's unique natural environment allows locals and visitors to participate in a diverse array of recreational activities year-round, however the majority of visitors experience the region though the peak winter season.

Priorities for the Snowy Mountains SAP are to capitalise on the unique cultural and environmental attributes which attract 1.4 million visitors annually to the region, revitalise the Snowy Mountains into a year-round destination, and reaffirm Australia's Alpine Capital (Destination NSW, June 2020 report). The revitalisation will focus on adventure and eco-tourism, improving regional transport connectivity, shifting towards carbon neutrality, increasing the lifestyle and wellbeing activities on offer, and supporting Jindabyne's growth as Australia's national centre for winter sports.

1.4 Snowy Mountains SAP in Kosciuszko National Park

The Snowy Mountains SAP area encompasses a total of 72,211 hectares (ha) of land, with a series of 'sub precincts' identified within the area. Where the Snowy Mountains SAP differs from other SAP's across the state, is the presence of a national park within the SAP investigation area. In the case of KNP, this specifically includes the presence of the existing alpine resort areas, and the identification of those areas as alpine precincts (refer to Figure 1.2).

As such, the Snowy Mountains SAP must:

- consider the existing regulatory and environmental management framework in KNP
- consider additional planning and management approaches to ensure the appropriate value protections are in place, and these protections continue though planning and operational phases of any future development
- ensure any future planning and environmental management framework is consistent with the aims and objectives of existing policies, legislation, and guidelines relevant to the national park
- ensure the future planning and management framework is able to respond appropriately when those values are impacted.

Guidance Note 1 – Carrying Capacity Framework

Following a process of technical assessments, and community and stakeholder consultation, a carrying capacity framework (CCF) has been selected as the most appropriate methodology to ensure a balanced approach to development, while protecting and managing the environmental, social and cultural values of the Snowy Mountains SAP alpine precincts.



Figure 1.2 Location of the Snowy Mountains SAP alpine precincts in KNP

1.5 Structure of this report

The report is structured as follows:

- Chapter 2 provides a summary of the strategic need for a CCF in the Snowy Mountains SAP alpine precincts.
- Chapter 3 outlines the methodology undertaken in the preparation of the CCF.
- Chapter 4 establishes a six-stage CCF for Snowy Mountains SAP alpine precincts.
- Appendix A introduces the concept of carrying capacity and assesses the current best practice methodologies for carrying capacity frameworks, with a focus on protected areas with similar characteristics and land uses to KNP.
- Appendix B reviews the existing regulatory and environmental management framework and strategic studies that underpin planning and environmental management within KNP and specifically in relation to alpine resort areas.
- Appendix D outlines the existing environmental management objectives established by National Parks and Wildlife Service (NPWS) to manage environmental values within alpine precincts.
- Appendix E outlines justification for the development of a CCF in the Snowy Mountains SAP alpine precincts, and identifies opportunities and constraints considered as part of the CCF development.
- Appendix F provides a summary of the outcomes of the technical assessments undertaken to guide the development of the Snowy Mountains SAP Master Plan and Alpine DCP for alpine precincts.
- Appendix G assesses the climate change risks as related to the values of the alpine precincts, which have been considered as part of the development of the CCF.
- Appendix H assesses existing environmental management performance within the alpine precincts, to provide strategic guidance on existing and future capacity constraints and environmental issues.

2 Strategic need for a Carrying Capacity Framework

2.1 Background

KNP is one of Australians most iconic and popular national parks. It is the predominant location of Australia's snow sports industry, contains several of Australia's highest peaks and some of its most unique and threatened ecosystems.

Guidance Note 2 – History of KNP

The history of KNP is a familiar story for the establishment of national parks around the world. It involves a series of land use changes that reflect societal values and attitudes over time. The trend has generally resulted in a strengthening of environmental controls, regulations and increasing levels of environmental management. The history of KNP also means legacy use such alpine recreation and renewable energy generation, remain key values which must be considered in any future planning and management.

The Snowy Mountains region is the traditional lands of the Ngarigo people. The tribal homeland stretches from the western slopes of the coastal ranges to the eastern side of the Kosciuszko plateau and further north. Included in the Ngarigo land is the peak of Mount Kosciuszko and the Snowy Ranges. Other groups have traditionally made the journey to the areas to access its resources during summer (OzArk, Environment a& Heritage, 2022).

For almost a century after the first Europeans ventured into the region in the 1820s, the Snowy Mountains were largely, though not exclusively, the preserve of Aboriginal people, graziers (sheep and cattle) and miners, and people employed in various rural support industries (NPWS, 2006). It is thought that skiing in Australia commenced in the early 1860's in the Snowy Mountains, associated with the gold mining activities, as both a recreational activity and a means of transport (OzArk Environment & Heritage, 2022a).

From the early 1900's an interest in tourism, along with recognition of the scientific value of the region, saw some areas of the current day national park preserved. The focus of this protection was based on recreational value and the preservation of game in the area. In 1909 the first accommodation specifically associated with skiing areas was constructed at Diggers Creek (OzArk Environment & Heritage, 2022a).

From the 1930's, the mountain areas of the region were gaining recognition not only for further recreational value, but also for their conservation significance. This recognition preceded the acknowledgement of the impacts of livestock grazing, and its subsequent withdrawal around Mt Kosciuszko, and a strengthening of snow lease controls (NPWS, 2006). It was also at this time some development activities at Charlotte Pass commenced to manage and promote recreation by the government.

In 1941 the NSW government began an inquiry into the power-generating potential of the rivers of the Snowy Mountains, proposing a scheme in 1944 to use the areas water for power and irrigation, and divert the waters of the Snowy River. Due to the complexity of state views around the use of water, the federal government introduced legislation that led to the establishment of the Snowy Mountains Hydro-electric Authority, to implement the power generation plan. This plan would result in a 25-year construction period, with Snowy Mountains Hydro-Electric Scheme (Snowy Hydro Scheme) opening in 1974. The Snowy Hydro Scheme consisted of seven power stations, 16 dams, 780 kilometres of aqueducts, tunnels and roads and railway tracks. It remains an integral part of Australia's renewable energy generation, evident by the Snowy 2.0 development, which is aimed at strengthening on demand energy and large-scale energy storage in the Snowy Mountains. At the same time as the Snowy Hydro Scheme was being developed, the Kosciuszko State Park was established via the *Kosciuszko State Park Act 1944* (State Park Act). The establishment of the State Park and its boundaries, as with previous areas of preservation in 1906 and the 1930's, was one driven by the societal values at the time. The focus on soil and water conservation, as well as plans for the development of hydro-electric potential of the mountains, resulted in the gradual withdrawal of grazing leases in KNP. It is noted however, that it was not until 1972 that grazing within the entire park was terminated (NPWS, 2006).

An amendment to the State Park Act opened the way for the development of the first private ski accommodation in the 1950's and 1960's. Perisher Valley was the first modern day ski resort to be built in 1952, this was followed by development of Thredbo Valley with the construction of the Alpine Way in 1954. The Thredbo Village was extended in 1964 with expanded commercial lodges and club lodges, as well as several ski lift expansions (OzArk Environment Heritage, 2022a). The two villages differed in that lodges at Perisher were dispersed throughout the valley, while the Thredbo Village was much more compact, a legacy that remains today, and impacts the amenity and visitor enjoyment values of both areas.

In 1967 responsibility for the State Park was transferred to the NPWS under the NSW *National Parks and Wildlife Act 1974* (NPW Act). Section 30E of the Act, states the purpose of reserving land as a national park to 'identify, protect and conserve areas containing outstanding or representative ecosystems, and natural or cultural features, landscapes or phenomena that provide opportunities for public appreciation, inspiration, sustainable visitor use and enjoyment'.

Today, the popularity of the park is evident, with KNP being the fourth most popular national park in NSW, with up to 3.2 million visitors each year. A number which is growing annually and predicted to continue to grow. With this popularity comes the needs to manage the impacts of visitors, and balance the parks recreational use with its environmental, cultural and social values. While the recreational activities undertaken in KNP are wide ranging, the winter presence of snow remains the main drawcard for many visitors, and thus the period when visitor impacts and the need to adequately manage these impacts are the greatest.

2.2 Existing management of visitation

Modern day KNP is a culmination of various factors which have influenced its establishment, expansion, and development over time. Existing visitor management remains tied to those influences, including historical land use, the presence and management of the ski industry and the legacy of the Snowy Hydro Scheme.

All these factors remain an influential presence in decision making and environmental management in areas of KNP. This is reflected by the existing regulatory and environmental framework (discussed in detail in Appendix B), which has resulted in various management areas being defined, and a series of head and sub leases established to manage operations within alpine resort areas (Specifically Thredbo, Perisher, and Charlotte Pass as relevant to the Snowy SAP). This existing framework allows for a management focus on high visitation areas around alpine resorts, sets an upper limit on development in KNP using a bed limit, and separates wider landscape level management from alpine resort operations (where appropriate to do so).

While the existing framework has remained in operation for some time and has generally resulted in positive environmental and social outcomes, it is not without its limitations. The framework is based on segmented, often overlapping roles and responsibilities between NPWS, DPE and resort operators, and it has generally resulted in development occurring on a case-by-case basis with limited strategic planning. It has also resulted in limited development in response to visitor growth, reduced the potential for renewal works on aging buildings and infrastructure, and placed pressure on services infrastructure (such as roads, wastewater, parking). These limitations result in negative impacts to the amenity, visitor enjoyment, and environmental values which attract visitation to the region, and which are key objectives of KNP.

2.3 Future management of visitation

The Snowy Mountains SAP planning process provides a unique opportunity to consider the regulatory and environmental management framework which underpins visitor management in high visitation areas of KNP. It also allows for the consideration of a series of aspirations in theme areas which have traditionally not been a significant focus of the existing management framework. The Snowy Mountains SAP planning process allows for a long-term view on the interactions between visitation growth and the infrastructure to support that growth, while minimising impacts, and protecting and enhancing environmental, social and cultural values. Such a process is not, however, without challenges. To meet stakeholder, community, and visitor expectations, it requires a structured, collaborative, and creative approach such as the implementation of a CCF.

A CCF is a method for managing visitors in a protected area, taking into consideration what are appropriate levels of impact based on a series of selected values, and facilitating a response when those values are impacted. Consideration of the implementation of a CCF has been previously investigated by NWPS as an appropriate tool to manage visitors.

CCF's are complex and expensive frameworks to develop, implement and monitor; however, the Snowy Mountains SAP master planning process provides a unique opportunity to consider how to best manage visitors and design an appropriate CCF for implementation in areas where the impacts of visitation are greatest. The CCF brings together the Snowy Mountains SAP aspirations, supporting technical assessments and the legislative framework. It provides a level of certainty, clear direction, and confidence that the provisions implemented are appropriate, but also flexible enough to introduce innovation and provide proponents with a clear view on what is considered appropriate development and where that development may occur. It also provides a planning response when impacts to values exceed expectations.

A detailed literature review of published CCF's is included in Appendix A and a summary of the assessment process, opportunities and considerations, and challenges of implementing a CCF in KNP is included in Appendix E.

A CCF, in conjunction with technical assessments and the SAP Master Plan, would:

- identify appropriate development in appropriate areas and consider where 'hard capacity' constraints exist. That is, where there is a physical limit on visitation, a physical limit to the infrastructure capacity to manage that visitation, or a limitation imposed by the exclusion from an area
- provide solutions to those constraints where possible and appropriate to do so
- consider 'soft capacity' constraints, which are generally not managed well under traditional assessment methodologies. This includes constraints which impact visitor experience such as crowding or ongoing management constraints such as impacts to biodiversity and water quality.

To do this, the CCF needs to acknowledge the historical and modern day use of the park by the ski industry and the social and economic values this provides to the public and local community. It also needs to balance those interests with the protection, preservation and enhancement of heritage and environmental values. As such the CCF must consider the range of stakeholders and wide scope of interests and agendas, in developing and guiding appropriate outcomes.

3 Methodology

The following methodology has been undertaken in the development of the CCF. The steps can be divided into a context analysis (desktop assessment), detailed assessments (evidence base), and the final CCF (structure plans) (Figure 3.1). Specifically, the methodology included:

- an analysis (by literature review) of the current best practice methodologies for carrying capacity assessments, with a
 focus on protected areas with similar characteristics and uses to KNP (Appendix A). This included:
 - a summary of the contemporary concept of carrying capacity, an in-depth analysis of published carrying capacity frameworks and review of examples of the implementation of CCFs in Australia and internationally
 - a review of the limitations of CCF's and the use of monitoring indicators to guide decisions, and an assessment
 of the most appropriate published CCF for consideration in the Snowy Mountains SAP alpine precincts.
- a review of the existing regulatory and environmental management framework in alpine precincts, specifically in relation to alpine resort areas of Thredbo, Charlotte Pass, Perisher, and Selwyn and smaller operators outside these areas (Appendix B and Appendix D). This included reviewing the current mechanism for managing visitors and environmental values (including management requirements and performance indicators) in alpine resort areas, and previous work undertaken by NPWS in reviewing the current mechanism for managing visitor numbers
- consideration, in consultation with DPE and NPWS, of an appropriate CCF in the context of the Snowy Mountains SAP and specifically in alpine precincts (Appendix E)
- consultation with key stakeholders including NPWS, Thredbo, Perisher, Charlotte Pass, DPE, Regional Growth NSW and Regional NSW, including participation in Enquiry by Design (EbD) workshops in Thredbo
- a review of technical studies developed as part of the Snowy Mountains SAP Master Plan. The technical studies
 were used to inform the capacity constraints on key issues such as traffic and access, infrastructure, biodiversity and
 water quality, and to identify key outcomes to manage the Snowy Mountains SAP driven increases in visitation for
 each technical area
- development of the CCF to bring together the Snowy Mountains SAP Master Plan, Alpine DCP and ongoing environmental management in alpine precincts.





4 Snowy Mountains SAP Carrying Capacity Framework

Chapter 4 provides the details of the six stage CCF to be implemented in the Snowy Mountains SAP alpine precincts (Figure 4.1). The CCF is component of the Snowy Mountains SAP master planning process and provides a structure for the appropriate management of future visitation to 2061 within the sensitive environment of KNP.



Figure 4.1 Outlines of the CCF for the Snowy Mountains SAP alpine precincts

This CCF is structured as follows:

- Stage 1 (Section 4.1) establishes aims and objectives of the CCF.
- Stage 2 (Section 4.2) identifies environmental, social and cultural values which require protection and management via a series of value specific management objectives.
- Stage 3 (Section 4.3) refines the geographical scope of the CCF identifying the location of existing and future areas of high visitation.
- Stage 4 (Section 4.4) identifies the existing environment, including threats to identified values and provides consideration of current and future capacity constraints or conditions and opportunities via a review of relevant technical studies.
- Stage 5 (Section 4.5) identifies the mechanisms and actions within those mechanisms to ensure values are
 protected.
- Stage 6 (Section 4.6) establishes a monitoring and response procedure for adaptive management of visitor impacts and future development within the Snowy Mountains SAP, and KNP governance framework of the alpine precincts.

4.1 Stage 1 – Aims and objectives

The purpose of Stage 1 is to establish the strategic aims and objectives which guide the CCF. The aims and objectives established in this stage have been developed in consideration of the management objectives as outlined in the existing regulatory and environmental management in KNP (refer to Appendix D) and in consideration of the Snowy Mountains SAP aspirations.



Figure 4.2 Stage 1 – Carrying Capacity Framework

Guidance Note 3 – Stage 1 of the CCF

Determining of the strategic aims and objectives is the first step of a CCF and allows for the high-level identification of what is ultimately being achieved through its implementation. These aims and objectives are fundamental to ensure that future visitor management and future development is appropriate for the setting in which it exists, and that environmental, social and cultural values, the highest level of value definition, are maintained or enhanced. The objectives have been established in consideration of the known values which exist in KNP, existing legislative aims and objectives, and aspirations as set out in by the Snowy Mountains SAP planning process.

The objectives of the CCF are to:

- 1 manage the growth of visitation in alpine precincts to ensure the protection, maintenance, and enhancement of identified values, specifically but not limited to:
 - a ensuring biophysical values (including habitat, biodiversity, landforms and landscapes) are protected, maintained and enhanced
 - **b** ensuring cultural heritage values are enhanced and cultural heritage places, objects and features of significance to Aboriginal people are protected, conserved, and promoted
- 2 ensure opportunities are provided for visitors to undertake a wide range of recreational activities at places and in ways that optimise the quality of the experiences available, while minimising adverse impacts upon the values of KNP and conflicts with other users

- 3 ensure development within the Snowy Mountains SAP alpine precincts:
 - a is commensurate with the Snowy Mountains SAP Master Plan
 - **b** is appropriately located and designed in a manner commensurate with the aspirations and all value objectives
 - c is staged in an appropriate manner to ensure adverse environmental, social and cultural impacts are minimised
 - d does not inhibit the ongoing maintenance of biophysical values, improved social outcomes, and the regeneration of cultural heritage values
- 4 ensure all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities, and where appropriate enhance environmental, social and cultural values
- 5 respond to negative impacts or non-compliance by limiting future development until non-compliances have been investigated, resolved, and reversed
- 6 ensure alignment with the objectives of the Snowy Mountains SAP Master Plan and KNP PoM
- 7 ensure any proposed development, that does not align with the SAP Master Plan and supporting Alpine DCP must be appropriately assessed.

4.2 Stage 2 – Values and value objectives

The purpose of Stage 2 is to identify the specific values which are important, and to set management objectives for their protection. The values and management objectives have built on from those as identified in the KNP PoM and discussed in Appendix D. These include NPWS led values and objectives, as well those led by the Snowy Mountains SAP aspirations, such as those relating to sustainability, which have historically not been a key focus of NPWS.





Guidance Note 4 – Identification of values and value objectives

This stage builds on from the CCF objectives in Stage 1 to define the environmental, social and cultural values and set specific value objectives. This stage acknowledges the values identified in the existing environmental management framework, and then builds on those by identifying additional, or more specific, values and value objectives which traditionally have not been a focus on existing regulation or management. The inclusion of these additional values will result in a strengthening of the existing values in KNP.

4.2.1 SAP values – KNP

Table 4.1 provides a summary of values which are present within the SAP investigation areas in KNP. Identifying these values provides a strategic direction for their management and protection within the CCF. These values have been established in consultation with NPWS, DPE, building on existing environmental management values identified in, and managed by the KNP PoM, as well as inputs from technical specialist assessments completed as part of the Snowy Mountains SAP master planning process.

Classification	Existing values	Updated values
Environmental	Water quality, Pollution Prevention & Incident Management, Biodiversity, Cultural Heritage, Air Quality, Emissions, Energy Conservation, Waste Management	Water Quality (including alpine wetlands and riparian areas), Water resources, Biodiversity (including aquatic biodiversity), Landscape (including soil resources), Sustainability, Climate Change (CO ₂ emissions and energy conservation, climate resilience, ESD leadership).
Social	Sustainable Recreation, Resort Amenity	Sustainable recreation and community involvement, resort amenity/urban design, visitor experience.
Cultural	Cultural Heritage	Aboriginal cultural heritage (sense of place, continued connection to country), Built cultural heritage.

 Table 4.1
 General classification and values requiring protection

4.2.2 Value objectives

Table 4.2 establishes the management objectives for of the values identified in Section 4.2.1. These objectives have been built on from those identified in the KNP PoM (refer to Appendix D) to ensure consistency with existing management framework, and where appropriate, additional objectives have been identified to capture all values.

Value	Objectives
Water quality	 protect the environmental health and aquatic ecosystems of alpine streams from development and visitor activities protect, preserve, and enhance riparian and alpine wetland areas to ensure the protection of ecosystem functions, and water quality values ensure the environmental condition of all watercourses and waterbodies is maintained or improved. prevent and manage leaks, spills, and unlicensed discharges of potentially harmful substances to the environment.
Water Resources	 ensure the sustainable use of water resources and protect water resources from overuse ensure all operators demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.
Biodiversity	 preserve the unique landscape and biodiversity values protect flora, fauna, and ecological communities to prevent loss of biodiversity avoid impacts to threatened ecological communities, threatened species and their habitats preserve and rehabilitate natural waterways, which contribute to the areas character and biodiversity restore, maintain, and enhance vegetation and ecosystem functions in existing and previously disturbed areas implement threat management actions to protect flora, fauna, and ecological communities avoid impacts to endemic alpine biodiversity with highly restricted distributions.
Landscape	 prevent and manage leaks, spills, and unlicensed discharges of potentially harmful substances to the environment ensure all environmental accidents, pollution events and contamination are responded to rapidly and effectively to protect park values and visitor safety minimise waste, maximise resource recovery and prevent environmental harm from waste disposal ensure all operators implement measures to protect soils resources
Sustainability	 ensure environmental resilience and sustainability are implemented into all development activities invest in renewable energy and green infrastructure aim for a carbon negative future develop opportunities to connect with nature continue protections of the vulnerable alpine environment.
Climate change	 reduce or offset CO2 emissions ensure all operators and new developments consider future climate change support operations and development associated with year-round visitation improve the efficiency of energy consumption and increase the use of renewable energy ensure all operations and activities are undertaken in ways that minimise the production of greenhouse gas emissions.

Table 4.2 Summary CCF value objectives

Value	Objectives
Sustainable recreation and community involvement	 ensure the recreational opportunities and facilities of the alpine resorts are provided and managed sustainably ensure a range of recreational activities are available to suit all visitors encourage community cooperation and involvement in the management of values.
Resort amenity/ urban design	 conserve and enhance the existing amenity of the alpine resorts and surrounding areas managing light spill from existing and future developments ensure scenic quality is maintained and, wherever possible, enhanced conserve and enhance the existing alpine landscape character
Visitor experience	 ensure visitors to the alpine resorts have an enjoyable and safe experience ensure visitors have a range of recreational activities available.
Aboriginal cultural Heritage	 conserve and promote the Aboriginal cultural heritage values of the alpine resort areas, including promoting and enhancing sense of place, continued connecting with country and co design frameworks identify, protect, and manage aboriginal heritage sites.
Built cultural heritage	 conserve and promote built cultural heritage values identify, protect, and maintain built cultural heritage sites.

4.3 Stage 3 – Visitor impacted areas

The purpose of Stage 3 is to define the geographical scope of where the CCF would apply. While it is noted, there are impacts associated with visitation within the entire Snowy Mountains SAP study area, this CCF only applies to the alpine precincts which are defined as those within the boundaries of KNP.





Guidance Note 5 – Visitor impacted areas

Identifying where visitor impacts are the greatest, and when those impact occurs, is a fundamental step in the CCF. It creates a separation of geographical areas or zones and allows regulations and management to be targeted to high visitation areas where impacts of visitation are the greatest.

In KNP, the existing regulatory and environmental management framework (as discussed in Appendix B) creates this separation via a distinction between high visitation zones, referred to as 'visitor service zones' (which includes alpine resort areas, development nodes, and operational centres) major and minor road corridors, backcountry and wilderness areas. This separation of zones, recognises, that areas of reduced visitation such as backcountry or wilderness, while remaining important from a management perspective, require a different level of management, and may not need the same resources or oversight to maintain their value objectives.

In KNP this separation of key parts of the national park has been of particular importance due to the sharing of regulatory responsibilities (between government agencies), and the presence of operational stakeholders (alpine resorts and accommodation providers) which are a key driver of the high visitation to the region.

The CCF builds on the existing management areas in KNP, by reclassifying some of the existing 'visitor service zones', which experience the bulk of visitation, as alpine precincts in the Snowy Mountains SAP, as well as establishing additional alpine precincts, where some development activities would help manage future visitation in KNP.

Figure 4.5 and Figure 4.6 show the Snowy Mountains SAP alpine precincts, all of which are located within the boundary of KNP.



Figure 4.5 List of Snowy Mountains SAP alpine precincts



Figure 4.6 Location of Snowy Mountains SAP alpine precincts

Guidance Note 6 – Alpine resort areas

The CCF builds on the existing governance and environmental framework which is present in KNP to establish the alpine precincts – alpine resort areas. As part of the establishment of the previous governance and environmental framework it was recognised that these areas are where the majority of visitation occurs, and thus are the areas where the greatest level of regulation and management is required to ensure values are protected.

This section provides a high-level summary of the key values for each of the alpine resort area. Further details of the values and the condition of those values is included Stage 4 (Section 4.4).

4.3.1.1 Perisher Range Resort

The perisher range resort includes several smaller areas including the Perisher Village, Guthega, Blue Cow, Smiggin Holes, as well as Bullocks Flat which provides unique non-private vehicle access (via the Skitube and over snow transport) to Perisher and Charlotte Pass. The Perisher Range is the location of the Perisher Alpine Resort, one of Australia's largest alpine resort areas, and contains some of the highest alpine accommodation in NSW. As such the area contains significant recreational and visitor experience value (with a predominance of winter visitation) and provides a unique opportunity for on snow accommodation which is limited in NSW.

From an environmental perspective the area contains significant biodiversity, and water catchment values, with several creeks and waterways traversing the precinct. This includes Perisher Creek, Pipers Creek, Farm Creek, Blue Cow Creek and Spencers Creek, while the key waterway adjacent to Bullocks Flat is the Thredbo River. These waterways provide a high quantity and quality of water for downstream users including hydro-electrical generation. In addition, all the tributaries of the Snowy River form part of the Snowy River Endangered Ecological community.

The Perisher Range precinct also contains many alpine peat and bogs in lower areas of the Alpine resort and adjacent to roadways, accommodations and parking areas which contain a high level of ecosystem value. This high level of ecosystem value also includes the presence of endangered ecological communities, and threatened species, which are located throughout the precinct.

The following key attributes of the Perisher Range area require protection or consideration in any development activity:

- key waterways such as alpine wetlands and the potential to impact water quality
- infrastructure requirements associated with any new development
- winter transport and access considerations
- biodiversity constraints and amenity protections in village areas.

4.3.1.2 Thredbo Village

Thredbo Village is the only true alpine village located in NSW, and is the location of the Thredbo Ski Resort. The village and resort areas contain high amenity, and recreational values in both winter (winter sports activities) and summer (hiking, mountain biking, summer events). Thredbo Village provides a key route for backcountry access to the Kosciuszko walk and access to the main range (including direct access via chairlifts and walking trails).

Thredbo Village is traversed by the Thredbo River, which contributes around 69% of the average annual flow into Lake Jindabyne, with a catchment for around 34 km² upstream of the Thredbo Village, and 52 km² downstream. The river is part of the Snowy River Endangered Ecological Community, one of the threatened ecological communities present in the precinct.

Thredbo Village also contains cultural heritage significance that includes both the built environment, related to the history of the ski industry in Australia as well as Aboriginal cultural significance of the alpine rivers and surrounds.

The following key attributes of the Thredbo Village area require protection or consideration in any development activity:

- key waterways such as Thredbo River and the potential to impact water quality
- infrastructure requirements associated with any new development
- winter transport and access considerations
- biodiversity constraints, bushfire risk and amenity protections
- geotechnical risks.

4.3.1.3 Charlotte Pass

Charlotte Pass is the location of the Charlotte Pass alpine resort, and the only alpine resort in Australia that does not have a road vehicle access during the winter. The small village contains several ski clubs (with cultural heritage significance) and is set in the highly aesthetic Spencers Creek Valley, with significant landscape elements (and value). As with the Thredbo and Perisher alpine precincts, the waterways of Charlotte Pass contain high catchment values associated with the minimal levels of disturbance, as well as biodiversity values associated with the upper catchment wetlands. This high level of ecosystem value also includes the presence of endangered ecological communities, and threatened species, which are located throughout the precinct. Charlotte Pass is also a key route for backcountry skiers and hikers including the Mount Kosciuszko summit walking trail.

The following key attributes of the Charlotte Pass area require protection or consideration in any development activity:

- key waterways such as alpine wetlands and the potential to impact water quality
- infrastructure requirements associated with any new development
- winter transport and access considerations
- biodiversity constraints and amenity protections
- the heritage significance of the existing buildings and facilities.

4.3.1.4 Selwyn

While it is noted, no value identification has extended to Selwyn due to the ongoing recovery from the 2020 bushfires, and no changes to the existing development or changes to the planning pathway for any other areas of KNP is considered as part of this CCF. As such the Selwyn alpine precinct has not been considered further as part of this assessment.

4.3.2 Alpine precincts – Tourism opportunity areas

Guidance Note 7 – Tourism opportunity areas

The Snowy Mountains SAP master planning process has identified six additional alpine precincts that are considered appropriate for varying levels of additional development activity. These areas have been selected based on several factors, including but not limited to, existing land use and infrastructure, level of existing disturbance, presence and value of biodiversity and cultural heritage, location and proximity to alpine resort areas, and visual amenity.

Most of these areas have also been previously recognised within the governance and environmental management framework, however the level of regulation and management is commensurate with the potential impacts of visitation with operations and footprints in these precincts smaller in size and intensity of use.

4.3.2.1 Thredbo Ranger Station

The Thredbo Ranger Station is located along Alpine Way between Bullocks Flat and the Thredbo Village. It consists of an area of buildings used by NPWS for general operations activities. There is currently no public access to the site, however there is opportunity to re-purpose the existing buildings for tourism use.

The following key attributes require protection or consideration in any development activity in these three areas:

- the proximity of the precinct to the Thredbo River, and their potential to impact water quality
- the availability of a suitable source of water and limitations of extraction licences
- transport and access considerations (in both summer and winter)
- amenity considerations of the Thredbo Village
- biodiversity constraints, and bushfire risk
- the provision of adequate infrastructure to service future visitation.

4.3.2.2 Sponars Chalet

The Sponars Chalet is located on Kosciuszko Road around 9 km from the Perisher Village. The precinct is located at an altitude of 1500 metres and the chalet currently has a provision for a total of 100 beds (as defined by the KNP PoM). Sponars Chalet is located adjacent to Diggers Creek and is popular in winter due to its proximity to Perisher, and its affordable rates.

The following key attributes of the Sponars Chalet area require protection or consideration in any development activity:

- the proximity of the precinct to the Diggers Creek, alpine wetlands and the potential to impact water quality
- infrastructure requirements associated with any increase to hotel capacity
- winter transport and access considerations
- amenity and biodiversity considerations of the surrounding area
- the heritage significance of the existing facilities.

4.3.2.3 Ski Rider Hotel

The Ski Rider Hotel is located on Kosciuszko Road around 13 kilometres from the Perisher Village. The hotel provides additional accommodation in KNP outside of the key alpine resort areas, with a free shuttle bus service to access Perisher and Smiggin Holes. The hotel is a full-service hotel, offering accommodation, food, entertainment, and onsite ski equipment hire. The existing KNP PoM currently allows a total of 339 beds in the hotel. The site is located adjacent to Sawpit Creek and the surrounding areas are heavily vegetated with native bushland. As with Sponars Chalet the site is currently popular in winter due to its proximity to Perisher, and its affordable rates.

The following key attributes of the Ski Rider Hotel require protection or consideration in any development activity:

- the proximity of the precinct to the Sawpit Creek, and potential to impact water quality
- infrastructure requirements associated with any changes to the hotel capacity
- winter transport and access considerations
- biodiversity constraints associated with native vegetation communities located around the site.

4.3.2.4 Kosciuszko Tourist Park

The Kosciuszko Tourist Park (also known as Kosciuszko Mountain Retreat) is located on Kosciuszko Road around 17.5 kilometres from the Perisher Village and 16 km from Jindabyne. The site contains multiple accommodation options including chalets, cabins, caravan sites and camping facilities, with the KNP PoM currently allowing for a total of 72 beds. As with Sponars Chalet and Ski Rider, the park provides additional accommodation in KNP outside of the key resort areas. It is also the only campsite in KNP that provides shower, indoor cooking, and communal areas. The site is set among native bushland, adjacent to Sawpit Creek.

The following key attributes of the Kosciuszko Tourist Park require protection or consideration in any development activity:

- the proximity of the precinct to the Sawpit Creek, and potential to impact water quality
- infrastructure requirements associated with any changes to the chalet, cabin, caravan or camping sites
- winter transport and access considerations
- biodiversity constraints associated with native vegetation communities located around the site.

4.3.2.5 Creel Bay

Creel Bay is located around 24 kilometres from Perisher via Kosciuszko Road. NPWS have recently expanded existing cottage style accommodations providing additional year-round opportunities adjacent to Lake Jindabyne. There is good opportunity for further year-round development at this location.

The following key attributes of the Creel Bay require protection or consideration in any proposed development:

- the proximity of the precinct to Lake Jindabyne and potential to impact water quality
- infrastructure requirements associated with any changes to accommodation capacity
- winter transport and access considerations
- biodiversity constraints associated with native vegetation communities located around the site.

4.3.2.6 Island Bend

Island Bend is a disturbed area currently utilised as a campground located around 17 kilometres from Perisher Village. The campground, located adjacent to Guthega Road and the Snowy River, contains 30 sites with picnic tables, barbecue, and toilet facilities. 4WD access can be required during wet weather to access the lower portion of the campground. The site offers the greatest potential for an expansion of existing camping facilities in KNP. The area has the potential for heritage items, as it is the location of the former settlement for the Snowy Hydro Scheme.

The following key attributes of Island Bend require protection or consideration in any development activity:

- the proximity to the Snowy River, and potential to impact water quality
- the availability of a suitable source of water and limitations of extraction licences
- infrastructure capacities associated with any increase in camping capacity
- transport and access considerations (in both summer and winter)
- amenity and biodiversity considerations
- the built cultural heritage significance including former worker camps in the area associated with the early Snowy Hydro works.

4.4 Stage 4 – Snowy Mountains SAP areas, values and consideration of capacity constraints

The purpose of Stage 4 is to assess the existing conditions of key values identified in previous stages, and where appropriate, consider constraints of services and infrastructure which directly or indirectly impacts these values.

This stage is based on the technical assessments completed to guide the Snowy Mountains SAP master planning process, and considers the impacts of the Snowy Mountains SAP led visitor growth (Section 4.4.1.1), and climate change projections (Section 4.4.1.2) on those values, or service and infrastructure demands.

Stage 4 of the CCF provides a summary of the existing conditions and future considerations of each technical assessment. More details, including the assessment methodologies, and background information is included in each paper, and should be read in conjunction with this framework.





Guidance Note 8 – Snowy Mountains SAP technical assessments

As discussed in Appendix A, the provision of technical assessments, while vital to ensuring robust planning and accurate outcomes, is often a key challenge in the implementation a CCF. They require a high level of technical expertise and time and are generally cost prohibitive.

The technical assessments completed for the Snowy Mountains SAP have been designed to guide the planning process and ensure that all technical areas are well understood. The technical assessments consider the entire Snowy Mountains SAP study area which includes both Jindabyne and surrounds, as well as alpine precincts (as identified in Section 1.1). However, for the purpose of the CCF, Stage 4 focuses on technical assessments of the alpine precincts.

Each technical assessment, considering the related technical theme, was developed to:

- gain an understanding of the existing context of the Snowy Mountains SAP study area (including the alpine precincts)
- provide examples of benchmarking or best practice planning, and management in areas or regions of similar characteristics
- assess the existing environment/or existing provision of services
- consider the implications of future visitation (considering growth scenarios and climate change)

 provide recommendations on the planning or management response to ensure future visitation is managed appropriately and is consistent with the Snowy Mountains SAP aspirations.

As related to the CCF, the outcome or recommendations of each assessment (refer to Appendix F) is then fed into Snowy SAP planning, regulatory and environmental management mechanisms which make up Stage 5 of the framework.

4.4.1 Considerations and assumptions

4.4.1.1 Future visitation

To assess the potential for future value impacts, future visitation and population forecasts were provided by the Centre for International Economics (CIE) in their Context Report "Strategic economic context for the Snowy Special Activations Precinct" (CIE, 2020) revised forecasts of visitation and population (CIE, 2020a), and updated visitation and population projections (CIE, 2022). These forecasts have been used to determine where any exceedances to capacity constraints exist, and where possible, the likely infrastructure requirements to manage visitors and protect key values.

Guidance Note 9 – Future visitor growth and the CCF

Considering future growth in visitors is key to understanding and managing visitation in KNP. It is equally important that this future growth includes any changes as a result of planning, such as the Snowy Mountains SAP. At its most fundamental, the CCF needs to consider the demand for visitors to ensure this demand can be met, and infrastructure can be provided in a manner that maintains environmental, social and cultural values of KNP.

4.4.1.2 Climate change

Climate change poses a significant challenge to the NSW Alpine Region. Through the development of the Snowy Mountains SAP, the need to assess the impacts of, and plan for climate change was a key theme.

WSP completed an assessment of the climate change impacts as part of the KNP carrying capacity review (Appendix G). The assessment included:

- a summary of the climate change projections produced as part of the NSW/ACT Regional Climate Modelling (NARCLiM)
- a climate change risk assessment (Table G.2 in Appendix G) to highlight the key climate change risks that have the potential to impact the carrying capacity of the KNP
- an assessment of the implications of climate change on snowmaking and the flow-on impacts for energy and water consumption.

In addition, a Climate Change Adaptation Plan (DSquared, 2020) was developed to further consider impacts associated with climate change, and detail mitigation plans and strategies to be incorporated into the master plan.

Guidance Note 10 – Climate change and the CCF

Climate change is projected to create significant challenges for the Snowy Mountains region and one which may place additional strains on the visitation capacity of the alpine precincts. To understand what these impacts may be, it is important to acknowledge the climate change projections for the region and ensure long-term planning takes these projections into consideration. These projections have the potential to not only impact environmental values, but also impact the ability of alpine resort operators to provide and maintain high levels of recreational value. The impacts of climate change therefore are a key consideration in the development of the CCF.

Climate projections

In 2018/2019 DPE carried out a detailed study of models produced as part of the NSW/ACT Regional Climate Modelling (NARCLiM) project. The purpose of the study was to provide annual, monthly and seasonal future climate projections specifically for the Alpine Region and surrounds.

Key observations from the projections include:

- increase in mean maximum temperatures in the near (2030) and far future (2070) across all seasons
- large decreases in the number of cold nights (-2°C) and increases in mean minimum temperatures
- more dry days with large reductions in precipitation in winter and spring
- projected reduction in precipitation is greatest in winter and spring and significant reductions in natural snowfall are expected during the snow season
- increases in the annual mean Forest Fire Danger Index (FFDI).

A full summary of climate change projections is included in Table G.1 in Appendix G.

Climate change risk assessment

To inform the development of a CCF, WSP completed a preliminary climate change risk identification process to highlight the ways in which climate change may affect the carrying capacity of KNP in the future. These risks have then been linked to the existing EMS KPIs discussed in Section B1.9.

The purpose of this process is to highlight how these climate change risks could influence existing KPIs, either by altering KPI baselines or influencing the ability for these KPIs to be achieved by alpine resort management and/or NPWS. This process would assist in driving a more detailed consideration of climate change impacts in the establishment of future guidelines for managing visitor impacts and the carrying capacity of KNP.

In summary climate change impacts and related responses in KNP has the potential to impact water quality, energy conservation, resort amenity, air quality and CO_2 emissions, biodiversity and recreational activities. A detailed summary of these potential impacts is included in Table G.2 in Appendix G, and where applicable have been incorporated into the relevant technical assessments summarised in Sections 4.4.2 to 4.4.12.

Climate change and artificial snowmaking

Artificial snowmaking is currently used in Australia and around the world to complement natural snowfall and extend the ski season. Typically, artificial snowmaking in the alpine resort area commences in early May and continues through to August. Snowmaking may continue into September depending on snow coverage and weather conditions.

Snowmakers generally operate from late afternoon through to the early morning, during periods when optimal ambient snowmaking conditions occur (below -2°C wet bulb). Snowmakers may run 24 hours a day if required.

Snowmaking is an energy and water intensive process and makes up a significant amount of winter energy and water demand at Perisher, Thredbo and Selwyn resorts. The increased requirement for artificial snowmaking would result in additional demand for water and energy.
4.4.2 Biodiversity

This section has been informed by the *Snowy Special Activation Precinct – Biodiversity Assessment of Alpine Sub-Precincts* (Biodiversity Study) (WSP, 2022) and based on discussions with NPWS. It provides summary of the existing biodiversity values within the alpine precincts and considers the management implications of the interaction of future visitation, development and biodiversity values.

Guidance Note 10 – Biodiversity and the CCF

A key objective of KNP, as defined in the *National Parks and Wildlife Act 1974* incudes 'the conservation of biodiversity, maintenance of ecosystem function, and the protection of the ecological integrity for present and future generations". To ensure these objectives are at the forefront of planning decisions in the Snowy Mountains SAP alpine precincts, the consideration of biodiversity values is a key component of the CCF.

Impacts to biodiversity values could include both direct impacts such as the removal of vegetation or intrusion into habitats, or indirect impacts associated with other processes and activities:

- direct impacts can be managed through an avoidance or minimisation policy, whereby exclusion zones are established, to prohibited or limited disturbance of known biodiversity or ecosystem vales and reduce the potential for cumulative impacts associated with future development activities
- indirect impacts can be managed through infrastructure design, the implementation of ongoing management procedures, and/or management plans to ensure populations are protected, maintained, or enhanced. For example, this could be in the form of fauna crossings, pest species management, rehabilitation plans and activities, or through actions such as the reduction of stormwater run-off particularly in sensitive habitats.

The interaction of these direct and indirect impacts with the CCF, mean that biodiversity values form both a physical or hard limit constraint to capacity, as they limit the available space for future development activities, and also a soft limit, in that they require ongoing management to ensure day to day activities are do not negatively impact values.

4.4.2.1 Existing conditions

Figure 4.8 provides a summary of the existing biodiversity values in the alpine precincts, these values have been informed by the Biodiversity Study, which contains a detailed assessment of biodiversity values within each of the alpine precincts.



Figure 4.8 Summary of existing biodiversity values in KNP

The Alpine region of NSW is characterised by a sub alpine climate and environment which is subject to continuous snowfall for one to four months of the year. The vegetation of KNP is rich and diverse reflecting the range of climates, altitudes, landforms, soils, and geology. In general, the lower altitude area is dominated by grassy woodlands, from the subalpine woodlands vegetation class. As altitude increases the vegetation changes to lower subalpine woodlands dominated by *Eucalyptus niphophila* and tall health shrubland. At Charlotte Pass, the area is dominated by the presence of Alpine heaths (boulder fields) and alpine bog and fens.

Threatened ecological communities

One plant community type (PCT) within the alpine precincts, Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion (PCT 637) is consistent with a threatened ecological community (TEC):

- Alpine Sphagnum Bogs and Associated Fens listed as endangered under the EPBC Act
- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, Southeast Corner, South Eastern Highlands and Australian Alps bioregions – listed as an Endangered Ecological Community under the BC Act.

This TEC is present at Charlotte Pass, Perisher, Guthega and Kosciuszko Tourist Park precincts.

Threatened fauna

KNP contains significant biodiversity and is known to provide habitat for approximately 300 vertebrate species. Threatened species and significant habitat known to occur in alpine precincts include:

- a significant population of Mountain Pygmie Possum (Burramys parvus) at Blue Cow and Charlotte Pass
- Broad-toothed rat (Mastacomys fuscus) which has been recovered in all alpine resort areas
- Guthega Skink (Liopholis Guthega) is known to occur at Charlotte Pass, Thredbo, and the Perisher Range
- sphagnum bogs and fens which are important habitats that offer breeding sites for many threatened fauna and migratory fauna which occur in the area
- habitat for numerous other threatened fauna (refer to section 3.2.5 of the Biodiversity Study).

Other significant values identified include the presence of connectivity corridors, old growth snow gum woodlands, and boulder fields. These are further discussed in section 2.2 of the Biodiversity Study.

4.4.2.2 Future considerations

In consideration of the Snowy Mountains SAP master planning process, the protection of biodiversity values and consideration of opportunities related those values can be viewed in two ways.

Firstly, by using front end loaded technical assessments, such as the Biodiversity Study, an evidence-based approach can be adopted to determine the best outcome and provide a clear pathway for the right types of future development, in the right location. This approach is based on the general hierarchy principle of avoidance, minimisation, mitigation and offset of impacts. This approach would:

- ensure development within areas of high conservation value (Montane Peatlands and Swamps) is avoided
- focus on mapping areas best suited to future development, which includes consideration of areas already disturbed due to existing development, cleared areas and areas supporting exotic vegetation
- ensure development is of low impact and suitable for the location such as co-locating or infill developments, and developments near existing infrastructure
- create appropriate buffers between high ecological constraints and development
- require any residual impacts to be further assessed.

This approach recognises that areas of good condition vegetation have the highest biodiversity values and ensures development in these areas is avoided or minimised. This approach also considers additional elements required for development, such as associated infrastructure as well as bushfire asset protection zones.

The second approach for the protection of biodiversity lies with operators such as alpine resorts to implement appropriate Environmental Management Systems (EMS). The provision of an EMS is aimed at protecting, maintaining and enhancing biodiversity values in the alpine precincts, and allow NPWS to set target and implement programs to monitor biodiversity while engaging with operators to support biodiversity improvement programs. It would also allow NPWS to set requirements on the management of key species and values for which they have key interests. This would include ongoing monitoring of key threatened species, management of weeds and pest species and rehabilitation of disturbed areas.

4.4.3 Traffic, transport and access

This section has been informed by the *Snowy Special Activation Precinct Technical Study Report: Engineering – Transport* (Transport Study) (WSP, 2022a). It provides summary of the existing traffic, transport and access arrangements in alpine precincts, as well as arrangements to and from Jindabyne. The report then considers how traffic, transport and access could be managed with the expected future growth in visitation.

Guidance Note 11 – Traffic, transport and access and the CCF

How visitors access alpine precincts is a major factor for consideration in the CCF. While traffic, transport, and access are not specific values which require protection, they do provide a function, which if not operating in an efficient and safe manner, can diminished visitor experience, impact amenity, and result in poor environmental outcomes.

Currently 92 percent of visitors to KNP arrive by car, with public parking provided at Perisher, Bullocks Flat and Thredbo. This reliance on private vehicles is driven by factors such as pricing, a lack of alternative options, supporting infrastructure, convenience and the availability of accommodation within alpine precincts. This dependence on private cars results in significant congestion during peak times, capacity constraints for parking, and poor safety outcomes, especially during poor weather conditions, or snowfall.

Developing transport solutions which focus on customer needs, improved connections, the development of places, and sustainability outcomes, would reduce congestion, improve visitor experience and safety, and also reduce some of the direct and indirect impacts to environmental and social values (such as visitor experience) in alpine precincts.

4.4.3.1 Existing conditions

Figure 4.9 provides a summary of the existing traffic, transport and access characteristics in alpine precincts. These values have been informed by the Transport Study, which contains a detailed assessment of the existing characteristics within each of the alpine precincts.

Road network

The key roads to access the alpine precincts include Kosciuszko Road (access to Perisher Valley) and Alpine Way (access to Thredbo), which are both operating close to their capacity during peak periods. At the peak rates, any interruptions such as a breakdown, collision, bad weather or even the shockwave from unexpected braking causes the traffic flow to deteriorate. In addition, these roads are frequently affected by poor weather conditions due to their altitude, with snow chains required to be carried and fitted when roads become icy. Some of the key roads within the Snowy Mountains SAP have experienced high numbers of crashes, with many single-vehicle crashes where the vehicle has left the roadway after losing control.

Public transport

Besides the Skitube and internal resort shuttles, public transport does not have a significant profile with visitors as a reliable and convenient form of transport within the Snowy Mountains SAP.

Traffic, Transport and Access





Alpine Resort parking

Parking within the alpine resorts is in high demand, from both day visitors and overnight guests, and is increasingly becoming an issue, especially as parking extends away from the resort to the side of the road as formal car parks reach capacity. There are also occurrences of chain bays being utilised for car parking, and parking outside of these formalised areas presents a road safety risk within the National Park and impacts to the environment.

There are a total of around 8,000 parking spaces in KNP and the nearby area, including around 2,700 within the Perisher area (of which around 820 are informal overflow parking on Kosciuszko Road), 3,700 spaces at Bullocks Flat and 2,500 at Thredbo (which includes private off-street parking).

Day trippers typically arrive from 8.00 am and depart by 5.00 pm. Overnight guests staying in the resorts typically have car parking associated with their accommodation in Thredbo. Some accommodation in Perisher has limited overnight car parking and guests typically park their vehicles in overnight parking at Bullocks Flat and access the resort via the Skitube.

On good snow days, the overflow parking on the side of Kosciuszko Road at Perisher is not always available due to safety concerns and snow clearing. If car parking is full at the resort, TfNSW implements its Traffic Management Plan to close the road and redirect traffic to Bullocks Flat. There is evidence that also on these peak snow days that parking at Bullocks Flat is also at capacity and that some overflow parking occurs along the Alpine Way before entry into Thredbo.

During the snow season (June long weekend to October long weekend) there is no vehicle access to Charlotte Pass and no dedicated parking at Perisher (for Charlottes Pass visitors), an issue which has been raised by Charlotte Pass Alpine Resort. In summer, there is an informal parking at the turn around end of Kosciuszko Road which is often at capacity during peak periods in summer.

Skitube

The Skitube is a train service which shuttles visitors between Perisher/Blue Cow and Bullocks Flat during the winter ski season. The shuttle operates two or three carriages between Perisher and Blue Cow, and three or four carriages between Bullocks Flat and Perisher. Travel time is around 10 minutes from Bullocks Flat to Perisher, and around 5 minutes from Perisher to Blue Cow. A passing loop just outside the first tunnel allows additional capacity on the Bullocks Flat to Perisher section. At Perisher, there is a loop around the island platform that allows trains to pass. However, current common operation is to run separate services (no passing required). The station platforms have been constructed with sufficient length to accommodate four carriages. With a maximum capacity of 225 people per carriage, it has a claimed maximum capacity of 4,500 people per hour.

The Skitube provides an option for accessing the Perisher Range, without the need to travel via private car into KNP, however anecdotal evidence suggests that some visitors find the ticket prices too high, and instead try to hitch-hike up to the Alpine resorts along Kosciuszko Road. In addition, for family and friend groups, the relative economy of driving and paying the NPWS entry charges soon outweighs the cost of buying individual Skitube tickets.

4.4.3.2 Future considerations

To inform future transport within, to and from alpine precincts, the Kosciuszko National Park Access Strategy (KNP Access strategy) has been developed. It provides focused considerations on key elements, including customers, connections, places, and sustainability. It also provides evidence of constraints and proposed solutions to improve those constraints in the SAP precincts. This section provides a summary of the KNP Access Strategy, more details are provided in chapter 9 of the Transport Study.

Customers

The transport needs of KNP must cater to a wide variety of visitors and residents, while protecting the environmental qualities that attract visitation in the first place. Currently car travel dominates access to KNP, in part as pricing supports this. There is currently a lack of alternate transport options to cater for a wide range of budgets. To drive transport patterns that assist in achieving the vision of the Snowy Mountains SAP, a review of transport costs needs to be undertaken. This pricing system needs to be flexible and competitive. The transport solutions that are proposed need to be bespoke solutions that combine to benefit all customers, and also plan for seasonal operations, journey locations as well as consider the changes in summer visitation over time.

Connections

The characteristics of the road network in KNP results in the reliance on a few key roads (Kosciuszko Road and Alpine Way), with little choice between alternative routes and a limited ability of road expansions due to the sensitive environment along the corridors.

The following considerations have been assessed as part of the development of transport solutions in KNP with reference to connections:

- Throughput from increasing capacity to match demand, expanding the network and increasing the occupancy of vehicles, and therefore the efficiency of the transport system.
- Directness reducing the overall journey time, increasing the convenience and the size of group that can be accommodated.
- Weather from managing the impact of adverse weather, improving the reliability of the transport system, improving shelter and increasing the size of the fleet to cater for different weather conditions.
- Technology making use of technology advancements and providing flexibility to adopt future improvements in technology related to customer guidance, technology within vehicles and timetabling.

- Parking in terms of the location, quantity and technology that manages its use.
- Internal Park Movement whether they assist movement within resorts, to hiking and mountain biking and whether they provide a shuttle service.

Places

The transport-related place impacts have been considered in terms of the potential opportunities created to influence:

- Anchors/Destinations including The Perisher group of resorts, Charlotte Pass, Guthega, their related impacts on Jindabyne, and trail heads for hiking and mountain biking.
- Hubs in terms of transport and park-and-ride facilities.
- Amenity from visual, passenger comfort and public spaces including the town centre and retail core.
- Corridors influencing how legible they are, the sensitivity of the environment through which they pass, whether they are weather affected and how constrained they are.
- Environment including the protection/management of human impact and effects on the picturesque National Park setting.
- Seasonality whether they provide in winter, summer, or year-round benefits/impacts.

Sustainability

The transport-related sustainability has been considered in terms of the potential opportunities created to influence:

- Trip generation in terms of the number of trips, type (purpose) of the trip, the time of the trip and the mode of transport.
- Safety for all road users, especially vulnerable ones such as pedestrians and cyclists, for workers and for wildlife.
- Social access for all customers and access at all times.
- Type of vehicle including the ability of the vehicles energy source to contribute to sustainability and low emissions (including electric and hydrogen).
- Economic Development cost competitiveness between modes, cost of entry, competitiveness with other alpine destinations, financial sustainability and the cost of construction and maintenance.

4.4.4 Housing and accommodation

This section has been informed by the *Snowy Special Activation Precinct - Housing and Accommodation Study* (Housing and Accommodation Study) (Ethos Urban, 2022) as well as assessments completed as part of this report. It provides summary of the existing housing and accommodation in alpine precincts and considers the implications of future growth on demand. While this section focuses on alpine precincts, due to the nature of housing and accommodation in the region and relationship between alpine precincts and Jindabyne, also discusses availability and demand outside KNP.

Guidance Note 12 – Housing, accommodation and the CCF

The supply of housing and overnight accommodation is a key component of the CCF. It fundamentally provides information on how many people are staying overnight, and thus using infrastructure and services in a specific area on any given day. Implementing a hard limit to capacity provides a level of certainty on the infrastructure requirements to facilitate overnight visitation and ensure that the resulting impacts to values can be managed appropriately.

In the alpine precincts, a bed limit is the current methodology to manage overnight visitation. Some alpine precincts have an allowable bed limit, as set by the KNP PoM, which places a hard limit or physical capacity on availability. NPWS also use this limit to determine leasing fees within the alpine precincts. This methodology plays a key role in limiting development to an acceptable level, thus maintaining amenity values, and limiting overdevelopment. While it is well suited to areas where visitation is limited to those staying overnight, it does not

provide for the ongoing management of day visitation, which is a key diver of visitor related impacts. It should therefore be viewed as one component or management tool as part of the CCF.

The CCF (and supporting technical papers) provides a unique opportunity to examine the current bed limit and consider the interactions with other factors (such as Transport and Access) and value protections in alpine precincts. The availability, quality, location, and supporting infrastructure need to be balanced to ensure positive value outcomes.

4.4.4.1 Existing conditions

Figure 4.10 provides a summary of the existing housing and accommodation in alpine precincts.



Figure 4.10 Housing and accommodation in KNP

As discussed in Appendix B, the existing mechanism for managing overnight visitors in KNP is based on the establishment of bed limits for each alpine resort area, and surrounding support areas. These bed limits include a total number of beds available for use in each alpine precinct and represent the upper limit to availability. The use, release and management of these beds is undertaken via separate leasing agreements in each precinct.

Table 4.3 provides a summary of the bed limits in the alpine precincts alpine resort areas.

Table 4.4 provides a summary of the existing bed limits for TOA's.

Table 4.3 Existing bed limits in alpine precincts – resort areas

Alpine precincts – Resort areas	Existing bed limit
Perisher Range	4,887
Guthega	330
Smiggin Holes	1,016
Perisher Village	3,541
Thredbo	4,820
Charlotte Pass	611
Total	10,318

Table 4.4 Existing bed limits in alpine precincts – tourism opportunity areas

Alpine precincts –Tourism opportunity areas	Existing bed limit
Thredbo Ranger Station	0
Ski Rider	339
Sponars chalet	116
Creel Bay	0
Kosciuszko Tourist Park	72
Total	527

Key issues as related to the supply of short-term accommodation in KNP include:

- The availability of short-term accommodation in alpine precincts and outside KNP varies throughout the year and by location. During the winter periods, accommodation providers in alpine precincts regularly have high occupancy rates of 95–100% resulting in shortages of accommodation. High occupancy rates are also experienced during peak summer periods in Thredbo. This shortage prompts visitors and seasonal workers to seek other means of accommodation such as Airbnb, room share, and in some circumstances, camping in and around Jindabyne.
- While volumes of visitor and seasonal workers continue to rise, there are strong peaks in visitation and long periods
 of low demand, and supply remains constrained. As such peak demand for accommodation will remain strong and
 peak period undersupply means that many visitors will pay high prices for accommodation, regardless of value for
 money or condition.
- A long-term deterioration in the condition of short-term accommodation stock is threat to growth of the tourism industry, as it is likely to start impacting the reputation of the area as a visitor destination.
- Consultation with accommodation providers in KNP found that there is difficulty securing loans to further invest in their resorts due to the short leases that National Parks typically offer. This is particularly the case for boutique providers who have no guarantee on lease renewal leading has led to unwillingness to invest in upgrades to accommodation and in some instances, boutique providers facing financial issues when investing in improvements.
- A high proportion of accommodation is owned by ski clubs. These are exclusive type of accommodation available to club members only.
- Some alpine resort operators provide beds on site as part of an employment contract. Around 500 seasonal workers
 have accommodation provided in the alpine precincts.

4.4.4.2 Future considerations

The CIE forecast growth projections show the highest peak in overnight visitation occurs in the winter of 2041. Peak demand then reduces from 2041 to 2061 due to reduced seasonality and increasing visitation in the summer months (a key objective of the Snowy Mountains SAP). However, in terms of peak overnight visitation, winter months are projected to still generate the highest accommodation demand (per night).

Figure 4.11 shows the projected growth in visitor bed night demand vs the existing bed limit (KNP PoM) for Perisher (and accommodation providers along Kosciuszko Road) and Thredbo is shown on Figure 4.12. Based on this analysis, there would be a shortfall of around 2200 beds in Perisher and 2150 beds at Thredbo in 2041. This analysis assumes a consistent demand ratio during the peak periods.



Figure 4.11 Existing Perisher bed limit vs enhanced growth scenario provided by CIE



Figure 4.12

Existing Thredbo bed limit vs enhanced growth scenario provided by CIE

The Housing and Accommodation Study has profiled the existing housing context, housing market including residential development activity pipeline, identified trends influencing housing supply and identified case studies relevant to issues faced in the Snowy Mountains SAP.

Key outputs identifying the required housing and accommodation need have framed the following objectives moving forward:

- an additional 1,857 new permanent residential dwellings would be required by 2061. It should be noted, this is
 limited to areas outside alpine precincts (and KNP) only. No provision of dwellings for permanent residents should
 be proposed for alpine precincts
- deliver an additional 2,327 short term accommodation units to meet the forecast visitor needs by 2061. This includes
 the provision of short-term accommodations both in alpine precincts as well as in Jindabyne. For this to occur an
 increase to the existing bed limit in KNP would be required
- provide an additional 72 units for seasonal workers to meet peak demand in 2036, with flexible accommodation that can be re-purposed or removed as seasonal worker demand declines from 2036 to 2061. As above, this includes the provision of seasonal worker accommodation in both KNP and Jindabyne.

4.4.5 Visitor experience and amenity

This section has been informed by early investigations undertaken for this report (refer to Appendix A to Appendix E), in addition to data provided by alpine resort operators. The purpose of this section is to provide an assessment of the level of visitor experience and resulting amenity in the alpine precincts – alpine resort areas (refer to section 4.3.1), and consider the implications of future visitation on those values.

Guidance Note 13 – Visitor Experience and the CCF

The management of visitor experience is a key aspect of the CCF, and one which, in alpine precincts is heavily influenced by providing high-quality recreational experiences for the public. The provision of this recreation value is a key objective of NPWS and alpine resort operators and is also identified as an objective of the Precincts-Regional SEPP (refer to Appendix B).

The assessment, and management of visitor experience is one of the most challenging aspects of a CCF. It is based on variable, subjective, interrelated, and often difficult to quantify factors. One individuals' or groups' experience does not necessarily represent others.

Factors and considerations which are likely to influence visitor experience/amenity in alpine precincts include:

- economic (overall costs lift tickets, national park access fees, accommodation, food and service prices, and perceived values for money)
- environmental (snow quality, weather, available terrain, visual amenity, nature-based experience)
- social/recreational (the availability and quality of recreational opportunities, travel times, travel comfort, convenience, waiting times at ski lifts, ticket windows and food and service locations, and crowding).

While many of these factors or variables are considered in other sections of Stage 4 (such as traffic, transport, and access, or infrastructure) this section aims to use a surrogate measure of visitor experience to assess the impacts of future growth. It does this by defining a 'busy' day within alpine resort areas based on existing ski lift scan data and an understanding of the patterns of visitation in alpine resort areas. The assessment of this surrogate measure can provide an indication not only of on mountain constraints, but also other constraints which impact visitor experience (such as commercial space, shops, restaurants, kiosks etc) which would also require addressing.

The Snowy Mountains SAP aims to reduce the seasonal visitation peak by increasing visitation in the non-winter months. However, the winter months are expected to remain the predominant drawcard to the alpine region, and the period of the year when visitation is most constrained. As described, this assessment is based on the ski lift scan access data for the period 2015–2019, where the ski lift scan access data represents the number of individuals passing though chair lift access gates. It shows the distribution of visitors throughout the year, and by days of the week, thus providing an indication of visitor numbers during a 'busy' day which can be forecast forward using the growth scenarios provided by CIE.

While this assessment does not meet the requirements of a comfortable carrying capacity assessment, which focuses on ski slope capacities and is a framework used in ski resort planning (discussed in Section A1.2.7 in Appendix A), it does provide an indication on the level of growth for which agencies and operators need to plan for and be able to manage visitation appropriately.

Limitations of the assessment include.

- data provided is of commercial sensitivity, and therefore is unable to be published
- data does not include visitors who do not access the alpine resort chair lift facilities
- data does not allow for the consideration of the impact of snow conditions which is a key factor in the numbers of skiers accessing alpine resort areas on any given day.

The assessment is based on the following assumptions.

- a direct link exists between access scans in alpine resort areas and the perceived level of visitor experience/amenity.
 This assumes a higher number of visitors accessing the resort area would result in a diminished level of amenity, and a lower experience outcome
- the assessment focuses on the months of July, August and September (as the peak winter period where capacity constraints are known to occur)
- a 'busy' day has been defined as a day when the number of visitors fall within 15% of the existing 'peak visitation'
- 'peak visitation' is based on the peak daily visitor numbers for the month of August between 2015 and 2019
- projections of visitor growth (2021–2061) are based on the enhanced visitor growth projections provided by CIE (refer to Section 4.4.1.1), which acknowledge the impacts of the Snowy SAP and expected decline in winter visitation due to climate change (Section 4.4.1.2)
- no allowance has been made for changes in visitor numbers based on weather conditions, such as poor snow years
- data used in the assessment was provided by a single alpine resort area, however, for the purposes of this assessment have been considered to apply all alpine resorts. The assumptions are general in nature and based on analysis of defined 'busy' days. These days should not vary greatly between alpine resort areas.

4.4.5.1 Existing conditions

The skiing season typically extends between the June and October long weekends. Figure 4.13 shows an example of visitation distribution during this period. As expected, visitation rises quickly in June or July (depending on early season snow conditions), extends throughout August and into September, before declining in the latter half of September. July and August are considered the peak periods of visitation. These months experience similar visitation numbers, however in general, July's visitation shows more consistency between weekdays and weekends. This is likely associated with the presence of the school holidays, and families having extended stays. In August, peak visitation is generally higher than July, however significantly more skewed to weekends. Following periods of higher snowfall visitation increases, regardless of the day of the week.



June - July - August - September

Figure 4.13 Typical visitation pattern in a winter season

Table 4.5 provides a summary of the number of 'busy' days across the alpine resort area (2015–2019). A review of the data indicates that in general 'busy' days are confined to each Saturday in July, and Saturdays and Sundays in August, and Saturdays and Sundays generally during the first week in September.

Table 4.5	Number of da	vs with access sca	ns within 15% of	peak (2015-2019)

Year	Number of days with access scans within 15% of peak (2015–2019)		
	July	August	September
2015	1	2	0
2016	4	4	0
2017	4	6	3
2018	9	8	3
2019	7	5	0
5-year average	5	5	1.2

4.4.5.2 Future considerations

Figure 4.14 and Figure 4.15 highlight the number of days alpine resorts in KNP can expect to reach the 'busy' criteria set out in this report. The figures show the number of projected 'busy' days during the months of July and August.



Figure 4.14 Number of 'busy' days in Thredbo Alpine resort



Figure 4.15

Number of 'busy' days in Perisher Alpine resort

In summary:

- for Thredbo (Figure 4.14), the CIE projections show the number of defined 'busy' days would peak in July with a total of 26 days of the month being defined as busy. This peak is likely to occur in 2035 and extend until 2056 before declining. For the month of August, the peak in visitation would result in a total of 22 days of the month considered 'busy', this peak is expected to extend from 2038 to 2042 with a slight decline for the remainder of the assessment period
- for Perisher (Figure 4.15), the CIE projections show the number of defined 'busy' days would peak in July with a total of 31 days of the month being defined as busy. This short-lived peak is likely to occur in 2039 before declining to 26 days. For the month of August, the peak in visitation would result in a total of 13 days of the month considered 'busy', this peak is expected in 2033 and extend for the remainder of the assessment period
- the data indicates that visitation would peak at around 35-40% above existing levels by 2038
- no days defined as 'busy' using this methodology were noted in September. While this is a result of the averaging
 out of Saturdays and Sundays in each month, it is likely alpine resorts would experience 'busy' days in early
 September during high snowfall years or when conditions are good
- a review of the data suggests that the number of visitors during the month of July is more consistent and does not
 result in the same drop in numbers during the weekdays, as experienced in August. This is likely due to school
 holidays falling in July. As a result, July presents as the month with the greatest increase in 'busy' days, and August
 remains the peak in terms of visitor numbers, however they are more heavily skewed to the weekend days.

4.4.6 Flooding and water quality

This section has been informed during stakeholder engagement with NPWS and the following documents:

- Snowy Special Activation Precinct Technical Study Report: Engineering Flooding and Water Quality (Flooding & Water Quality Technical Paper) (WSP, 2021)
- Snowy Mountains Special Activation Precinct Salt Impact Management Plan (SIMP) (WSP, 2021b), and
- Climate Change impacts on the Kosciuszko National Park Carrying Capacity and Artificial Snowmaking at NSW Alpine resorts (Climate Change Report) (Appendix G); and
- NSW Alpine resorts Environmental Performance Report 2014–16, (NPWS, 2017)

This section provides summary of the existing hydrology values within alpine precincts and considers the management implications of the interaction of future visitation, climate change and development on surface water quality and surface water resources.

Guidance Note 14 – Hydrology and the CCF

The establishment of KNP was heavily influenced by its water resources, and the value provided for the Snowy Hydro scheme, both in terms of quantity and quality. Today a key objective of KNP PoM, is achieving a high level of water quality in surface water bodies, and thus one of the key considerations of visitor management and this CCF.

When considering hydrological process in the CCF, the two main considerations are flooding and water quality:

- the extent of flooding, and flood risk is one of the physical constraints which influences the availability of land suitable for development. Any development must consider the potential for flooding, with development prohibited in areas of high flood risk.
- in regard to water quality, there are a number of factors which influence the quality of surface water bodies in alpine precincts. This can include natural influences from catchment characteristics, impacts from exposed and disturbed soils, and impacts from anthropogenic activities such as contamination from point sources.

The CCF (and supporting technical papers) provide an opportunity to examine the existing flooding and water quality characteristics in alpine precincts, and ensure any future developments considers the impacts to and from flooding, as well as impacts to water quality in surface water bodies in KNP. It would also provide an opportunity to build on the existing water quality monitoring program and link the outcomes to future development. This would ensure water quality is maintained and there is a response to non-conformance (further discussed in Stage 5 and Stage 6).

The availability of water resources and implications of snowmaking requirements is discussed in section 4.4.11 (Infrastructure).

4.4.6.1 Existing conditions

Figure 4.16 provides a summary of the existing conditions as related to flooding and water quality.



Figure 4.16 Hydrology factors in KNP

Flooding

Flooding in the alpine resort areas of KNP is managed via the Precincts-Regional SEPP. Flood Prone Land which describes the provisions applicable prevention of development of flood prone land. The intent of the clause is to prevent development of land subject to flooding and to prevent development of land subject to inundation up to the 1 in 100-year flood level (also referred to as the 1% AEP), where the works are likely to have adverse impact to flood behaviour.

Hydraulic modelling completed as part of the Flooding and Water Quality Technical Study, shows that the flood behaviour within the extended Snowy Mountains SAP area is primarily confined to existing defined watercourses and rivers, with very little area exhibiting widespread surface flooding. Even in the extreme events such as the Probable Maximum flood (PMF) event, no major overbank areas were inundated and only a relatively minor increase in flood extent was exhibited beyond the existing watercourses.

In the Thredbo Alpine Precinct, the majority of Thredbo Village remained relatively immune to flooding up to the PMF level event, however some public open space areas along Friday Drive and both buildings and carparks along Chimneys Way were flooded to some extent in the 10% AEP flood and above. It is noted that the areas along Chimneys Way were primarily flooded due to low depth local overland flow. Friday Drive at the Thredbo River bridge north east of the car parking areas appears to be flood immune in the 10% AEP storm events, but not in the 1% AEP or beyond.

The Perisher Range A1pine Precinct has a smaller upstream catchment then the other locations and the creeks running through the Perisher village appeared to overtop at an earlier stage then the other locations within the Snowy Mountains SAP. It is expected that this area will exhibit flooding events that are shorter and faster to peak then in other locations. In particular it was noted that Kosciuszko Road was immune to flooding in up to the 0.5% AEP flood event and that most major buildings and carparking infrastructure was relatively flood free up to the 1% AEP Climate Change 2090 condition.

Water quality

Water quality varies within alpine precincts and is largely dependent on the contributing surface water catchment. For the watercourses immediately downstream of urban development, including roads and carparks, the water quality tends to be poor due to the presence of urban pollutants. In alpine areas stormwater quality has been poor, with sources of stormwater pollution including:

- salt from de-icing activities
- sediment runoff from dirt roads
- oil, trace metals from parking areas, and
- rubbish.

Water quality and biological health monitoring of the rivers and streams in the KNP has been undertaken since 2004. The water quality monitoring results show that the electrical conductivity (EC) in alpine streams is generally very low, and low salt concentration are a typical characteristic of KNPs fresh flowing waters. It has been noted in recent unpublished studies that elevated EC immediately downstream of the roads and carparks is having an impact on aquatic systems

The KNP PoM notes that effluent from sewage treatment plants associated with the alpine resorts and other high use sites is discharged to water courses in the park. The results of the water quality monitoring suggest that the sewage treatment plants discharging into these watercourses create constant but generally mild pollution. The long-term impacts of these effluent discharges on the park's rivers and streams are unknown. In addition to threats identified by the Cooperative Research Centre for Freshwater Ecology, the KMP PoM notes the following other threats to water quality:

- nutrient enrichment from feral animals
- ongoing disturbances associated with catchment modifications from past grazing and mining activities
- increased sediment loads from road and walking track erosion after fire events.

4.4.6.2 Future considerations

Flooding

The flood modelling indicates the waterways are largely incised and flooding is generally confined to narrow floodplains, which means, the narrow floodplain widths are unlikely to pose any constraints on future development.

Climate change projections have less rainfall/snow annually but potential increases in summer/autumn rainfall and increases in rainfall intensity. The understanding of projected changes in rainfall can be used to inform future infrastructure planning across the SAP areas and subsequently build resilience to future flooding events.

Water quality

The Snowy Mountains SAP aspirations highlight the need to ensure stormwater runoff is managed to minimise impacts to the natural environment of the KNP and to ensure Lake Jindabyne and its tributaries continue to be suitable for recreational uses and water supply for the urban areas. Water is a key feature of many aspects of the Snowy Mountains SAP. Water is used for recreation (as snow for snow sports, as water for lake uses) and power generation across the Snowy Mountains SAP areas and therefore its quality should be considered equal to the quantity

The 16 years of water quality data has provided a good understanding of the existing water quality conditions downstream of Thredbo Village and the Perisher Valley Ski resorts and the monitoring should continue to be able to identify impacts of future development in the KNP. The monitoring data could be used to adjust KNP Management practices in the future to further reduce the impact to the KNP.

Future climate projections indicate a reduction in mean annual rainfall across the Snowy Mountains SAP study area. Snow precipitation is also predicted to decrease due to future climate changes which will impact cloud seeding. Overall, a reduction in rainfall leads to a reduction in stormwater runoff but this is offset to some degree by the higher concentration of pollutants carried by the water.

It is assumed that the development of future growth areas will result in larger impervious surfaces across the Snowy Mountains SAP study area. This is likely to result in an increase in pollutant generation which may to some extent be offset by a reduction in runoff volume. The increase in pollutant concentrations, along with an increase in the visitor population, resulting in an increase in annual total loads of pollutants, will need to be considered in the design of future development and infrastructure.

4.4.7 Geology

The section has been informed by the *Snowy Mountains SAP Technical Study Report: Engineering – Geotechnical* (Geotechnical Study) (WSP, 2021c). It considers the existing geotechnical conditions present in the alpine precincts and identifies future considerations as they relate to future visitation development opportunities, and geotechnical constraints.

Guidance Note 15 – Geology and the CCF

The geotechnical characteristics of an area are an important consideration to the CCF. Geology or geotechnical risk represent one of the key physical or hard constraints which may limit the availability of space in alpine precincts or influence the type and design of future development.

4.4.7.1 Existing conditions

Figure 4.17 provides a summary of the existing conditions as related to geology in the alpine precincts. Geotechnical risks are currently managed via the *Geotechnical Policy – Kosciuszko Alpine Resorts* (DIPNR, 2003) which sets out structural and geotechnical requirements within alpine resort areas. Each resort area has been considered individually and geotechnical risk plans created for each site to identify areas where an upfront geotechnical report is required for development applications.





4.4.7.2 Future considerations

There are opportunities for future development in areas mapped as low susceptibility with a lower potential for landslides as development will be less influenced by geotechnical hazards. Table 4.6 provides a summary of results from the regional susceptibility zoning maps, additional details are in included in chapters 3 and 4 of the Geotechnical Study.

Alpine precincts Geotechnical risks (low, medium and high susceptibility) Alpine resort areas Thredbo Most of Thredbo is in high susceptibility area with higher potential for landslides. This does not indicate that the area is not able to be developed, however growth and development would need to consider higher potential for more onerous design requirements to account for geotechnical risks. Charlotte Pass Charlotte Pass contains a mix of low and medium susceptibility areas with lower and moderate potential for landslides. Perisher Range Most of the Perisher Range is in an area of medium susceptibility with moderate potential for landslides. Tourism opportunity areas Sponars Chalet Sponars Chalet is in an area of medium susceptibility with moderate potential for landslides. Ski rider Ski Rider is mostly located in an area of low and medium susceptibility with lower and moderate potential for landslides. Kosciuszko Tourist Park Kosciuszko Tourist Park contains a mix of low and medium susceptibility areas with lower and moderate potential for landslides.

Table 4.6Summary of outputs from regional susceptibility zoning maps

4.4.8 Groundwater

This section has been informed by the *Snowy Special Activation Precinct Technical Study Report: Hydrogeology* (Hydrogeology Study) (WSP, 2021d). It provides a summary of the exiting groundwater characteristic in alpine precincts and considers the implications of future visitation, and Snowy Mountain SAP key development opportunities.

Guidance Note 16 – Groundwater and the CCF

One of the key considerations of visitor management is the availability of a reliable and secure water supply. There are a number of factors to consider when determining if a groundwater resource is a suitable supply. This includes the presence of an aquifer that can sustain extraction volumes, the existence of infrastructure or ability to drill and install groundwater bores, the regulatory framework to extract water via licencing conditions, and the right to extract groundwater from a specific location. If and only when all these factors are acceptable, is a groundwater resource considered a reliable and secure water supply.

Another key consideration in relation to visitor management are impacts to groundwater resources from development or operations that have the potential to result in impacts to groundwater quality and/or quantity:

 impacts to groundwater quality can result from activities such as contamination from point sources, or the secondary result of changing groundwater levels which results in a change to the chemical quality of groundwater impacts to groundwater quantity is an activity that results in a change to the accessibility of groundwater. The
extraction of groundwater through pumping of groundwater bores or intersection through excavation can
impact on groundwater levels. This change to groundwater quantity may impact on other groundwater users
such as neighbouring groundwater bores or the environment depending on the degree of change on
groundwater levels.

The technical assessments to support the CCF have focused on the availability of a groundwater resource. The protection of groundwater values from impacts to quality and quantity as a result of development and operations would be managed by existing guidelines and legislation aimed at protecting groundwater resources.

4.4.8.1 Existing conditions

Figure 4.18 provides a summary of the existing groundwater conditions in alpine precincts.



Figure 4.18 Groundwater conditions in KNP

The Snowy Mountains SAP study area is located directly over the Lachlan Fractured Rock Coast (LFB) Groundwater Source (which includes alpine precincts). The LFB groundwater source has unallocated water available, and the provision to obtain Water Access Licence (WAL) to extract groundwater as a water supply. Providing a works approval application is consistent with the rules of the water sharing plan and impact assessment is deemed acceptable then water supply works approval would support the granting of a WAL. However, as demonstrated through reported groundwater yields, just having the regulatory ability to obtain a WAL does not guarantee a water supply. The underlying bedrock granite and fractured rock geology results in a relatively poor groundwater resource with high spatial variability, as demonstrated by the numerous number of dry bore previously drilled within the Snowy Mountains SAP study area.

4.4.8.2 Future considerations

In consideration of the future use of groundwater resources, due to the constraints associated with obtaining suitable groundwater yields, alternative water sources should be considered first. Increasing existing water licence allocations or obtaining water licences for alternative surface water sources may be more appropriate and cost effective for the volumes required for snow making or town supply.

Given the groundwater characteristics of the alpine resort areas, there are no current projections for the use of groundwater resources in KNP. Any consideration of future extraction or use, should consider the following:

- if additional raw water resources are required, surface water should be first considered
- groundwater should only be considered if all other water sources/efficiencies savings are deemed insufficient to meet demand estimates
- success in obtaining a suitable groundwater resource for water supply is dependent on favourable geological conditions
- if a suitable groundwater resource is determined, there are several rules around the installation of new water supply bores near sensitive environmental areas such as groundwater dependent ecosystems, which may prevent new bores from being installed in alpine areas
- groundwater yield is insufficient to consider groundwater use for snowmaking activities
- implications of climate change and changes in alpine rainfall snowfall of groundwater recharge
- the impacts of road salt use on groundwater resources is not considered a high risk. The solubility of salt is dominated by surface water runoff, with pooling and evaporation concentrating and precipitating into the soil profile only, with low infiltration into local groundwater.

4.4.9 Aboriginal cultural heritage

This section has been informed by the Snowy Mountains Special Activation Precinct Technical Study Report: Aboriginal Cultural Heritage Assessment Report (Aboriginal Cultural Heritage Report) (OzArk, 2022), which includes consideration of the Snowy Mountains Special Activation: Preliminary Aboriginal Cultural Values Assessment (Donaldson, S, 2021).

The section aims to identify opportunities to conserve significant cultural values in alpine precincts, and to devise strategic mapping to allow for appropriate planning and protection of aboriginal cultural heritage values.

Guidance Note 17 – Aboriginal cultural heritage and the CCF

The conservation of objects, places, and features of cultural heritage value, and of significance to Aboriginal people is a key objective of the NPW Act. The Snowy Mountains SAP is within the land of the Ngarigo People. Scientific evidence indicates a long history of Aboriginal use and occupation of the high country and demonstrates successful adaptations to extreme environmental conditions.

The consideration of aboriginal cultural heritage values within the CCF can take the form of two approaches. The first is through geographical means where value is assigned to a particular site or place. The protection of these values can be achieved though the implementation of development controls, in accordance with specific

legislation aimed at protecting Aboriginal sites. The second approach to value protections may be more intangible, as in a 'sense of place' or 'continued connection to country' for individuals, families and communities.

The Snowy Mountains SAP planning process has the potential to include protections for known aboriginal sites, consistent with existing legislation, as well as encourage the implementation of plans and programs to enhance those values, which by nature are less tangible however are of significant importance to Aboriginal people.

4.4.9.1 Existing conditions

Aboriginal people and cultural heritage value

The Snowy Mountains SAP is within the land of the Ngarigo People, which extends from the western slopes of the coastal ranges to the eastern side of the Kosciuszko plateau and further north, between the coastal ranges and the mountains on the banks of the Murrumbidgee River. The tribal boundaries also include the peaks of Mount Kosciuszko and the Snowy ranges. As noted in the KNP PoM:

"From an Aboriginal perspective land and people are inseparable. The mountains provided Aboriginal people with food, shelter, clothing, tools, utensils, and medicine. Beyond this the messages underlying the stories of ancestral beings, who shaped the plant and animal communities and the landscapes themselves, governed all aspects of traditional Aboriginal society. These story lines link people and features of the mountains with those of other distant places to this day.

Cultural heritage resides as much in intangible values, as it does in physical form. Just as people shape landscapes, landscapes also shape people. Places within the park have been the scenes of innumerable human experiences. Some of these have survived as legends or anecdotes, others are remembered within place names, songs, literature, art, traditional knowledge, customs, symbolism, or spiritual observance. More still reside in the memories of communities, families, and individuals. For many people, these human experiences, be they firsthand or retold, real or imagined, are what give meaning to a place. All of them help shape community and personal perceptions, attitudes, values, and identities."

Based on a small sample set of interviews with Ngarigo men and women (Appendix 3 of the Aboriginal cultural heritage report), some community members have a contemporary connection to the landscape of the area and there are known tangible places connected to ceremonial or historical landscapes present in the SAP study area. This includes places and landscapes such as:

- Curiosity Rocks near Jindabyne
- Kalkite Mountain, Lubra Rocks, and Porcupine Rocks in KNP
- ceremonial grounds at the confluence of Wollondibby Creek and the Snowy River now submerged beneath Lake Jindabyne
- archaeological features associated with Bullocks Flat and the Thredbo Valley in the KNP, and
- historic burials associated with the former Cobbin Creek Station to the south of Jindabyne.

In addition, items of high cultural significance were identified such as the 7,000 year old kangaroo tooth necklace found near Cooma in 1991 and currently stored in Canberra at the Mitchell Archives. It is noted that most of these places or landscapes are not located in alpine precincts.

In summary, the following cultural values have been expressed by some of the aboriginal community:

- ancestral connections to the cultural landscape
- ongoing spiritual connections to country
- past inter-tribal gatherings and communal/ritual use of country
- cultural practices associated with the use of natural resources

- acknowledging and maintaining the original names for places (Targangal, Giandara/Kiandra, Cobaragundra, Carangal, Yarrangobilly, Nangar/Nungar, Coolamine, Pulletop/Pullelop, Mullanjandry, Wereboldera Bogong, Cobbera/Cobborra and Orungal)
- knowing, using, and acknowledging ancient pathways across the landscape
- contemporary cultural connections to archaeological sites (stone artefacts, stone arrangements, bora grounds, burials, scarred trees, and axe grinding grooves)
- caring for country including working and protecting archaeological sites
- remembering and acknowledging past conflicts
- remembering and acknowledging historical associations including those associated with work (brumby running, snagging logs, building cattle infrastructure, tracking, guiding, stock work, wattle bark collection, sheep shearing, station cooks, fruit picking, railway construction, track building, forestry, council gangs and domestics)
- maintaining cultural connections to the landscape today and into the future.

Aboriginal sites

A total of eight aboriginal sites have been previously recorded within the alpine precincts (refer to Chapter 7 of the Aboriginal Cultural Heritage Report), these include:

- a Potential Archaeological Deposit (61-3-0097) at Guthega
- a Potential Archaeological Deposit (61-3-0099) at Perisher south
- a Potential Archaeological Deposit (61-3-0112) at Perisher
- an Artefact (61-6-0104) at Friday flat in Thredbo
- an artefact (61-6-0099) at Ramshead Creek
- an artefact (61-6-0100) at Ramshead Creek
- an artefact (61-6-0083) at Merrits Park
- an artefact (62-1-0016) at Sawpit creek camping area.

A further four sites were identified during survey works including:

- an isolated find at Sawpit creek
- three isolated finds at Creel Bay.

Aboriginal cultural heritage potential

Alpine precincts generally have low archaeological potential as they are located within landforms with moderate to steep slopes. Those areas that are flatter have generally been previously disturbed by development.

In summary:

- small areas in the Thredbo Village, Perisher Range (including Guthega) and Kosciuszko Tourist Park alpine
 precincts have high potential due to the previous recording of an Aboriginal site. Landforms designated as having
 'high potential' are either those where sites have been previously recorded or landforms that are flat and close to
 water
- a more extensive area of high potential is noted within the Creel Bay alpine precinct that includes a spur landform that descends towards the former course of the Snowy River
- no other alpine precincts have areas of high archaeological potential. With the remainder of the surveyed areas
 considered as having low archaeological potential (generally consisting of sloping landforms or elevated landforms
 distant to water) or considered disturbed lands (landforms which have been modified in a clear an observable way
 either though earthworks or though building/car parking construction)
- some small areas, adjacent to the Thredbo River in the Thredbo Village and the Thredbo Ranger Station alpine
 precincts were identified as having moderate archaeological potential. Areas with moderate potential include
 landforms with a gentle gradient either close to a waterway or along an elevated landform such as a spur overlooking
 a waterway.

Figure 4.19 shows an example of mapping for Aboriginal cultural heritage potential in the Thredbo Village alpine precinct. Section.8.3 of the Aboriginal Cultural Heritage Report contains a complete inventory of archaeological potential mapping for future consideration of Aboriginal heritage values in all alpine precincts.



Figure 4.19 Thredbo Village – Aboriginal cultural heritage archaeological potential

4.4.9.2 Future considerations

Proposed development activities in alpine precincts, would have a very low impact to Aboriginal cultural heritage values due to the few Aboriginal sites recorded, and lack of intangible heritage values identified in the areas surveyed (as outlined in the Aboriginal Cultural Heritage Report). This statement is based on surface survey only. The undertaking of test excavation may alter the potential impact to Aboriginal cultural heritage values. However, at this stage of the investigation, the results of the surface survey indicate that significant Aboriginal cultural heritage values will not be harmed by development activities within the areas surveyed in each alpine precinct.

Avoiding and minimising harm

The conservation of objects, places, and features of cultural heritage value, and of significance to Aboriginal people is a key objective of the NPW Act. To manage potential harm to significant aboriginal objects and places, the primary objectives are to always avoid impact, and where impacts cannot be avoided, any development opportunity should be amended to reduce the extent and severity of impacts through the use of reasonable and feasible measures.

Opportunities to conserve aboriginal cultural heritage values

In the consideration of opportunities to conserve aboriginal cultural heritage values, the principles of ESD should be taken into account with reference to Aboriginal cultural heritage (refer to Table 4.7).

ESD principle	Response
Avoiding and minimising harm	As appropriate management of aboriginal cultural heritage values is primarily determined based on their assessed significance, as well as the likely impacts of the proposed development. As precise impacts are unknown at this stage, the following management options are general principles in terms of best practice:
	 Avoid impact – by altering the development proposal or avoiding impacts to an aboriginal site. Minimise harm – if impacts are unavoidable then approval to disturb sites under the authority of an approved permit must be sought.
	Very few Aboriginal sites were recorded during the survey, so site avoidance may be possible.
The integration principle	The Snowy Mountains SAP Master Plan presents a strong case for the broader environmental benefits arising from environmentally responsible development. The environmental consequences of future development will be further assessed when those impacts are known.
The precautionary principle	The Snowy Mountains SAP heritage investigation has followed the precautionary principle though undertaking a robust Aboriginal cultural heritage assessment to ensure that harm to Aboriginal objects and values is minimised. The survey adopted a precautionary principle when it came to describing and assessing landforms within the survey areas.
The intergenerational equity principle	It is assessed at this stage, and without undertaking test excavation, that the Snowy Mountains SAP will not harm significant Aboriginal cultural heritage values and that there will be a manageable diminution of intergenerational equity should the sites recorded here be harmed.

 Table 4.7
 Application of ESD principles to the Snowy Mountains SAP (Aboriginal cultural heritage)

4.4.10 Shared heritage

The section has been informed by the *Historic Heritage Assessment* (Historic heritage report) (OzArk Environment & Heritage, 2022). It provides summary of the known historic heritage values within alpine precincts and to devise strategic mapping to allow for appropriate planning and protection of historic heritage values.

Guidance Note 18 – Shared heritage and the CCF

The preservation of cultural heritage values, in this case shared heritage, is a key component of the CCF and is recognised by the inclusion of historical elements in the KNP PoM.

Historical elements are a significant drawcard to alpine precincts and contribute to amenity, recreation, and visitor experience values which require management. The KNP PoM and supporting legislation, which includes the *Heritage Act* 1977, Precincts-Regional SEPP and NPWS s170 register provide the layers of protection for a range of elements associated with early European activities, including elements of pastoralism, huts, mining, water harvesting and recreation (including skiing).

In terms of impact to historic heritage items, the best process for assessing the significance of the impact is to first understand the identified heritage values of the item. Protecting, preserving, and enhancing historical elements requires capacity considerations in relation to physical constraints on development, but also additional requirements on the modifications (including renewal) of historical elements in KNP.

4.4.10.1 Existing conditions

Figure 4.20 provides a summary of shared heritage in and around alpine precincts. A detailed history of these areas is included in Chapter 3 of the *Historic Heritage Assessment*. This includes a list of notable buildings in the Thredbo Village, Perisher Range and Charlotte Pass (included in section 3.2 and 3.3 of the Historic heritage report).





4.4.10.2 Future considerations

The major aim of the historic heritage survey was to both record any previously unknown heritage items and to provide information to allow the survey areas to be categorised into zones of heritage potential. This would allow for greater consideration of heritage value protections and guide future development in alpine precincts.

All survey areas have been mapped into one of five categories to determine the heritage risk of any development planned for that area. In simple terms, future development in a zone of 'low heritage risk' is unlikely to encounter historic heritage constraints. Conversely, planned developments in zones of 'high heritage risk' are likely to need to consider historic heritage in the design and approval process.

The categories used here are:

- High heritage risk: This category contains areas where there are known items of significant heritage value. This includes items identified on statutory heritage lists, items identified in the Historic heritage report as having high or likely heritage values, items of potential heritage significance identified by previous investigations, and items identified on the NPWS Historic Heritage Information Management System. Areas of high risk are mostly confined to the alpine resorts.
- Moderate heritage risk: This category contains areas where there are likely to be items of significant heritage value or, in the case of the alpine resorts, are within alpine precincts identified as having heritage values or intact architectural styles. Areas of moderate risk are mostly confined to the alpine resorts in KNP.
- Low heritage risk: This category includes areas that are very unlikely to contain significant historic heritage items.
- Archaeological potential: in KNP this area of this category are confined to Island Bend, due to the potential for widespread remains from a workers' township associated with the Snowy Mountains Hydro-electric Scheme.
- Disturbed lands: This category refers to landforms that have been modified for roads and car parks and assumes that any historic heritage values at these locations have been lost. However, development in these areas would need to consider impacts on the heritage values of neighbouring items (if applicable). Additionally, within all the other areas detailed above, there are areas of disturbed land that are too small to be meaningfully mapped at this scale.

Figure 4.21 shows an example of the historic heritage potential mapping for the Charlotte Pass precinct. Section 7 of the historic heritage report contains a complete inventory of strategic mapping for future consideration of heritage values in all alpine precincts.



Figure 4.21 Historic heritage potential – Charlotte Pass

4.4.11 Infrastructure

This section of the report has been informed by Snowy Mountains Special Activation Precinct Technical Study Report – Engineering – Infrastructure (Infrastructure Study) (WSP, 2021e) and the Snowy Special Activation Precinct Technical Study Report – Engineering – Renewable Energy (Renewable Energy Study) (WSP, 2021f). It provides summary of existing infrastructure in alpine precincts (including capacity constraints), and considers appropriate strategies for the provision of infrastructure to ensure appropriate management of future visitation.

Guidance Note 19 – Infrastructure and the CCF

Infrastructure is a defining feature of the CCF. Visitors to and workers in an area require the supply of water and energy, in addition to services such as wastewater, telecommunications and waste management. As infrastructure demands can be quantified, the servicing of this demand can be seen as a physical constraint in a CCF, where an upper limit of capacity can be identified. And while infrastructure is not a specific value which requires protection, the provision of infrastructure and services do provide a function, that if not operating effectively or if fails, can have significant impacts to multiple values in KNP.

Given the existing constraints identified in alpine precincts, any provision of infrastructure to support a growth in visitation must consider solutions that have a minimal increase on development footprint and/or impact, including technological advancements, refurbishment or in-situ upgrades, or reuse/repurposing of existing infrastructure where possible.

4.4.11.1 Existing conditions

Figure 4.22 provides a summary of the existing conditions and constraints as related to infrastructure in alpine precincts. Table 4.8 provides a summary of the existing infrastructure capacity (water availability, wastewater treatment, and supply of electricity and gas, and waste) in the alpine resort areas.



Figure 4.22 Summary of Infrastructure existing conditions

Table 4.8	Assessment of	alpine resort	area infrastr	ructure capaci	ty
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Alpine resort area	area Alpine resort infrastructure					
	Water availability/ extraction	Wastewater treatment	Electricity supply	Gas supply	Waste	Telecommuni- cations
Thredbo						
Perisher						
Charlotte Pass						

The table uses a traffic light system to assess the level of capacity; green – no current capacity issues; orange – partial or unclear of capacity issues; red – capacity exceeded. The table includes an assessment of major infrastructure users (Alpine resorts), however excludes Selwyn due to the reconstruction from the 2019/2020 bushfires.

These capacity constraints are further discussed in Table 4.9. A full assessment is included in the Infrastructure Study.

Infrastructure and services	Summary
Water availability/supply	The current annual water extraction and peak demand for the various NPWS water supply systems indicate compliance with existing extraction licenses and key infrastructure assets. Compliance of water extraction for private systems contains some data gaps, with potential exceedances of extraction licencing noted at Guthega and Thredbo. It is however acknowledged, there are ongoing discussions regarding water access with regulators.
Wastewater treatment	Peak wastewater loading occurs in winter due the high seasonal pollution and visitation, and the increased stormwater inflow and groundwater infiltration to reticulated systems. As a result, there have been several non-compliances with Environmental Protection Licences (EPLs) across KNP. This suggests wastewater treatment systems are beyond their operational capacities during this period. It is also noted that current data collection and extraction license management are areas which could be improved.
Electricity and gas	Gas supply to the alpine precincts is set up as small, localised networks in specific areas such as Perisher, while other areas rely on distribution by onsite storage tanks or cylinders. Gas supply is managed by Elgas, which has a small depot in Cooma and cylinder swap in Jindabyne. Larger orders, for operators such as Thredbo and Perisher, are trucked from Port Botany in Sydney or from Victoria if required.
Waste	Jindabyne landfill has limited space available within its existing landfill cell. The site expected to reach capacity around early to mid-2023. Snowy Monaro Regional Council has developed a waste management strategy that would result in the development of a waste transfer station. Waste would be transferred to landfill assets in Cooma (which has a capacity of 20 years, under its current configuration). Given the capacity constraints in the existing landfill, a temporary expansion would be required to facilitate short term needs.
	Waste sludge from sewage treatment plants (STPs) (managed by NPWS) is transported and applied to land in Berridale (outside KNP).
	Recycling is collected by licenced waste contractors and taken to a materials recovery facility in Canberra or Cooma.
Telecommunications	There are issues with the limited availability of NBN broadband, and mobile services at various locations in KNP, including a lack of service at some resort areas. While telecommunications services at Alpine resorts are generally adequate, a number of the operators in alpine precincts have reported that telecommunications services are

 Table 4.9
 Summary of existing infrastructure capacity constraints

4.4.11.2 Future considerations

Water use and supply

With the projected increase in the visitor growth for alpine resort areas. The forecast additional water demand during the peak August period for the Perisher Valley Resorts and Thredbo shows a significant increase in peak demand of around 450 kl/day and 400 kl/day respectively (refer to Section 6.1 in the Infrastructure Study).

If not properly managed the increase in demand would result in increased likelihood of exceeding extraction limits. Although details of the treatment capacity are unclear, this increase in water demand would also result in increasing pressure of the treatment capacity of the infrastructure.

unreliable and detrimental to business.

The demand for water is likely to be exacerbated by the need for artificial snowmaking to complement natural snowfall and extend the ski season. Typically, artificial snowmaking commences in early May and continues through to August, coinciding with the peak winter visitor demand. An analysis of the impacts of climate change on water demand (refer to Appendix G) shows an increase of 7% by 2030, and 42% by 2070.

Based on current licencing conditions, demand (for both potable water and water used for snowmaking) would significantly exceed extraction licencing at Perisher by 2039. Based on current data, the extraction licence limit at Thredbo would not be reached. It should be noted there are a number of discrepancies in extraction data, which make an accurate assessment difficult.

Wastewater

With the projected increase in the visitor growth, it is likely that the existing wastewater systems would be under high pressure. The various existing ageing asset and performance issues could potentially pose challenges in managing such increase due to their limitation in treatment capacity. The forecast additional wastewater demand during the peak August period for the Perisher Valley Resorts and Thredbo shows a significant increase in peak demand flow of around 2400 kl/day and 2500 kl/day respectively (vs current discharge licence limits of 1600 kl/day and 2000 kl/day respectively). As such the wastewater systems throughout alpine precincts would need to be upgraded in line with future growth and development.

Electricity

Table 4.10 provides a summary of the calculated electricity demand for the Snowy Mountains SAP areas. Based on the growth projections, upgrades would be required at three of the four substations supplying electricity to the areas.

Snow Mountains SAP Precincts	Substation	Additional load estimate (MVA)	Available capacity (MVA)
Charlotte Pass, Thredbo Ranger Station, Thredbo Village	Thredbo Substation	21.98	17.70
Perisher Village, Smiggin Holes	Perisher Substation	14.085	8.70
Sponars Chalet, Ski rider, Guthega, Kosciuszko Tourist Park	Snowy Adit Substation	1.20	9.90
Bullocks Flat	Bullocks Flat Substation	2.37	5.3

Table 4.10 Future electricity demand

Source: WSP, 2021e

In consideration of the provision of energy, the Snowy Mountains SAP has strong renewable energy aspirations that should be considered as part of any future development or use in alpine precincts.

These aspirations are outlined in the Renewable Energy Technical Study (WSP, 2021h) and include 'A renewable future' and 'Climate Positive and Carbon negative'.

A review of potential energy deliverable opportunities to support the Snowy Mountains SAP (including solar, distributed generation, geothermal and hydrogen) is included in Section 3 of the Renewable Energy Technical Study (WSP, 2021f).

Telecommunications

Future demand for telecommunications has not been undertaken. It is expected that upgrades to telecommunications networks are required at most alpine precincts.

Gas

Future gas demand has not been calculated. The gas infrastructure servicing the NPWS area can be scaled up to meet increased demand through the delivery agreements established with Elgas. It is not recommended for any backbone or reticulated network to supply the area. A detailed SWOC analysis of electricity and gas infrastructure is included in section 4.2 of the Infrastructure Study.

Waste and resources recovery

It is expected that the area will experience a 5% annual growth in waste disposal. A detailed breakdown of waste streams is included in section 7.3.2 of the Infrastructure Study.

4.4.12 Sustainability

This section of the report has been informed by the *Snowy Mountains Special Activation Precinct: Ecologically Sustainable Development (ESD) Plan* (ESD Plan) (DSquared, 2022a) as well as assessments undertaken to inform this CCF. This section differs slightly in approach to the other sections in Stage 4 of the CCF, as it provides a summary of the existing sustainability initiatives implemented by alpine resorts, and then outlines the themes and strategies identified to provide long term sustainable outcomes for the Snowy Mountains SAP. It should also be noted that many of the ESD themes identified in this section, are also applicable in other sections of Stage 4.

Guidance Note 20 – Sustainability and the CCF

The concept of sustainability is wide ranging in its association with the CCF as the implementation of sustainability initiatives have far-reaching consequences on the ability of an area to effectively manage visitation while minimising impacts and maintaining sustainability values. Most of the themes identified in the ESD report have value considerations which are directly linked to values or services and infrastructure which are also discussed in other sections of stage 4 of the CCF.

There are a number of sustainability initiatives currently being implemented by alpine resort operators in alpine precincts. These are predominantly related to their own operational goals and objectives and in consideration of their 'social licence' to operate, which means the community expectations of what they do and how they do it.

Where the CCF and ESD link, is ensuring the implementation of current and proposed ESD initiatives, but also ensuring those ESD themes, goals and objectives continue to remain in line with community expectations and are able respond to new innovations or changes to those expectations over time.

4.4.12.1 Ecological Sustainable Development initiatives

Figure 4.23 provides a summary of the ESD initiatives considered appropriate for the alpine precincts.



Figure 4.23 ESD themes of relevance to the Snowy Mountains SAP

Table 4.11 provides details on the sustainability initiatives currently being implemented by alpine resort operators.

Alpine resort	Environmental initiatives and activities
Thredbo	Thredbo was the first Australian ski resort to have its major operations powered by renewable energy, through a contract for 100% renewable energy with Red Energy and Snowy Hydro. Thredbo resort lists the following environmental initiatives and activities:
	 Organics recycling machine: composting food waste via a closed loop system.
	 Plastic reduction plan: removing single-use plastic products.
	 Rehabilitation: stabilising soil and providing habitats for native animals as part of the mountain bike trail development.
	— Repurposing materials: building materials have been reused in landscaping.
	— Collaboration with external sustainability providers, including:
	 Greenfleet: since 2009, Thredbo has partnered with Greenfleet to offset resort vehicle emissions including all fuel used to run snow groomers and shuttle buses Carbon offset: a voluntary forestry carbon offset program for guests, enabling them to purchase a tree for \$4 when buying lift products EarthCheck: Thredbo measures its environmental performance using the EarthCheck benchmark, achieving a silver certification for three consecutive years Keep it cool: a local non-profit based in Jindabyne who work to support environmental initiatives in the Snowy Mountains.
	 Environmental week: a week dedicated to driving awareness about environmental initiatives with the broader community.
	 Biodiversity Management: in partnership with the NSW National Parks and Wildlife Service, Thredbo acts to protect native flora and fauna within the resort. This includes fauna crossings and planting of native flora.
	 Energy Management: Energy efficient equipment (Gondola, lifts, snow-making machines, heat pumps and lighting) and solar PV installations have reduced energy and utilised renewable energy.
	 Waste Management: multiple separation and recycling initiatives are practiced for common and more challenging waste streams at the resort.
	 Water Management: water use is reduced through water efficient appliances and fittings and water quality is monitored.

Table 4.11Summary of sustainability initiatives by alpine resort

Alpine resort	Environmental initiatives and activities
Perisher	Perisher's operator has implemented environmentally sustainable activities as part of the Vail Resorts network who share a commitment to net zero operating footprint. This includes:
	 improving waste diversion across all operational areas, including a focus on organics composting removal of waste bins in staff areas to encourage better utilisation of centralised waste separation stations
	 replacing single-use plastic straws with compostable alternatives
	 removal of single-use plastic products like condiments and implementing reusable crockery and cutlery across various operational areas
	 increased the number of water stations to encourage BYO drink bottles and reduce single-use plastic bottles
	 incorporating habitat connectivity features in development proposals, with three new fauna crossings installed in the last 2 years
	 using innovative construction techniques to avoid or minimise disturbance to biodiversity campaigning to reduce litter and holding clean-up activities.
	Perisher is a member of the CERES Business for Innovative Climate and Energy Policy as well as RE100. The resort engages with vendors and suppliers to identify and collaborate on opportunities to reduce emissions and impacts. Information is published with progress shared in their annual report. Vail Resorts measures GHG footprint and in 2016, calculated a per skier footprint of 0.0127T CO2 per visit.
Charlotte Pass	There are efforts to improve access with shared car parking and group transport proposed at Sawpit Creek. The resort has a local wastewater treatment plant which discharges to Spencers Creek Bog. The 10-year master plan for Charlotte Pass notes upgrade to this facility, including roofing over tanks, recladding of buildings and automated programmable logic controllers. Charlotte Pass aims to monitor stormwater and increase investment in energy saving initiatives, as well as developing waste programs to raise awareness. The area around the resort is primarily snowgum woodland and alpine bog and fen of high biodiversity value. The resort is compact with buildings in close proximity to one another allowing pedestrian access.

4.4.12.2 Future ESD considerations

Table 4.12 provides a summary of key opportunities and considerations within the alpine precincts as they relate to the ESD themes.

ESD themes	Key opportunities and considerations
Climate resilience	 transition alpine resorts most vulnerable to climate change to alternatives to snow-based tourism, by developing year-round growth scenarios for the resorts implement urban design, infrastructure and building standards to increase climate resilience.
Emissions	 develop a framework for reducing emissions with options for energy efficiency, renewable energy and circular economy opportunities incorporated emissions calculators are used to test development scenarios to plan zero emissions pathways for development.

 Table 4.12
 Summary of key opportunities and considerations within the SAP investigation area
ESD themes	Key opportunities and considerations
Energy	 develop opportunities for 100% renewable Power Purchase Agreement (PPAs) to enable redevelopment projects to be powered by renewable energy and to enable existing developments to be decarbonised over time. support solar PV and battery storage systems on a smaller scale to support individual development where viable integrate energy efficiency and productivity into development design guidelines, with whole of lifecycle emissions considered.
Environment	 touch the ground lightly is the overarching theme for new buildings and infrastructure green infrastructure embedded into urban design develop existing buildings and previously developed sites consider the environmental impacts of all proposed new infrastructure and building development and develop sustainable design principles and benchmarks for the region.
Society	 priorities community and visitor health and wellbeing through inclusion of wellbeing principles in all development develop opportunities for 'wellness' tourism and eco-tourism create opportunities for social infrastructure celebrate heritage, inclusion and diversity.
Mobility	 work towards a fully integrated transport model prioritising Park and Ride facilities for access to alpine precincts promote zero emissions transport and infrastructure, prioritising public transport options.
Circular Economy	 support waste management and recycling infrastructure develop promote circular economy relationships between Snowy Mountains SAP businesses.
Water	 an integrated water cycle is established based on water sensitive urban design (WUSD) principles, including better management of stormwater quality and quantity new water infrastructure and urban planning should incorporate water sensitive urban design wastewater treatment systems in the alpine areas should be upgraded to closed loop systems with no pollution to alpine streams build capture and reuse infrastructure should be included in all new developments.
Leadership	 develop an overarching EMS for all development within alpine precincts, which is integrated with the CCF, KNP PoM and alpine resort EMS encourage new developments within the Snowy Mountains SAP to develop an EMS to control the environmental aspects of the development develop a framework for sustainable design and certification of new development and building assets.

4.5 Stage 5 – Value protection mechanisms and standards

Stage 5 of the CCF sets out the mechanisms by which the values identified in Stage 2 are protected. It includes a summary of the mechanisms, as well as performance standards or measures to be applied to their protection (where appropriate).



Figure 4.24 Stage 5 – Carrying Capacity Framework

The mechanisms included in this CCF include:

- the Snowy Mountains SAP Master Plan (including structure plans)
- the Alpine DCP
- a certified precinct ISO 14001 environmental Management System (EMS)
- environmental management site plans (EMSP).

Table 4.13 in section 4.5.5, outlines a summary of the values and standards (where appropriate) and through which mechanism they are protected, or their management is addressed.

4.5.1 Snowy Mountains SAP Master Plan

The Snowy Mountains SAP Master Plan is the statutory planning document to support the Precincts-Regional SEPP. It is the primary step in the protection of KNP values from the CCF perspective. As such it can be viewed as both a component of, and an outcome of the CCF. Its co-development with the CCF allowed for the consideration of aspects of the Master Plan as they were developed and the inclusion of key areas as they were defined.

Guidance Note 21 – Strategic value protections

The purpose of the Snowy Mountains SAP Master Plan is to establish the vision, aspirations, and principles for the Snowy Mountains SAP, and identify performance criteria at a precinct scale for amenity, environmental performance, and the provision of infrastructure. The principles, which underpin and guide planning in alpine precincts were developed in partnership with key stakeholders (including NPWS) are based around economic development, infrastructure and transport, environment and sustainability, community and place and landscape. The Master Plan also includes detailed land use provisions via detailed structure plans for each alpine precinct. These set out appropriate development aspirations and consider strategic environmental protections for those areas. This ensures development types are planned for, in suitable locations, and ensures the protection of values such as biodiversity, visual amenity, and cultural heritage.

The Snowy Mountains SAP Master Plan has been developed with the input of key technical assessments, which have identified capacity constraints, considered future growth scenarios, and provided recommendations to manage and mitigation potential impacts (refer to Appendix F).

Based on these technical assessments, community and stakeholder engagement and planning workshops, the Master Plan establishes high level goals and objectives, and outlines matters that are addressed in the Alpine DCP.

4.5.1.1 Structure plans

The structure plans are a key component of the Master Plan, as they identify and guide development in each alpine precinct. They aim to facilitate development or re-development activities in line with the Snowy Mountains SAP aims and aspirations and provide a design response to the expected growth in visitation in KNP.

Structure plans allows for the identification of areas considered most appropriate for development, and for the constraints outlined in Stage 4 of the CCF to be considered. The 'preferred scenarios' have been refined through the master planning process in response to the progression of technical assessments, and in response to community and stakeholder engagement.

The structure plans for KNP focus on infill and improvement of existing development in the resort areas of Thredbo, Charlotte Pass and Perisher, as well as some new locations (refer to Stage 3) in areas where development has previously taken place or where existing disturbance is present. It should be noted, no structure plans have been developed for Selwyn due to the ongoing recovery from the 2020 bushfires, and no changes to the existing development is considered as part of this CCF.

Guidance Note 22 – Structure plans for alpine precincts

The Snowy Mountain SAP structure plans have been developed with consideration of design principles aimed at preserving key values of each area, they are based on the principles of:

- touching the ground lightly by:
 - limiting development to disturbed areas with a small number of expansion areas to limit cumulative impacts from development
 - moving towards resort consolidation and renewal
 - delivering on ecological sustainable design principles
- focusing on alpine villages by creating village centres as community and visitor focal points, including quality public spaces and walkability, defining character and gateways to improve legibility and connectivity
- strengthening alpine resort areas and other locations for year-round activities and ensuring the provision of infrastructure to improve and diversify accommodation (including appropriateness for year-round activation)
- ensuring design elements are appropriate with the alpine setting and conditions, and distinct to precinct characteristics
- planning for new infrastructure to support the existing and future visitation, including new transport and
 access choice to reduce the dependence on private vehicles, and support a carbon negative transport system.

The structure plans for each alpine precinct provide a summary of the existing conditions, and describe the changes made to the draft plans following their exhibition in 2021. This includes consideration of public consultation, as well as updated technical assessments used to guide the master planning process.

Perisher Range

The structure plans for Perisher Range have been divided into individual precincts within the Perisher Range Alpine Resort area. These areas include Perisher Valley (including Pipers Gap), Smiggin Holes, and Guthega. No structure plans have been developed for Blue Cow or Bullocks Flat.

Perisher Village and Pipers Gap

The structure plan for Perisher Village focuses on aligning with the long-held goal of developing a mixed used village as a focal point for year-round activation as well as long-term public transport accessibility. The plan focuses on disturbed sites and optimal utilisation of the open parking areas. Specifically, the structure plan includes:

- a new central village with accommodation, commercial areas, community facilities with a walkable plaza and connections to transport modes
- expansion of the existing emergency services precinct
- limited infill development opportunities in the central area, and potential for further infill renewal areas to the north, south and east
- a new car park has been proposed at Pipers Gap, with pedestrian links to improve road and pedestrian safety.

These infill and development opportunities would allow for an increase to the existing bed limit of 1,677 tourist beds and 52 staff beds, taking the total bed limit in the Perisher Village to total of 5,270 beds. It would also allow for an additional 2,662 square metres of commercial floor space.

Further details are included in section 8.6 of the *Structure Plans* (Jensen Plus, 2022).

Guidance Note 23 – Perisher Valley structure plan and the CCF

The structure plan for the Perisher Valley recognises the significant amount of change and growth which is anticipated for the Perisher Valley. Due to the location and altitude, the growth plans take into account Perisher experiencing better snowfall in future years than other alpine resort areas. As such this makes Perisher a key opportunity for new development targeting both winter and non-winter visitation.

Smiggin Holes

Smiggin Holes is part of the larger Perisher Range Alpine Resort, however, as it is located at a lower altitude it has less reliable conditions, which over time due to the impacts of climate change mean will become less and less suited for winter sports. This suggests that Smiggin Holes is not considered an appropriate location for any many major new developments. This would avoid adding developments which have the potential to become future stranded assets.

The structure plan for Smiggin Holes includes modifications to the existing use arrangement and minor redevelopment opportunities which are able to facilitate an update to the existing tourist bed limit to a maximum of 1193 (an increase of 177), and allow for an additional 1,200 square metres of commercial floor space. The predominant development opportunities focus on the integration with the proposed improvements to public transport options, linking Smiggin Holes with surrounding areas as well as Jindabyne.

Further details are included in section 8.7 of the Structure Plan (Jensen Plus, 2022).

Guidance Note 24 – Smiggin Holes structure plan and the CCF

The structure plan for Smiggin Holes acknowledges the limited opportunities for future development activities due to the impacts of climate change. As such development opportunities are focused on improving mobility to and from the alpine precinct via a tourist development note, additional car parking and a new gateway. While there is some capacity for updates to the accommodation supply, this is limited to alterations in existing use of buildings and does not include new opportunities on greenfield areas of the precinct. This approach to development opportunities is consistent with the aims and approaches of the Snowy Mountains SAP master planning aspirations and the CCF.

Guthega

The structure plan for Guthega aims encouraging year-round visitation, without changing the characteristics of the precinct. There are significant biodiversity and environmental values, as well as high bushfire risk which limit major expansion of new buildings or land uses. As such the structure plan provides for:

- greater links to existing and potential new walking trails
- ski lodge and accommodation upgrades, however, provides no provision for an increase to the existing bed limit, which is to remain at 330 beds
- road sealing
- greater use of ski amenities buildings, and improved connectivity with a gateway marker and links to a shuttle bus stop, new trail head and parking
- additional wayfinding, picnic facilities and low-key infrastructure to support day visitation.

Further details are included in section 8.8 of the Structure Plan (Jensen Plus, 2022).

Guidance Note 25 – Guthega structure plan and the CCF

The structure plan for Guthega acknowledges the existing unique characteristics of the village, and its location as the departure point of many backcountry tails and hikes. It aims to improve the amenity and visitor experience of the precinct though the facilitation of upgrades to existing buildings and ski lodges, and improved connectivity with Jindabyne and surrounding areas in KNP, as well as encouraging greater use of existing facilities. The structure plan recommends enhancing links to walking trails as well as providing additional facilities for backcountry users who wish to use Guthega as a base, starting point or through point on longer trips.

The structure plan also recognises the significant biodiversity and environmental values, in addition to the elevated bushfire risk, which each constrain opportunities for new development. This approach to development opportunities, is consistent with the aims and approaches of the Snowy Mountains SAP master planning aspirations and the CCF.

Thredbo Village

The structure plans for the Thredbo alpine precinct use the existing character of what is working and builds on it. It aims to retain and build on the existing village character, with a focus on infrastructure improvements for pedestrian connectivity, as well as long-term public transport accessibility.

In terms of development opportunities, new development land is relatively limited due to constraints such as biodiversity, aboriginal heritage and surface water bodies, as such, the plan focuses on significant infill opportunities in the main village, with some low-density expansion in the west at the existing gold course location. These infill and development opportunities would allow for an increase to the existing tourist bed limit of 1361 beds and 274 staff beds, taking the total bed limit in the Thredbo alpine precinct to total of 6,455 beds. Given the success of the current village atmosphere, the current form of the village would be maintained. It would also allow for an additional 2,035 square metres of commercial floor space.

Further information, including detailed illustrations are included in section 8.8 of the Structure Plans (Jensen Plus, 2022).

Guidance Note 26 – Thredbo Village structure plan and the CCF

The structure plan for the Thredbo alpine precinct acknowledges the high value placed on its village atmosphere, its popularity as both a summer and winter destination. It also considers the significant biodiversity and heritage values along with areas of geotechnical risk. As such, the structure plan focuses on enhancements via upgrades to existing infrastructure, facilities and accommodations, and some infill development where it is appropriate to do so, and in a type or style appropriate for the village setting.

Another key outcome of the structure plan is the focus on the creation of an arrival node, public transport interchange, and improved pedestrian linkages though the village. Mobility has been identified as a major constraint for future growth, and the development of these would seek to alleviate some of the constraints associated with the current dominance of private car to access the precinct. The provision of additional overnight accommodation within the village would also seek to alleviate some of these mobility issues during peak periods, and improve the visitor experience, and amenity values of the precinct.

Charlotte Pass

The structure plan for Charlotte Pass (including the Charlotte Pass trail and Kosciuszko Road head) focuses on investments in public realm improvements, some limited urban expansion, the retention of significant vegetation, and improved connections between the village and trail heads for the various walks which can be accessed from the area. The structure plan highlights include:

- Charlotte Pass can continue to grow as a winter resort and increasingly become a node for summer visitation
- there are opportunities for new development sites with improvements to public realm, access and parking and public gathering points suggested. These new development sites consider the existing biodiversity constraints that are present in much of the precinct, with areas of high biodiversity value hugging areas of developed land. As such the structure plan generally limits future development to disturbed areas, plus the renewal of existing sites. It allows for an additional 2,010 square metres of commercial space
- to enable an increase in the existing bed limit by total of 238 beds (to a maximum of 849 bed), the renewal of older accommodation would allow this increase in accommodation capacity over time, this would also be supported by sewage treatment plant upgrades to meet existing and future visitor demands
- increased visitation can be supported by proposed shuttle bus services from Jindabyne (in summer), as well as
 formalisation of car parking in the precinct including improvements to Charlotte Way, and the intersection with
 Kosciuszko Road

- provide landscaping elements and defining a village entry with appropriate signage and pathways to attract and inform visitors. The emphasis would be on indigenous knowledge and European heritage
- in terms of the built environment, the form and materiality of new buildings will be based on the strong precedents provided by the existing chalet and existing high-quality buildings. In addition, improved sustainability, durability, and access design outcomes would be developed
- formalisation of the roadside parking for day visitors on Kosciuszko Road, and an improvement of linkage between the village and the trial head for the Kosciuszko Summit Walk, Main Range Track and the Snowies Alpine Walk which will provide new walking tracks to Guthega and Perisher Village.

Guidance Note 27 – Charlotte Pass structure plan and the CCF

The Charlotte Pass structure plan seeks to guide significant improvements in the visitor experience and amenity values of the alpine precinct. Specific development activities focusing on public realm opportunities such as an amphitheatre and public plaza, are aimed at improving the village atmosphere and contributing to the activation of summer visitation to the village. From a mobility perspective, the plan seeks to improve connectivity with Jindabyne, and the immediate surroundings, via both the provision of shuttle bus services, and greater connections between the village and the existing trail head at the end of Kosciuszko Road. These upgrades would also improve visitor safety and traffic issues which are currently present during the summer months.

To preserve and protect environmental values, such as biodiversity, landscape, and hydrology, the structure plan seeks balance in creating opportunities for tourism growth and expansion, limiting building footprints or development expansion, and minimising potential direct impacts to biodiversity and changes to landscape and hydrology values in the alpine precinct. These values would be further protected though the upgrades to the sewage treatment plant to account for existing and future demands from visitation.

This outcome, is consistent with the aims and approaches of the Snowy Mountains SAP master planning aspirations and the value objectives of the CCF.

Further details are included in section 8.4 and 8.5 of the Structure Plan (Jensen Plus, 2022).

Thredbo Ranger Station

The structure plan for Thredbo Ranger Station supports the re-development of the disturbed site as a small eco-tourist destination, including the remediation and revegetation of existing disturbed areas. Specifically, the structure plan supports:

- reuse and upgrade of the existing building
- development options including a 20 room trout fishing lodge and/or glamping tents
- site remediation and revegetation
- upgrades to site access and linkages to transport modes.

The Thredbo Ranger Station development opportunity would allow for the establishment of a new bed limit to a maximum of 100 beds. Any new developments would be operated by a tourism provider, rather than NPWS.

Guidance Note 28 – Thredbo Ranger Station structure plan and the CCF

The structure plan for the Thredbo Ranger Station is aimed at repurposing an existing structure and area of existing disturbance within KNP, and establishing a high quality, low impact accommodation option for visitors. This development would be focused on providing additional summer activation of KNP, to reduce the impacts of climate change on tourism opportunities to 2061.

This development opportunity would provide additional options for recreation in KNP, improve visitor experience, and has appropriately considered the existing constraint, which includes high value biodiversity, and the potential for flooding risk on lower section of the precinct and would aim at rehabilitating specific areas such as former chair lift infrastructure. This seeks to remove stranded assets associated with historical recreation that are no longer in use. As such, this outcome is consistent with the aims and approaches of the Snowy Mountains SAP master planning aspirations and the value objectives of the CCF.

Further information, including detailed illustrations are included in section 8.16 of the *Structure Plan* (Jensen Plus, 2022).

Sponars Chalet

The structure plan for Sponars Chalet supports development which focuses on upgrading the existing facilities and allowing for potential future expansion of new buildings and accommodation options. Specifically, the plan provides:

- a re-development area has been identified which covers the existing building footprint and surrounds
- establishment of walking tracks
- development of a watercraft landing or jetty.

The Sponars Chalet development opportunity would allow for an increase to the bed limit to a maximum 238 beds, an increase on the current 116 beds which are allowed. It would also allow for 500 square metres of additional commercial space. The structure plan recognises the existing heritage significance of the existing building and site. The protection of these heritage values would be considered via the Alpine DCP.

Guidance Note 29 – Sponars Chalet structure plan and the CCF

Sponars Chalet occupies a unique location as it is one of only three short term accommodation providers (outside alpine resort areas) which is located within KNP and along Kosciuszko Road. While the structure plan does not provide for significant development of the alpine precinct, it does acknowledge that there is opportunity for additional short-term accommodations via upgrades to the existing heritage listed building, and small areas of surrounding disturbed land.

The realisation of the structure plan would provide improved visitor experience and maintain amenity and heritage values with no significant impacts to environmental values located in the precinct. As such, this outcome is consistent with the aims and approaches of the Snowy Mountains SAP master planning aspirations and the value objectives of the CCF.

Further information, including detailed illustrations are included in section 8.10 of the *Structure Plan* (Jensen Plus, 2022).

Ski Rider

The structure plan for Ski Rider supports the re-development of the existing motel and improvements to the supporting infrastructure. Specifically, the plan supports:

- a new staff accommodation block
- improved and expanded accommodation though height increases
- refurbishment of the existing building (bar, bistro, accommodation units)
- upgrades to roads and amenities
- upgrade or replacement of the existing STPs
- improvements to the entry and exit of the resort.

The structure plan recognises the limited availability of developable space, and the limitation as a result on the bushfire risk in the alpine precinct. Thus there is no allowable increase to the existing bed limit of 339.

Guidance Note 30 – Ski Rider structure plan and the CCF

The Ski Rider Alpine Precinct is the second of the short-term accommodation providers located on Kosciuszko Road. Consistent with Sponars Chalet, the structure plan focuses on re-development over any significant expansion.

The precinct is largely constrained by biodiversity, bushfire and geotechnical constraints which limit the potential for expansion of the existing building and infrastructure footprints. As such there is no proposed increase to the allowable bet limit, with potential development focusing on the quality of the offering, improved linkages with future public transport opportunities, and upgrades to supporting infrastructure. These opportunities would maintain and improve the visitor experience and amenity values of the precinct, and ensure environmental values are protected and improved.

This outcome is consistent with the aims and approaches of the Snowy Mountains SAP master planning aspirations and the value objectives of the CCF.

Further information, including detailed illustrations are included in section 8.10 of the *Structure Plan* (Jensen Plus, 2022).

Kosciuszko Tourist Park

The structure plan for Kosciuszko Tourist Park provides for upgrades to camping facilities and opportunities for ecocabins. This includes an expansion of offering to include:

- new three-star accommodation
- an additional 50 tourist beds, increasing the limit to a total of 122 beds
- upgrades to the existing education centre
- connection and return to country opportunities
- establishment of park and ride facilities
- links to walking trails.

Guidance Note 31 – Kosciuszko Tourist Park structure plan and the CCF

The structure plan seeks to maintain the existing values provided by the Kosciuszko Tourist Park. As with Ski Rider, and Sponars Chalet, the park provides an additional option for short term accommodation within the boundary of KNP, it also provides a cheaper option (including camping) for visitors. The structure plan builds on these values by allowing for upgrades to existing facilities, as well as some new developments (considering existing environmental constraints) to provide additional accommodation options. The development opportunities to improve connection and return to country opportunities would provide for enhanced cultural heritage values. Additional development opportunities such as links to walking trails and links to public transport nodes would improve mobility and access to and from the precinct.

These outcomes are consistent with the aims and approaches of the Snowy Mountains SAP master planning aspirations and the value objectives of the CCF.

Section 8.12 of the *Structure Plan* (Jensen Plus, 2022) provides additional details including a visual representation of the structure plan.

Creel Bay

The structure plan for Creel Bay, aligns with the recent master plan for the site, which includes additional cottages, camping and day use areas on Lake Jindabyne. It would allow for the establishment of a new bed limit to 358 beds, and provide an additional low impact option for visitors to be accommodated in KNP.

Guidance Note 32 – Creel Bay structure plan and the CCF

The Creel Bay structure plan has been designed to align with the existing master plan for the stie which was developed by NPWS. The development of this area would provide a low impact option for additional accommodation within the boundary of KNP.

Further details are included in section 8.16 of the Structure Plan (Jensen Plus, 2022).

Island Bend

The structure plan for Island bend supports the development and expansion of camping and associated nature-based uses and facilities. Specifically, while managing the high bushfire risk, the plan provides:

- additional camping areas including a new campground suitable for school or interest groups (no cabins or roofed accommodation are proposed)
- upgraded entry, signage and markers
- development of connections to nearby (or proposed) walking trails
- lookouts and walking loops
- progressive rehabilitation of the former old township, with new camping opportunities.

There is no provision for the establishment of bed limits at Island Bend camping area. Upgraded camping facilities would be designed to meet capacity requirements of the proposed number of camping sites.

Guidance Note 33 – Island Bend structure plan and the CCF

The Island Bend structure plan sets out to preserve the character of the precinct, with a predominant continuation of the existing 'primitive' camping, which would remain managed by NPWS. This ensure the existing visitor experience and amenity values are preserved. The structure plan also identifies some provision for camping and accompanying facilities on the former airstrip targeted at group use (schools or similar). This would improve the accessibility and experience of those targeted groups.

A key constraint to the use of the alpine precinct is the presence of asbestos contamination associated with the former township area. The progressive decontamination of this area, prior to any use would mitigate this risk, and remove a long-standing contamination issue in KNP. With regards to the impacts to biodiversity and environmental values, the precinct contains small areas of high biodiversity constraints. The type and scope of development opportunities in this precinct would not result in significant impacts to biodiversity or other environmental values.

This approach to development opportunities in the alpine precinct, is consistent with the aims and approaches of the Snowy Mountains SAP master planning aspirations and the CCF.

Further information is included in sections 8.13 of the Structure Plan (Jensen Plus, 2022).

4.5.2 Alpine Development Control Plan

The Alpine DCP is the second step in the provision of value protection in KNP and would set out how certain values are to be protected in each alpine precinct. The Alpine DCP will follow the adoption of the Snowy SAP Master Plan.

Guidance Note 34 – Alpine DCP

The purpose of the Alpine DCP is to identify site level development controls which guide development in the alpine precincts based on predetermined standards and performance criteria. These development standards would be identified as appropriate for the context of KNP and based on the outcomes of technical assessment and existing development controls in the Precincts-Regional SEPP. The Alpine DCP would ensure any proposed development is the right development in the right place and is designed according to those predetermined standards and controls. This allows for a consistent approach to factors such as, but not limited to, built form, sustainability requirements, and infrastructure sequencing.

4.5.3 Environmental Management System (ISO14,001)

The third mechanism for value protection is the implementation of an EMS certified to ISO14001, informed by environmental performance indicators developed by NPWS. This would embed a holistic framework which serves to integrate the CCF, the Snowy SAP Master Plan, and the KNP PoM.

Guidance Note 35 – SAP EMS

The purpose of the EMS (ISO14,001) is to manage the day-to-day operations of alpine resorts, and to ensure all operations within the alpine precincts maintain pre-determined performance standards and where applicable, regulations. In this CCF maintenance of these performance standards are directly linked to the approval of further development in line with the in the Snowy Mountains SAP Master Plan and Alpine DCP. The details of the EMS would be developed by NPWS, with independent certification, consistent with ISO requirements.

It has been recognised that the ability of operators to achieve ISO14,001 compliance varies depending on several factors. As such mandatory input and compliance would be required from Alpine resorts (Thredbo, Perisher and Charlotte Pass) while other operators are supported and encouraged to implement an ISO 14,001 accredited EMS, or work towards the aims of the EMS to reduce environmental impacts in line with the Snowy Mountains SAP expectations (refer to Figure 4.25).



4.5.4 Environmental management site plans

An important element of the EMS, and the final step in the value protection mechanisms are management and monitoring requirements for specific alpine precincts, or specific operators within those precincts.

Guidance Note 36 – Environmental Management Site Plans

The purpose of the EMSP is to capture additional management requirements which are of importance to NPWS, however not captured in the earlier planning stages, or are not a fundamental management issue in a traditional EMS sense. They are aimed at managing issues of natural and cultural values which require ongoing consideration or have landscape scale implications. This includes the management of pests, weeds, litter and general amenity, specific rehabilitation works, and community involvement.

These management requirements may be built into and managed within the EMS (if appropriate to do so) or managed through an alternative mechanism such as a lease or license (where the requirement may be an EMSP). This final step in the value protection mechanism allows a regulatory management tool for operators where an EMS certified to ISO14001 standards and recognises the varying scale of operations within KNP.

4.5.5 Summary of values, and proposed mechanism for protection and management

Table 4.13 provides a summary of the values and standards (where appropriate) and identifies the relevant mechanism through which the values would be protected. The details in this section are based on the outcomes of the Snowy Mountains SAP technical papers. The details are not complete recommendations and should be read in conjunction with the technical paper outcomes in Appendix F.

Values	Snowy Mountains SAP Master Plan	Alpine DCP	Operator EMS	EMSP
Water resources, water quality and flooding	 The Master Plan (and supporting technical studies): explores opportunities for integrated water cycle management ensures a sustainable use of water involving a fully integrated water cycle that supports the needs of the precinct and the environment explores opportunities to improve water quality and reduce stormwater run-off (e.g., through passive landscape design) identifies appropriate supporting provisions relevant to water resources and quality (e.g., a stormwater management strategy) to be developed as part of the Alpine DCP ensure a 1% AEP flood planning level is adopted, and riparian zones are protected development should mitigate the impacts of local overland flooding through the provision of adequate site drainage systems. 	 The Alpine DCP would: require the upgrade of wastewater treatment systems in alpine areas to closed loop systems to limit pollution to alpine streams ensure water capture and reuse infrastructure is installed for all new developments, where conditions allow ensure point source pollution controls and stormwater controls are implemented (such as along roads, carparks, new developments) ensure the continuation of a water quality monitoring Program (WQMP) including expanded monitoring and monitoring for impacts of applied salt in KNP (roads and resorts) ensure future snowmaking technologies are appropriate and all potential impacts have been assessed and mitigated prior to development or use ensure development is sited, designed and located to avoid or mitigate the flood risk to people, property and infrastructure ensure consideration of emergency evacuation planning. 	 The EMS (14,001) would require the operator to: comply with the requirements of the WQMP which would be developed to ensure site specific compliance and compliance for biological, physical and chemical indicators of resort stream health compared to ANZECC guidelines (physical and chemical measurements) and AUSRIVAS KNP model (biological condition) ensure compliance against water extraction licencing track and report water consumption (including for snowmaking) and explore opportunities for water savings and measures to improve efficiency. 	To be developed in collaboration between NPWS and operators if required.

Table 4.13 Summary of Values, mechanism for protection and management

Values	Snowy Mountains SAP Master Plan	Alpine DCP	Operator EMS	EMSP
Pollution prevention and incident management	 The Master Plan: explores opportunities for integrated water cycle management for quality and quantity aspects of water management. 	 The Alpine DCP would: require the upgrade of wastewater treatment systems in alpine areas to closed loop systems to limit pollution to alpine streams explore opportunities to design and implement additional sewage treatment capacity (refer to - <i>water resources and water quality</i>) identify relevant performance criteria related to discharge of wastewater and contaminated stormwater (guided by the outcomes of the Flooding and Water Quality Study in Appendix F). 	 The EMS (14,001) would require the operator to: implement procedures to report all pollution incidents to relevant authorities in a timely manner ensure compliance with EPA discharge licenses for sewage treatment plans (STP's) ensure compliance with POEO Act 1997, UPSS Regulations 2008 ensure 100% of staff are inducted and have undertaken training in environmental incident management and response training. 	To be developed in collaboration between NPWS and operators if required.
Biodiversity	 The Master Plan (and supporting technical studies): maps, protects and preserves areas of high biodiversity value though the avoidance of development in areas of threatened ecological communities and threatened species habitat to minimise impacts to areas of high ecological value ensures development is concentrated in and around already disturbed areas focus development on colocation and redevelopment to minimise impacts to biodiversity minimises the impact of development to the environmental and natural landscape and consider the impacts of bushfire asset protection zones identifies appropriate supporting provisions to be developed as part of the Alpine DCP 	 The Alpine DCP would be developed to include design guidance for each alpine precinct to identify how biodiversity aims would be addressed. This would include: the retention and maintenance of existing native vegetation and areas of high ecological value additional planning and areas for new public open spaces, publicly accessible areas or paths, and appropriate management strategies riparian corridors, setbacks and design objectives for development which interfaces with watercourses plantings along road reserves that address visual amenity, public amenity considerations and road safety client ready species which are native species found in surrounding plant communities and are locally endemic to the alpine region site-based setbacks, landscaping and public domain requirements 	 The EMS would be developed to require the operator to: establish pest and weed management requirements with NPWS collaborate and participate with NPWS on species management actions undertake a rehabilitation plan to manage existing disturbed areas maintain existing areas of native vegetation. 	To be further developed in collaboration between NPWS and operators if required. However, specific site management requirements would include: — ensure no encroachment of vehicles or visitors into areas of high biodiversity value such as short cutting, vehicle crowding or passage.

Values	Snowy Mountains SAP Master Plan	Alpine DCP	Operator EMS	EMSP
	 establish appropriate buffers between areas of high ecological values and buildings and structures 	 how vegetation clearing and biodiversity offsets will be managed 		
	Sildenies.	to ensure biodiversity protections during the short- term construction phase of development.		
Riparian and wetland areas	The Master Plan (and supporting technical studies):	The Alpine DCP would: — ensure setbacks to corridors are provided in accordance the Guidelines for controlled estivities	The EMS (14,001) would require the operator to:	To be further developed in collaboration between NPWS and operators if
	 ensures riparian corridors are preserved identify strategies for greening the precinct through revegetation, connecting habitat and greening riparian corridors identify relevant performance criteria related to maintaining or improving the ecological condition of waterbodies and riparian corridors in relevant catchments (if applicable). 	 develop a landscape and vegetation plan to manage and protect riparian and wetland areas identify relevant performance criteria related to preservation and revegetation of riparian corridors. 	assist relevant agency (as required) to protect and rehabilitate riparian and wetland areas in accordance with <i>Biodiversity Conservation Act</i> 2016 and The <i>Environmental Protection and</i> <i>Biodiversity Conservation Act 1999</i> (<i>Cth</i>).	required. However, specific site management requirements would include: — rehabilitation of riparian areas.
Aboriginal cultural heritage	 The Master Plan (and supporting technical studies): promotes and enhances the cultural heritage of the Snowy Mountains region to ensure the unique culture and history of the region is celebrated acknowledges the First Nations people and country informs protection and preservation of Aboriginal culturally significant places and artefacts and ensures the appropriate management of areas of high archaeological potential promotes, maintains and enhances continued connection to country. 	 The Alpine DCP would: promote development and precinct design that recognises its connection to country prepare an Aboriginal Cultural Heritage Management Plan (ACHMP) as the primary instrument to manage aboriginal cultural heritage in alpine precincts (considering the recommendations of the Aboriginal Cultural Heritage Study outlined in Appendix F) incorporate interpretation opportunities across alpine precincts, in consultation with the local land council incorporate the principle of promoting cultural awareness through design of Country that can enhance senses of culture, and diverse, rich differences explore opportunities to deliver Aboriginal cultural awarenes 	The EMS (14,001) would require the operator to: — assist relevant agencies (if required) to help protect non -Aboriginal heritage sites, Aboriginal Heritage sites and places in accordance with relevant legislation.	To be developed in collaboration between NPWS and site operators if required.

Values	Snowy Mountains SAP Master Plan	Alpine DCP	Operator EMS	EMSP
Shared heritage	 The Master Plan (and supporting technical studies): promotes and enhances the cultural heritage of the Snowy Mountains region to ensure the unique culture and history of the regions is celebrated maps, protects and preserves heritage items and historic assets via the provision of strategic mapping of historic heritage values in alpine precincts identifies built form provision on historic heritage (e.g. retaining heritage items and encourage changes to occur away from significant elements or sections of heritage items). 	 The Alpine DCP would: include strategies for the reuse of heritage listed buildings, and principles for the design of the heritage curtilage protection of existing built heritage during construction or redevelopment works in accordance with relevant legislation. 	 The EMS (14,001) would require the operator to: assist relevant agencies (as required) to protect heritage sites, items and historic assets in accordance with <i>Heritage Act 1977</i>. 	To be developed in collaboration between NPWS and site operators if required.
Energy conservation	 The Master Plan (and supporting technical studies): sets aspirations for renewable energy supply explores opportunities to increase energy supply of the precincts from renewable sources identifies performance criteria on built form to ensure building bulk, orientation and design contributes to the energy efficiency of buildings supports the delivery of innovative renewable energy solutions to reduce carbon emissions and energy costs across the precinct and establish relevant performance criteria. 	 The Alpine DCP would: consider energy availability for hydrogen development explore opportunities to incorporate mandatory energy efficiency and building performance requirements explore opportunities to incentivise the relevant business accreditation on energy such as Earth Check for Business consider the opportunities and implications of new artificial snowmaking technologies to improve energy efficiency, while avoiding other adverse impacts to environmental values. 	 The EMS (14,001) would require the operator to: track and report energy use improve transparency of energy usage data and reporting requirements (e.g. public publishing of data) ensure compliance with proposed SAP energy targets 	Not applicable

Values	Snowy Mountains SAP Master Plan	Alpine DCP	Operator EMS	EMSP
CO ₂ Emissions	 The Master Plan (and supporting technical studies): explores opportunities for precincts to achieve a carbon neutral target and timeframe to ensure the SAP can become carbon negative in a viable manner supports the delivery of innovative renewable energy solutions to reduce carbon emissions and energy costs across the precinct develops an emissions boundary to accurately account for the SAP aspirations for net zero emissions. 	 The Alpine DCP would: ensure all development is carbon neutral certified in line with the Climate Active Precinct Standard (or equivalent) explore opportunities for reducing emissions in line with the Master Plan aspirations explore opportunities to incorporate mandatory energy efficiency and building performance requirements explore opportunities to incorporate new artificial snowmaking technologies to improve energy efficiency while avoiding other adverse impacts to environmental values. explore opportunities to support the transition to lower GWP refrigerants for buildings. 	 The EMS (14,001) would require the operator to: track and report scope 1 and 2 emissions and ensure GHG emissions data is reported annually by all operators improve transparency of energy usage data and reporting requirements (e.g. public publishing of data) ensure compliance with proposed emissions performance criteria. 	Not applicable
Climate Resilience	 The Master Plan (and supporting technical studies): explores opportunities to transition resorts most vulnerable to climate change to alternatives to snow-based tourism, by developing year-round growth scenarios for the alpine resorts includes a climate change adaptation plan to identify risk and opportunities and provide a transition plan for adapting to climate change. 	 The Alpine DCP would: prioritise developments that focus on alternatives to snow-based tourism implement building design, infrastructure and building design guidelines to increase climate resilience. 	Not applicable	Not applicable

Values	Snowy Mountains SAP Master Plan	Alpine DCP	Operator EMS	EMSP
Waste management	 The Master Plan (and supporting technical studies): supports the expansion of resource recovery and recycling industries and embed circular economy principles into planning and operations aligns with circular economy initiatives investigates opportunities to adopt a sustainability framework that connects organisation, processes and resources in a circular economy to gain efficiencies and minimise waste builds and grows on established connections businesses have with national and global circular economies and further expand sustainability initiatives to ensure the SAP Precinct is future proofed identifies appropriate supporting provisions related to waste regeneration and recycling establishes relevant provisions on hazardous development to ensure potentially hazardous wastes are appropriately managed to protect human health and the biophysical environment. 	 The Alpine DCP would: investigate further opportunities for new development to ensure waste is reduced and synergies are realised to benefit businesses and community explore opportunities to align with circular economy initiatives support participation in resource recovery and recycling opportunities where the facilities are located outside of alpine precincts. 	 The EMS (14,001) would require the operator to: manage litter and general resort amenity to established standards implement waste education programs to reduce waste generation, increase waste separation and reduce waste to landfill require operators to aim for a zero-waste-to-landfill policy, and follow the waste management principles of diverting as much waste from landfill as possible monitor and report waste disposal on an annual basis. 	To be developed in collaboration between NPWS and site operators if required.
Sustainable recreation & community involvement	 The Master Plan (and supporting technical studies): ensures development maximises sustainability opportunities that aims to achieve enhanced social performance ensures local community is involved and consulted on the Master Plan and have opportunities for involvement in the design, implementation, and ongoing management of the Snowy Mountains SAP promotes and maintains an enhancement of sense of place. 	 The Alpine DCP would: be developed based on community consultation as well as being placed on public exhibition for a minimum of 28 days 	 The EMS (14,001) would require the operator to: ensure the community have opportunities to participate in community environmental initiatives. 	Not applicable

Values	Snowy Mountains SAP Master Plan	Alpine DCP	Operator EMS	EMSP
Alpine resort amenity	 The Master Plan (and supporting technical studies): ensures growth and economic activity while minimising impacts through initiatives that 'touch the ground lightly' identifies preferred development opportunities for alpine precincts protects, maintains and enhances visual amenity through the selection of key development sites in appropriate locations identifies relevant aims to ensure appropriate amenity and outlook for visitors and communities (e.g. to ensure that the precinct delivers excellent amenity for workers and businesses). 	 The Alpine DCP would: provide detailed strategies for protection of amenity ensure all developments are appropriately located and designed for the desired alpine precinct amenity ensure all development are constructed and maintained for the desired alpine precinct amenity explore opportunities to minimise impacts of development on air quality and amenity require alpine resorts (in partnership with the NSW government) to develop a ski slope master plans to ensure resorts are well balanced and crowding is managed appropriately (considering future growth expected in visitation). 	 The EMS would require operators to: undertake general amenity maintenance implement an amenity management system or monitoring program to ensure the protection of visitor experience and amenity values within the operator areas prevent and manage litter to an agreed scope (with NPWS) and undertake downstream, down wind and off-site inspections including transects in identified problem areas be responsible for education, awareness, and promotion of resort amenity. 	To be further developed in collaboration between NPWS and operators if required. However, specific site management requirements would require: — regular maintenance of gross pollutant traps.
Visitor experience	 The Master Plan (and supporting technical studies): establishes performance criteria on maximising opportunities for recreation by communities and visitors to the SAP identifies opportunities for additional short-term accommodations in alpine precincts ensures a range of activities are available for visitors to undertake. 	 The Alpine DCP would: ensure development controls protect key visitation values of alpine precincts ensure travel times to key resort areas are acceptable explore opportunities to use plantings to create a pleasant environment for walking and cycling, for workers, visitors, and the community require alpine resorts (in partnership with the NSW government) to develop ski slope master plans to ensure resorts are well balanced and crowding is managed appropriately (considering future growth in expected visitation). 	 The EMS would require operators to: implement an amenity management system or monitoring program to ensure protection of visitor experience and amenity values within the operator areas ensure records of public complaints are kept and reviewed annually. 	To be developed in collaboration between NPWS and site operators if required.

Values	Snowy Mountains SAP Master Plan	Alpine DCP	Operator EMS	EMSP
Alpine resort Transport and Access	 The Master Plan (and supporting technical studies): ensures a fully integrated transport model is developed which provides a seamless transport service between Jindabyne and alpine resort areas ensures the establishment of improved placemaking at transport hubs in alpine precincts and associated hubs in Jindabyne promotes alpine precincts as a year-round destinations to reduce issues with seasonality peaks encourages a modal transport shift away from cars and support travel demand management implement equitable access to alpine precincts for all with competitive pricing for sustainable modes targets transport solutions that provide employment in the region. 	 The Alpine DCP would: ensure improved public transport facilities are developed to improve access to alpine resort areas and TOAs ensure the creation of a frequent and rapid zero emission vehicle shuttle service linking key destinations implement real time information to manage parking capacity introduce ITS to alert drivers to conditions and improve road safety establish a cap on existing parking supply at existing/approved levels. provide priority access to zero emissions shuttles and other high occupancy vehicles. 	 The EMS would require operators to: in collaboration with TfNSW, ensure records of traffic volumes and over capacity parking at high visitation nodes including alpine resort car parking and Skitube, were centralised and reported on a regular basis. 	Not applicable
Land Management	 The Master Plan (and supporting technical studies): identifies and selects areas of development in appropriate locations that minimises the potential for land management issues and seeks to improve land management outcomes identifies and selects areas of development in appropriate locations avoids areas with higher potential for landslide. 	 The Alpine DCP would: ensure adequate engineering consideration on areas of medium to high geological risk develop a landscape and vegetation plan to manage the recreational activities that require earth works. 	 The EMS would require operators to: ensure minimum snow coverage guidelines are followed ensure all earthworks (such as development of seasonal mountain bike trails) are undertaken in accordance with relevant guidelines. 	To be further developed in collaboration between NPWS and operators if required. However, specific site management requirements would require operators to: — achieve original development approvals, delivery on rehabilitation plan — 'no bare earth' except for tracks, building curtilages under eaves, defined hardened areas.

4.6 Stage 6 – Implementation, monitoring and compliance and adaptive management

The establishment of an implementation, monitoring, response, and compliance process for the CCF is the final stage. This stage is aimed at managing the cumulative impacts it seeks to protect, and ensuring there is a mechanism for identifying, and responding to negative impacts to values. While this stage can be viewed via two separate approaches, development approvals and ongoing operations, the two are fundamentally linked, with compliance with mechanisms and management outcomes the key trigger for the continuation of development activities.





Guidance Note 37 – Monitoring, compliance, and response

For a CCF to function correctly, that is to ensure that the impacts of visitation are maintained within an acceptable range, and that development does not result in inappropriate impacts to identified values, the development of monitoring and response procedures or process is vital. In a simple system, this would mean monitoring impacts and adjusting visitation limits to suit. Given the characteristics of KNP and the alpine precincts, and the complexity in managing the range of values identified, the compliance and response procedures must be fit for purpose.

The main tool of this monitoring and compliance is the Snowy Mountains SAP EMS, which provides the provision for the ongoing management of operations in alpine precincts. Operators are required to maintain an acceptable level of performance, that is comply with EMS requirements and outcomes, before development activities can take place (in accordance with the Snowy Mountains SAP Master Plan, Precincts-Regional SEPP and Alpine DCP).

4.6.1 Development

Development applications on land within the Alpine Precincts will be assessed on a merit basis and require consistency and/or compliance with the Snowy Mountains SAP Master Plan, Precincts-Regional SEPP, Alpine DCP, and Kosciuszko National Park Plan of Management. The assessment process will also encompass the application of this framework and require proponents to demonstrate ongoing compliance with an annually certified ISO 14,001 EMS. The Department of Planning remains the consent authority for development applications within alpine precincts.

Permissible land uses are prescribed under the Precincts-Regional SEPP. These uses are consistent with the applicable aims and objectives of the SEPP, and the vision and principles of the Snowy Mountains SAP Master Plan. The Precincts-Regional SEPP is currently being amended to include new sub-precincts in addition to the alpine resorts and accommodation already prescribed. The amendment also seeks to expand exempt development provisions and introduce complying development provisions.

4.6.2 Operations

For ongoing operations:

- all major operators (alpine resort areas) undertaking activities in alpine precincts are required to maintain an ISO 14,001 certified EMS, which connects to the Alpine DCP and is consistent with the requirements of the KNP PoM. The EMS would require annual reporting to NPWS, independent auditing, and a 5-year review period
- all smaller operators, undertaking activities in alpine precincts, are required to maintain site specific EMSPs as agreed with NPWS. These plans as above would connect to the Alpine DCP and requirements of the KNP PoM, require annual reporting to NPWS, and a 5-year review period.

4.6.3 Adaptive management

The purpose of the review period is the first step in the establishment of the adaptive management requirements. The proposed review would include engagement with NPWS and stakeholders, as well as a steering group to be established and headed by an independent chair to guide decision making and rule on performance, response, and adaptation requirements.

The necessity of adaptive management requirements would include where modification of targets, goals and management decisions are needed in response to poor value protection outcomes, or where new or previously unidentified impacts to values become apparent. The adaptative management process is a fundamental component of this final stage of the CCF and maintaining the desired value conditions set out in Stage 5.

5 Conclusion

This report establishes a six-stage CCF to be incorporated into the Snowy Mountains SAP alpine precincts, which are located within KNP. The purpose of the CCF is to manage the expected growth in visitor numbers while protecting key environmental, social and cultural values that are present in the alpine precincts. The CCF builds on, and strengthens the existing tools to manage visitors, and ensure environmental and social values are protected, while allowing some specific development in alpine precincts.

The CCF:

- retains a bed limit to provide certainty for stakeholders, however, allows for an uplift this limit to an appropriate maximum level based on the constraints and opportunities identified in the Snowy Mountains SAP Master Plan, technical papers and this CCF
- considers how the impacts of day visitation is managed and uses the Snowy Mountains SAP master planning process
 to determine infrastructure requirements to manage those day visitors based on growth projections
- considers on mountain alpine resort capacities and includes the requirement for alpine resort operators to develop
 individual ski slope master plans (in partnership with the NSW government). The aim of these would be to manage
 future on-mountain visitation in a manner which ensures visitor experience, amenity and environmental values are
 maintained and enhanced
- brings together a tiered approach to the protection of environmental, cultural and social values via appropriate planning, monitoring and response provisions. Specifically, it implements:
 - the Snowy Mountains SAP Master Plan to set strategic and high-level visions, aspirations and principles for development opportunities and constraints
 - the Alpine DCP which would provide detailed planning and design guidelines for future developments, as well
 as detailed strategies for cultural heritage protections, environmental protection and management, amenity
 controls, infrastructure and services and staging of future developments
 - the requirement of an ISO 14001 certified Environmental Management System (EMS) for alpine resorts to ensure ongoing operational management is appropriate and monitoring and response procedures are in place, and
 - provides alternative management approaches for smaller operators, utilising site specific, environmental management site plans (EMSPs) to protect important values in alpine precincts.
- forms part of the conditions of development approval within the SAP framework.

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Appendix A

Carrying capacity literature review



A1 Carrying capacity literature review

A1.1 What is carrying capacity?

The contemporary concept of carrying capacity was first developed in the US around the 1960s, as an approach to manage visitors within sensitive natural areas. It was established to address concerns about crowding and what is considered appropriate use of specific areas (Castley et al. 2008; Worboys et al. 2015).

Carrying capacity can be used in multiple different contexts and includes a focus on recreation, biophysical, managerial, and ecological factors, predominantly in natural landscapes (Prato 2009; Worboys et.al. 2015). In areas where recreation activities form a key component of land use, carrying capacity is often defined as the number of visitors an area can sustain without degrading natural resources and visitor experiences (Prato 2001). This definition allows the inclusion of both social and ecological factors to decide on an appropriate level of use.

As research into carrying capacity evolved, more recent definitions have become more holistic, and have focused on the acceptability of human, ecological and economic impacts, biophysical features, social factors, and management policies (Prato 2001, 2009). Carrying capacity has moved away from simply visitor numbers, to managing the outcomes of human activity below agreed condition thresholds, including physical environmental impacts and visitor experience.

The concept of carrying capacity has the potential to be integrated into and complement the environmental impact assessment (EIA) process. Its use could provide more information on ongoing prevention and management of those gradual cumulative, and indirect impacts, not captured during the development approval stage. Potentially helping to achieve a more sustainable outcome (OEH, 2017, Lawrence 1997).

A1.2 Existing carrying capacity frameworks

There is a large body of literature and case studies on the development and implementation of carrying capacity methodologies. The most widely cited and well-known methodologies include Limits of Acceptable Change (LAC), Visitor Impact Management (VIM), Visitor Experience and Resource Protection (VERP), Recreation Opportunity Spectrum (ROS), Visitor Activity Management Processes (VAMP), the Tourism Optimisation Management Model (TOMM) and Comfortable Carrying Capacity (CCC) (Figure A.1).





Conceptually, most of these approaches do not differ greatly from one another, as they all aim to consider question of carrying capacity, appropriate visitor use, and impacts caused by their use. Individually they all place emphasis on a process or an issue. Such approaches are supported by the International Union for Conservation of Nature (Worboys et.al 2015) and included in the *Guidelines on tourism and visitor management in protected areas* (Leung Y, et al, 2018).

Most of these carrying capacity methodologies share similar characteristics: (1) defining recreational opportunities; (2) defining the key resource/values to be protected; (3) establishing thresholds above which conditions must be maintained; (4) implementing management action if predetermined condition and social standards were not met (Castley et al. 2008).

A1.2.1 Limits of acceptable change

Limits of acceptable change (LAC) was first developed by Stankey, McCool and Stokes (1984) to manage the increasing use and pressure on the Bob Marshall Wilderness Complex in the US. The LAC focused on attempts to determine what resource and social conditions are appropriate or acceptable, and how those conditions would be obtained. More simply, what is an appropriate level of use, and impact associated with that use? (McCool 1996). The approach focused on managing for desired conditions (Stankey, McCool & Stokes 1984).

The LAC framework is based on nine interrelated steps which focus on the selection of indicators and measurable standards (acceptable limits) and follow-up monitoring (Casteley et al. 2008; Worboys et al. 2015). Such process allows the monitoring of both ecological and social conditions to provide strategic management alternative (Castley et al., 2008). Another key feature of LAC is high stakeholder involvement throughout the whole decision-making process (Casteley et al. 2008; Stankey, McCool & Stokes 1984; McCool 2008; Worboys et al. 2015).

LAC has been applied worldwide and often at a landscape scale such as large reserves and protected area (Castley et al. 2008; Worboys et al., 2015), with the framework forming the basis for most of the protected area management planning in the US Forest Service (McCool, 1996), and in approximately 50 wilderness area under the National Forest System (McCool, 2008). Erkkonen and Itkonen (2006) has reported the use of LAC in national park planning framework in Finland. The LAC also forms the basis for the General Management Plan for Glacier National Park in Montana (McCool, 1996). Based on the wide use of LAC on the protected area in the United States, McCool (1996) has summarised that a few factors that would contribute to the success of LAC including a clear understanding of the LAC principles and concepts by the protected area managers, an intimate public participation, good understanding of LAC implementation by field level personnel and an appropriate bureaucratic procedure.

Despite the worldwide application of the LAC, there are some limitations within decision-making framework. LAC is reactive as there are no explicit linkages to overriding management objectives and does not identify the root causes of impacts (Castley et al. 2008). There is also only intermittent public involvement during the process (Brown et al., 2006). The whole process can also be costly and require time to implement especially on challenging task that require technical expertise (Brown et al., 2006; Worboys et l., 2015). Another limitation is there might be a lack of strategic direction for management topics if there are no current issues or concerns as the process focuses on issues and concerns that guide subsequent data collection and analysis (Nilsen & Tayler 1997).

A1.2.2 Visitor impact management (VIM)

Visitor Impact Management (VIM) was developed from a collaboration between researchers and the American-based National Parks and Conservation Association (Nilsen & Tayler, 1997; Worboys et al., 2015). VIM is variant of LAC and has also been incorporated into the Visitor Experience and Resource Protection process (Worboys et al., 2015).

VIM involves eight key steps including the specification of standards for key impact indicators and focuses on the importance of the understanding the causal factors to identifying management strategies (Nilsen & Tayler, 1997; Worboys et al., 2015). The VIM addresses the three basic issues related to impacts: problematic conditions, potential causal factors, and potential management responses (Castley et al. 2008; Nilsen & Tayler, 1997; Worboys et al., 2015). Thus, VIM is reactive and more suitable for site-specific problems with less resources (Castley et al. 2008; Nilsen & Tayler, 1997; Worboys et al., 2015).

Unlike LAC, the focus of VIM is oriented to sites and localised impact problems whereas LAC applies to areas and large-scale wilderness planning (McCool, 2008; Toews, 1999). VIM does not aim to assess potential impacts and has poor linkages to identifying impact root causes (Castley et al., 2008; McCool, 2008). During the process of developing a strategy for Riding Mountain National Park (RMNP) in Canada, Toews (1999) has pointed out that the lack of public involvement in VIM is a potential issue as public involvement is a large part of the decision making in RMNP.

A1.2.3 Visitor experience and resource protection (VERP)

The Visitor Experience and Resource Protection (VERP) was developed by the US National Park Service (NPS) in the early 1990s to help manage visitor use and carrying capacity in the national park system (Toews 1999; Manning 2002). The VERP is compatible with the NPS General Management Planning process and built on the Visitor Activity Management Process experience while adapting parts of LAC and VIM (Nilsen & Tayler 1997; McCool 2008). This framework emphasises on the quality of resources and visitor experiences by formulating indicators and standards of quality for desired future conditions of park resources and visitor experiences (Nilsen & Tayler 1997; Manning 2002). The process comprises a total of nine steps over four key phases: (1) framework foundation, (2) analysis, (3) prescriptions, and (4) monitoring (Manning 2002). A primary component of VERP is that the management actions would depend on the prescribed conditions for each established management zone (Toews 1999).

VERP was initially tested and applied in Arches National Park in response to the general management plan (Nilsen & Tayler 1997; Toews 1999; McCool 2008; Fefer et al. 2018). Since then, VERP has been revised and applied to the general management planning processes of several other US national parks including Grand Canyon, Yosemite, and Glacier National Park (Manning 2002; McCool 2008). VERP was also applied at the Yellowstone National Park to address the specific issue of snowmobiles encountered within the park (Manning 2002).

To understand the perceived effectiveness of applying the VERP framework in the US National Park system (Acadia, Glacier and Denali National Parks), a 2018 study (Fefer et.al. 2018) showed that closely following framework procedures and having quality partnerships with internal and external agencies to facilitate planning efforts, was essential to achieving desired outcomes. Ensuring early stakeholder engagement has been shown to improve acceptance and uptake of various conservation initiatives. The study also identified that the success of VERP could be limited by a lack of training and leadership in the social dimensions of resource management and suggested that operational structures within the VERP framework rather than the framework itself was a key limitation.

Other limitations of VERP include the level of support required from management agencies to ensure there is a high level of technical expertise to monitor the ecological components (Castley et al. 2008). Thus, commitment from all management levels and substantial investments are required (Hoff & Lime, 1997).

A1.2.4 Recreation opportunity spectrum (ROS)

Recreation Opportunity Spectrum (ROS) was initially implemented by the Bureau of Land Management and US Forest Service in response to the planning legislation during the mid-1980s (Nilsen & Tayler 1997; McCool 2008). ROS has been widely used in a variety of wildland recreation planning process from national to local recreational planning around the world (Castley et al. 2008; McCool 2008; Perez-Verdin, Lee & Chavez et al. 2008, Wynveen et al. 2020). Outside of the US, ROS has been used to manage recreation resources in Australia, New Zealand and Japan (Perez-Verdin, Lee & Chavez et al. 2008). The ROS is a management approach that identifies and determines the diversity of recreation opportunities that the protected and natural area settings can provide (Worboys et al. 2015; Wynveen et al. 2020). The underlying principle for ROS is that the provision of a range of opportunities could best assure recreation quality as visitors seek a variety of activities, settings and experience (Perez-Verdin, Lee & Chavez et al. 2008; Worboys et al. 2015). The recreation opportunities comprise three attribute types within the area setting: biophysical, social and managerial (McCool 2008; Perez-Verdin, Lee & Chavez et al. 2008; Worboys et al. 2015; Wynyeen et al. 2020). The ROS framework involves six processes which aim to determine the expected recreational opportunity in each setting, experience indicators and management parameters and guidelines (Nilsen & Tayler 1997; Toews 1999). The ROS framework provides guidance to protected area managers when creating creational opportunities to visitors while striving to preserve ecological integrity (Toews 1999). The emphasis on diversity in ROS also provides flexibility to mitigate any potential changes or disturbances to the recreation system such as demographic changes or technological advancement (Worboys et al. 2015).

Although ROS has been widely adopted around the world, there are still certain weaknesses within this framework. The success of ROS hugely depends on protected area managers agreeing on the spectrum of opportunities, the setting indicators and their criteria before any decision can be made (Nilsen & Tayler 1997; Toews 1999). Any disagreement could potentially affect the rest of the planning program (Nilsen & Tayler 1997). A rigid interpretation of standards or lack of appropriate data could also lead to failure of ROS. Managers also often perceive ROS as a tool that provides prescriptive rules instead of a framework supported by data and analysis (McCool 2008). ROS also has an overemphasis on recreational opportunity with limited focus on ecological integrity (Castley et al. 2008).

A1.2.5 Visitor activity management process (VAMP)

The Visitor Activity Management Process (VAMP) was created by Parks Canada as a companion process to the Natural Resource Management Process and to assist with the development of Management Plans for the national parks (Nilsen & Tayler 1997; Brown et al. 2006; Golder Associates 2016). VAMP is built on the ROS principle and could easily incorporate the VIM, LAC and VERP principles (Nilsen & Tayler 1997; Brown et al. 2006; Worboys et al. 2015). The VAMP strongly emphasises visitor opportunities while adopting concepts and techniques from marketing and social science (Nilsen & Tayler 1997; McArthur 2000; Brown et al. 2006; Worboys et al. 2015). Such an approach is particularly useful for making strategic and operational decisions about target markets and market positions (Nilsen & Tayler 1997; Worboys et al. 2015). There are seven general steps of the management planning process including analysis of visitor information such as type, number and diversity of visitors (Nilsen & Tayler 1997; Brown et al. 2006). Through appropriate educational and recreational activities, the VAMP aims to create a management plan focusing on the selection and creation of opportunities for visitors to experience a park's heritage settings (Brown et al. 2006).

A key feature of VAMP is the focus of the integrating heritage management with visitor management, allowing heritage managers to determine what people they want, and market specific experiences to match the demand, further minimising the potential conflicts and tensions between visitors, heritage and heritage managers (McArthur 2000).

Since the late 1980s, majority of VAMP implementation has been limited to national parks in Canada and has not been widely adopted in other countries with almost no application in Australia (McArthur 2000; Moore 2010; OEH). By the late 1990s, many of Canada's park management agencies have acknowledged that they had abandoned VAMP and returned to ROS and other frameworks to achieve goals that VAMP was designed for (Toews 1999; McArthur 2000).

The limited number of VAMP applications is due to some key weaknesses within the framework. These weaknesses include; VAMP is only well-developed at the service planning level but not at the management planning level, partly because the definition of "opportunities for experience" had not been built into management plans (Nilsen & Tayler 1997). This might have a huge impact on implementation of VAMP as management planning process is its focus (McArthur 2000). Most importantly, VAMP inputs could not be expressed spatially because there was no technical capability in the park management planning process (Brown et al. 2002). There was also a loss of momentum and management during 1990s partly because the approach was viewed as complicated and time consuming (Toews 1999). McArthur has also questioned how much VAMP can shift or change the culture of heritage management organisations to a more market centred approach as the success of implementing VAMP partly depends on how much culture change the organisations are prepared to adopt. VAMP also devotes less attention to ecological integrity or condition and focus much stronger on visitor opportunities (Castley et al. 2008).

A1.2.6 Tourism optimisation management model (TOMM)

The TOMM was first developed by Mandis Roberts Consultants in 1997 as a community-based initiative responsible for monitoring and managing the long-term sustainability of tourism on Kangaroo Island in South Australia. Initially a LAC methodology was proposed as a suitable model for Kangaroo Island, however the consultation process identified concerns over the perceived 'limiting' of tourism development on the island. Therefore, rather than set limits on activity, the model emphasis optimal performance, borrowing strengths from both the VIM and LAC methodologies. This allowed for key fields to be broadened to link with the tourism industry and local community (Sharma, K, 2004), aligning with its overriding objective of maximising tourism opportunity.

This methodology results in both strengths and weakness to its effectiveness as an overarching methodology to assess 'carrying capacity'. Its strengths lie in its ability to recognise the social and political constraints, as well as its extensive community and stakeholder engagement (Castley, 2008). Its weaknesses lie in its failure to specifically mention management objectives (Castley 2008) and also potentially focus on maximising tourism opportunity at the risk of compromising the underlying resource base upon which this depends. European based applications identified questions over its scientific rigor due to a lack of expert knowledge (Jiricka, et al 2014). These weaknesses, along with funding requirements for community-based organisations and challenges around broad opinions and views may from a significant barrier to implementation and answer the question as to why TOMM is often cited in literature, however its application is not widespread, as noted by McCool (2008).

A1.2.7 Comfortable carrying capacity

The most common methodology used to determine ski area capacities is Comfortable Carrying Capacity (CCC). CCC is a method used, among other applications, to determine the optimum number of skiers that can utilise ski area facilities per day, such that their skiing experience expectations are being met while maintaining the physical and social environment (Skoric, 2012). The application of CCC methodologies has been identified as of particular importance to the development of winter sports resorts to ensure resort infrastructure is not overburdened and pleasant recreational experiences are provided to visitors, it also helps ensure balanced capacities across resort facilities and provided certainty that facilities can meet anticipated demand (SE Group & Ascent Environmental, 2019) The calculation of a CCC figure is based on factors such as the spatial characteristics of terrain, the physical capacities of resort infrastructure (including ski lifts, food service and retail space), and acceptable slope densities (the number of skiers per hectare) (Skoric, 2012).

The CCC methodology has been used a key component of ski resort master planning processes in the United States and Canada, with the most recent example being the Big White Ski resort in British Columbia, Canada (BHA, 2020). CCC was used to inform the master plan by identifying an oversupply of certain types of terrain and helping to determine a balanced resort capacity.

An accurate CCC estimation is the single most important planning criteria for the resort as other related skier service facilities are planned around the mountain's estimated capacity, including parking, base lodge seating and other guest service facilities (SE Group, 2013). With an accurate CCC estimation, it is more likely that the resorts can deliver a more well-balanced outcome and further enhance guest experience by satisfying guest expectations for a quality recreation experience (SE Group & Ascent Environmental, 2019).

While CCC is well established in ski resort planning, several limitations remain as a developed carrying capacity methodology, particularly for the purposes of protecting certain values. These include:

 firstly, the output from the calculation should be considered as a dynamic number and many ski area consultants and large ski resorts have designed their own spreadsheets or models to produce the CCC. As a result, it is difficult to compare the outputs and report replication might lead to consistently wrong or insignificant results (Von Allmen & Salzmann, 2007)

- CCC is a planning figure and does not represent a regulatory cap on visitation (US Department of Agriculture, 2011). For example, the Draft Environmental Impact Statement on Breckenridge Ski Resort (BSR) Peak 6 Project in the United States showed it is typical for ski areas to experience peak days where skier visitation exceeds the CCC by as much as 25 percent. However, this would result in degradation of the resort's recreational experience as trails become crowded, lift-line wait times are longer and food service facilities are over capacity
- CCC as a concept is important in the initial planning of a pre-defined area, however, is not considered a framework (as per the other examples provided) as it does not include mechanism value identification or for ongoing value management, or compliance
- CCC concepts are difficult to comprehend as virtual densities are used, which cannot be directly measured
- previous environmental impact statements on ski resorts have also pointed out the calculation of CCC often contains numerous key assumptions and by its nature is partially subjective (SE Group & Ascent Environmental, 2019).

A1.3 Carrying capacity framework Implementation

A1.3.1 NSW National Parks and Wildlife Service

There are many and varying examples of plans of management for NSW national parks and reserves that place 'hard' controls or ceilings on visitation rates. These can include specified visitor numbers, such as:

- group sizes allowed on a particular track or at a particular place
- timing of visitation, including seasonal or weather-dependent closures
- mode of travel, such as controls on vehicle or cycling use.

However, there are few examples of explicit decisions on park use and resource protection that are overseen via a framework that monitors and responds to adverse changes in resource condition. One example is the trial of horse riding in NSW wilderness areas. Building from Pickering (2008), in which biophysical variables were nominated for management of horse riding in Queensland protected areas, an adaptive management framework for the horse-riding trial was devised (OEH 2015). The specific aims of that framework were to:

- identify and agree on known or potential impacts on important park values which may arise during the trial
- agree on appropriate social, economic, and environmental indicators of change for each of the known or potential impacts
- develop a methodology for scientifically credible and practical monitoring, and analyse and report on the status and trends of the selected indicators
- agree on acceptable limits of change (i.e. thresholds or triggers) following the establishment of a baseline for each indicator
- agree on appropriate intervention options for when any unacceptable change or trends occur.

A structured decision-making approach was used in stakeholder and manager workshops to decide what indicators to monitor, what thresholds to apply and, ultimately, what corrective actions to take when thresholds were exceeded. Four locations were trialled with slightly different management approaches being used at each location. These trials ended in April 2016 and the results published in 2017 (OEH, 2017). The first Draft Horse riding Management Plan was released in January 2021 (EES, 2021).

The horse-riding trial in wilderness is a useful example of a tailored but straightforward approach. The horse-riding monitoring trials included stakeholder consultation, the selection of environmental conditions and indicators, standards and thresholds, a toolkit of management responses and adaption mechanisms to adjust the program in response to perverse outcomes or new information.
A1.3.2 Victorian Alpine resorts

There is a total of six Alpine resorts in Victoria, including Mount Baw Baw, Mount Hotham, Falls Creek, Mount Buller, Mount Stirling, and Lake Mountain.

All the resort areas are located on permanent Crown land reserves, each managed by an Alpine Resort Management Board appointed under the *Victorian Alpine resorts (Management) Act* 1997. The alpine resort management boards are responsible for the development, promotion, management and use of each alpine resort. The boards are required to carry out their functions in an environmentally sound way and in accordance with an approved strategic management plan. Each board is represented on the Alpine Resorts Coordinating Council which is a government agency that focuses on the strategic direction and sustainable growth for the resorts.

The management of the natural and social environment is guided by objectives in ski-area management plans and monitored against key performance indicators (KPIs) within the corporate plans of each board. The environmental KPIs are strategic rather than operational but do include a renewable energy target, a solid waste disposal target and a target for the number of habitat protection programs to be implemented. All KPIs are reviewed and reported on annually and each resort operates under an environmental management system (BiosisResearch 2012; NIEIR 2012).

An NPWS review found that although the Victorian resorts have many significant environmental management features, many of their objectives and KPIs are not directly measurable against clear standards; the required level of monitoring and reporting is not consistently achieved; and it is also often not clear how adverse outcomes are corrected and who is responsible for that correction.

The Alpine Resorts Coordinating Council is currently working with boards and resorts to address this situation. Thus, Victoria is, in some ways, in a similar situation to New South Wales. The two states have previously had a biennial forum to exchange information and experiences to assist each other in improving the management of Australian alpine resorts.

A1.3.3 Kangaroo Island, South Australia

The TOMM was developed in 1997 as a community-based initiative responsible for monitoring and managing the longterm sustainability of tourism on Kangaroo Island in South Australia. It is unique in the fact that rather than being driven by a particular agency, the Kangaroo Island TOMM is fully funded through community, industry, and government partnerships. At the core of the model is a set of indicators that measure changes in economic, environmental, socio cultural and experiential environments. Based on information available, the indicators were last updated in 2009 and their assessment relies on measuring Kangaroo Island resident attitudes towards tourism and related activities. There are very few other examples of implementation of TOMM, locally in Australia or other parts of the world.

A1.3.4 New Zealand Department of Conservation

The New Zealand Department of Conservation clearly identifies the potential need to limit visitor numbers in favour of conserving a park's natural or cultural values as a part of their longstanding visitor strategy:

Protection of intrinsic natural and historic values may involve setting limits on visitor numbers, facilities, services
and commercial activity; where the impacts of increasing visitor numbers to a site are unknown, the Department will
adopt a precautionary approach until such time as it is clearly demonstrated that increasing numbers pose no
significant problem.

A project was commissioned to create a knowledge basket – or 'kete' – for an integrated approach to support the implementation of this strategy, considering social, cultural, environmental and economic planning, and management considerations (Warren et al. 2007).

In developing the kete, this project reviewed the practical implementation of biophysical carrying capacity concepts in New Zealand. This had most commonly occurred in the protection of specific fragile vegetation and soils; sensitive and threatened iconic wildlife species (especially marine mammals); and caves. For example:

- considerable work on carrying capacity in relation to soils and vegetation near tracks had occurred. Some thresholds
 for the number of walkers before damage occurs were found, but these vary widely even within the same type of
 environment. Mitigation by track improvement had increased the biophysical carrying capacity, but managers rarely
 addressed social carrying capacity issues, such as visitor experience
- a well-known example for wildlife protection is with the dusky dolphin (*Lagenorhynchus obscurus*) at Kaikoura. Researchers undertook detailed observations of dolphin behaviour and recognised that in the presence of tourist boats some significant changes occurred, including disruption to normal resting behaviour. Based on these observations, the researchers could establish rules for visitor numbers, behaviour and buffer distances for viewing dolphins (Wursig, et.al, 2007).

The project found the concept of biophysical carrying capacity and absolute thresholds of use to be very appealing to many decision-makers, but the problems included:

- different sites and activities can have different carrying capacities
- measuring impacts on biological and physical resources may not directly help establish carrying capacity because a strong cause-and-effect relationship between the amount of use and impacts may not exist.

One issue described was that, for less sensitive sites, carrying capacity may be determined by off-site factors (e.g. waste disposal at accommodation centres) or by on-site social factors (e.g. perception of overcrowding) long before any on-site biophysical effect becomes significant, highlighting the importance of incorporating value judgements such as park visitor enjoyment as well as biophysical factors.

A1.3.5 Parks Canada

Ski areas are the largest commercial leaseholders in Canadian National Parks, and thus can form some perspective on the management of environmental impacts for KNP.

Parks Canada has the following three-tiered ski-planning system:

- ski-area management guidelines which provide a framework for consistent planning and management of national park ski areas
- site guidelines for development and use that are specific to each ski area, and
- long-term plans for each ski area.

Required environmental conditions and standards are broadly defined in the site guidelines for development and use, and are reviewed, adapted, and supplemented during a strategic environmental assessment of a proposed development or use in that ski area. The site guidelines and strategic environmental assessment are released for public comment before finalisation. The prescribed outcomes are then delivered in the long-term plan developed for individual ski areas (Parks Canada 2006).

Parks Canada and the resort operator work together to develop the site-specific guidelines for a ski area. Visitor capacity is initially set by the available ski terrain, as well as the capacity of infrastructure and utilities. The actual extent of resource use by a ski resort is generally determined in the site guidelines with the assumption that mitigations can be implemented to reduce potential adverse ecological effects of the ski area for specific resources like water and wildlife. In cases where potential impacts to resources are not known when the site guidelines are developed, there is a requirement for the resort to gather the information required to determine the potential impacts of a development proposal to determine if effective mitigation of potential effects are possible (e.g. expansion of the lift system and potential effects on a species at risk).

Interpretation and enforcement are ongoing issues. Parks Canada frontline staff resolve most compliance issues through good relationships and negotiation. In very serious cases of non-compliance, Parks Canada can withhold a ski resort's business licence until the identified deficiencies are remedied. Although this is very rarely done, the latent threat appears to help achieve compliance on most occasions (Golder Associates 2016). There is also other legislation that could be drawn on to enforce compliance, including the Canada National Parks Act 2000 and legislation protecting aquatic, migratory bird and threatened species.

Monitoring by the operator is usually required by the conditions of development approval. Some collaborative programs for landscape-scale or sensitive issues are undertaken with Parks Canada and universities. Monitored human behaviour is matched to monitored ecological responses before decisions on visitor restrictions are made. This relies on well-designed research aimed at robustly capturing these potential cause and effect relationships.

Two examples of condition thresholds widely used in Canada are the 90/10 rule for water extraction and the 50/50 rule for ski runs. Water extraction is limited to 10% of daily flow and 90% of an instantaneous flow index. New or upgraded ski runs may only be 50 metres wide with 50 metres of native vegetation retained between runs. This rule reduces impacts on wildlife and fits within the optimum parameters for snow groomers.

Parks Canada requires that ski areas contribute to a unique, memorable national park experience and promote public appreciation and understanding of the heritage values of the park to enhance the visitor experience. This, however, can be difficult to manage in that in many instances, factors that contribute to a unique and memorable experience may be at odds with biophysical objectives. For example, the opening of new ski runs for skier enjoyment at the expense of removal of vegetation communities.

A typical example is Marmot Basin Ski Area in Jasper National Park. Parks Canada used a collaborative approach with resort operators based on a partnership agreement in the development of the site guidelines for development and use (Parks Canada 2017).

There is extensive use of fully compliant environmental management systems within the resort areas in Canadian national parks. Parks Canada expects ski areas to be leaders in environmental management, stewardship, and best practice to meet agreed goals that include initiatives that complement land-use policies and actions in the wider or adjoining park areas. In North America, the selection of a ski area by holiday makers is increasingly influenced by a resort's 'green' credentials or 'Green'' claims.

Key aspects of the Parks Canada system for managing ski resorts within national parks includes:

- ski-area management guidelines are separated from the individual park management plan, allowing the guidelines to be reviewed and revised independently of the plan of management
- ski resorts are required to provide calculations of skier number capacity to justify infrastructure design and management requirements Ski area plans are presented as a joint venture with a resort's chief executive officer and Parks Canada, with both parties' signatories to the proposals and the outcomes they contain
- does not allow new accommodation 'on slope' (with notable exceptions for expansions of existing resorts, such as Sunshine Village Resort in Banff National Park)
- does not utilise community forums, social surveys, or steering groups to engage with the public and stakeholders, instead running a traditional program of community consultation at key planning milestones
- has allowed resorts to forgo lease areas of high environmental value in exchange for approval to develop new and suitable ski areas outside their existing leases to achieve a substantial net positive environmental gain
- requires ski resorts to provide consultant expertise for complex environmental issues, but maintains oversight of their commitment to implementation
- has retained regulatory powers for all environmental conditions.

Sunshine Village Ski area is one of four long-standing internationally recognized ski areas in Banff and Jasper National Parks. Of similar nature to KNP, the resort is accessed via an 8-kilometre road, managed by Parks Canada. While the Ski resort has a capacity of 6,000 skiers, the area has insufficient infrastructure (transport/parking supply, ski out trails) to support these numbers (Parks Canada, 2018). Sunshine Village Ski also experiences similar operational challenges as those in KNP. Such as overcrowding, terrain constraints to parking space, impacts on sensitive environments and ecosystems, climate change, meeting wastewater management targets, strengthening links with indigenous groups and summer use of the resort.

The Sunshine Village Ski Report Site guidelines (Parks Canada, 2018) has identified desired outcomes relating to sustainable report planning, visitor access and design capacity, visitor experience, ecological integrity, heritage resources and indigenous relationships.

With specific reference to determining limits to development and growth, Sunshine Village Ski resort analysed the resorts capabilities (potential ski terrain, densities and limitations, commercial space, lift capacity, private vehicle parking, and mass transit capacity) and comparted them against industry standards. The result was the identification of a set future ski capacity (skiers, commercial space, and ski terrain), on the provision of long-term proposals being submitted (with set limitations) to ensure all development was undertaken within environmental management guidelines.

This methodology sets the onus on the ski areas to develop their long-term strategic plans for a period of 5 to 15 years, through the existing statutory assessment process, and within the guidelines set in the Sunshine Village Ski Report Site guidelines.

A1.3.6 US National Park Service

The application of VERP in Yosemite National Park in California, represents perhaps the most complex in US National Parks history. Six visitor experience indicators, three natural indicators and one cultural indicator were selected for monitoring and management. These included: visitors' encounters with other groups while on walking tracks or on the river; track and scenery diversity; parking availability; riverbank erosion; water quality; and indigenous plant resource distribution.

VERP requires the development of a public involvement strategy. In the Merced River process, this included the initial workshops then quarterly meetings and a public outreach program incorporating volunteer monitoring of indicator variables. It was found that volunteer monitoring helped the community recognise, perhaps for the first time, the inherent trade-offs that must be made when attempting to balance resource protection and the provision of high-quality experiences in the park.

Over time, concerns have been voiced about a lack of funding and incomplete implementation of the Merced River VERP framework and its program. Bacon et al. (2006) suggested the success of the VERP program is contingent upon it losing its distinctive identity as a process or framework and becoming a routine part of everyday business.

There are several other examples of VERP being implemented in National Parks including Arches, Glacier and Yellowstone.

A1.3.7 USA and Canada Ski Resorts

Several ski resorts in the US and Canada have incorporated the comfortable carrying capacity (Section A1.2.7) methodology into their impact assessment and master planning, including:

- Alpine Meadow Ski Area (SE Group, 2015)
- Diamond Peak Ski Resort (SE Group, 2014)
- Breckenridge Ski Resort (US Department of Agriculture, 2011)
- Loveland Ski Area (SE Group, 2013)
- Revelstoke Mountain Resort (Harry Measure + Associates, 2019)
- Squaw Valley Alpine Meadows (SE Group & Ascent Environmental, 2019)
- Big White Ski Resort (BHA, 2020).

A1.4 Limitations of quantitative carrying capacity methodologies

The concept of carrying capacity is a simple easy concept to understand and thus has been widely adopted worldwide to manage the visitors in protected area, national parks and conservation areas (Castley et al. 2008; Prato, 2009; Worboys et. al., 2015; Prato, 2001; McCool, 1996). However, there are multiple key limitations when adopting a quantitative approach based on numerical values (e.g. number of visitors).

The use of a numerical carrying capacity approach assumes that the human-environmental systems are stable and unchanging (Worboys et al. 2015; McCool & Lime, 2001). However, biological and social systems are often highly dynamic, complex and filled with uncertainties, thus capacities would vary under different social and environmental conditions caused by climate, fire and floods (Worboys et al. 2015; McCool and Lime, 2001, Prato 2009). Hence, such approach would only be suitable in a static environment. Multiple carrying capacities are likely to be required for different times and places in response to the dynamic nature of a natural system (McCool and Lime, 2001).

A numerical focus approach may not consider other potential underlying causes of impact because of its overemphasis on the importance of amount of use and therefore fail to provide any useful direction for managers (Farrell and Marion, 2002). Carrying capacity is comprised of at least two components: a biophysical component concerning visitors' impacts on the natural resources, and a social element related to visitors' type and quality of experience during their visit (McCool, 1996; Farrell and Marion, 2002). The amount of use by visitors might only be one of the many factors that contribute to impacting the above two elements (Farrell and Marion, 2002). Visitor behaviour, type of use, development actions and other variables may have greater impacts than visitor numbers (Farrell and Marion, 2002; Worboys et al. 2015, McCool and Lime, 2001, Lindberg, McCool & Stankey, 1997). The use of a numerical approach might overlook more appropriate and effective management actions by drawing resource managers' attention away from a broad range of management strategies (Farrell & Marion, 2002).

A numerical focus on levels or numbers of visitors might also lead to misguided simplicity (Lindberg et al. 1997). Management objectives of protected areas typically relate to the conditions of natural environment than number of visitors. It is unlikely for a numerical approach to achieve the management objectives especially if there is not a known relationship between use levels and impacts for what needs to be achieved (Lindberg et al.,1997). In some cases, carrying capacity has been misapplied to set visitor number without considering how the numbers can achieve the management objectives (Farrell & Marion, 2002).

These key limitations have therefore led to a shift in focus from asking the question "how many is too many?" to "what are the desired conditions?" and led to the development of alternative planning and management frameworks based on carrying capacity (Castley et al. 2008; Farrell & Marion, 2002; Lindberg, et al., 1997; McCool 1996; McCool & Lime, 2001).

A1.5 Use of monitoring indicators within carrying capacity frameworks

The shift to asking the question "*what are the desired conditions*?" shows that most of the existing carrying capacity frameworks such as VERP, LAC and VIM have a focus on maintaining condition thresholds, with a strong emphasis on outcomes rather than limiting inputs (e.g. visitor number limits). During the implementation of these carry capacity frameworks, it is important to understand that there is no one size fits all model and approaches will often need to be tailored to fit the relevant context and circumstances. Hybrid models that adopt some but not all features from published carrying capacity frameworks are often used by conservation agencies and can be essentially viewed as a 'toolbox' approach from which methods are picked to suit circumstances (OEH, 2016).

A1.5.1 Role of monitoring indicators

A key element shared by carrying capacity frameworks is the development and the use of environmental monitoring indicators (Brown et al. 2006). Different frameworks have various level of emphasis placed on these indicators (Nilsen & Tayler 1997) and most commonly rely on these and standards developed during the process to perform ongoing monitoring and evaluation when standards and quality have not been met (Brown et al. 2006). Suitable environmental indicators are usually first chosen to reflect the state of the desired conditions, then supported by monitoring plan and measures to be implemented in response to adverse outcomes. It is also important however to note that not all environmental conditions can be monitored and managed as many conditions are too difficult to measure or subjected to wider landscape influences.

The use of adaptive management processes ensures results are being measured, rather than just carrying out actions to achieve objectives, and allows informed decisions and adjustments to be made to help achieve objectives and deliver desired outcomes (Jones 2009).

Figure A.2 illustrates the process of how management responds to declines in selected monitoring indicators until standards are re-achieved. It should also be noted that the same process can be applied to social indicators such as visitor enjoyment, or traffic congestion.



(Source: Jones, 2009)

Figure A.2 Carrying Capacity performance indicator guide

A1.5.2 Monitoring indicators development opportunities

As discussed, there are often opportunities for land managers to develop a hybrid framework by adopting different existing framework features including implementing new environmental and social monitoring indicators to maximise the outcome for specific site. On top of being able to represent the general conditions, there are opportunities for new type of environmental and social indicators to be developed and implemented to help fulfil legislative requirements or even help achieve certain international environmental standards.

Historically, some carrying capacity frameworks such as ROS are developed in response to changes in planning legislative frameworks (McCool 2008). Hence, the selected indicators should be clear enough to be able to address and comply with the relevant mandatory legislative requirements in the area. In most cases where legislative requirements or guidelines influence indicators, quantitative methodologies determining compliance are far more straight forward and can be used, for example, water extraction against licence conditions.

The development of new indicators will also need to consider site complexities, especially if part of the protected area is operated under a public-private partnership agreement with existing lease agreements. The selected indicators will ideally be developed specific to the private business and incorporated as part of the commercial lease, for example, litter presence, weed presence and perceptions of crowding. This type of indicators aims to maintain the existing environment and avoid the potential over-commercialisation of the protected area, one of the biggest concerns when public authorities partnering with private business (Wilson, Nielsen & Buultjens 2008).

At a smaller scale, specific entities or private businesses might have their own Environmental Management Systems (EMS) or are required to have an EMS by the protected area management plan. This provides opportunities for the selected indicators to be developed in certain way which can be incorporated and strengthens the existing entity's EMS. These types of indicators can be related to elements like water consumption, extent of recycling and waste reduction that are related to international standards for EMS (e.g. ISO 14000) (Jovicic 2011).

For a complex site with multiple parties of different interest, it is likely that the most suitable carrying capacity framework would be a hybrid model comprises of indicators with above elements to fulfil the legislative framework, avoid over-commercialisation and maximise the environmental and social outcomes. These indicators are also likely to be a mix of quantitative, ensuring its analytical rigour and qualitative to capture elements that are more difficult to quantify such as visitor behaviour.

A1.6 Summary of published frameworks

Table A.1 provides a summary of the CCFs discussed in Section A1.2.

Limits of Acceptable Change (LAC) LAC is based on nine interrelated steps focusing — framework is reactive due to la on the selection of indicators and measures — explicit linkages to overriding	ok of IAC is widely
LAC is based on nine interrelated steps focusing — framework is reactive due to la	ck of IAC is widely
standards (acceptable limits) and follow-up monitoring. LAC has been applied worldwide and formed the basis for most protect area management planning in the US Forest Service, 50 wilderness area under the National Forest System, Finland and Montana. (CAPINE INKAGES to overheining management objectives (CAPINE INFORMATIONE (CAPINE INFORMATIONE (CAPINE INFORMATIONE (CAPINE INFORMATIONE (CAPINE INFORMATIONE (CAPINE INFORMATIONE (CAPINE INFORMATIONE (CAPINE INFORMATIONE (CAPINE INFORMATIONE (CAPINE INFORMATI	ck of EAC is widely accepted and well used; certain aspects of f impacts, an LAC framework ction for may be considered relevant for KNP. ement and Image: construction of the second

Details	Limitations	Applicability					
Visitor Impact Management (VIM)							
VIM is a variant of LAC with aspects also incorporated into the VERP framework. VIM involves eight key steps including the specification of standards for key impact indicators and focuses on the importance of understanding the causal factors in identifying management strategies. Suitable for site-specific problems with less resources.	 not suitable for large-scale areas and wilderness planning does not aim to assess potential impacts poor linkages to identifying impact root cause lack of public involvement. 	Aspects of this model have applicability, and it is often incorporated into VERP. It is most suited to assessing current impacts rather than potential impacts.					
Visitor Experience and Resource Protection (V	ERP)						
VERP is a hybrid framework built on VAMP while adapting parts of LAC and VIM. It involves nine steps over four key phases with an emphasis on the quality of a resource and visitor experience. Initially tested and applied in Arches National Park then applied to other US national parks including Grand Canyon, Yosemite, and Glacier National Park. Also specifically applied to Yellowstone National Park to address snowmobile issues.	 operational structure requires sufficient training and leadership in the social dimensions of resource management require a high level of technical expertise to monitor ecological components require commitments from all management levels require substantial investments. 	A modified VERP model has potential applicability to KNP given the existing frameworks and stakeholder commitments that exist in KNP (further discussed in Appendix B and Appendix D.					
Recreational Opportunity Spectrum (ROS)		1					
ROS has been widely used in variety of wildland recreation planning processes from national to local recreational planning around the world. ROS is a management approach that identifies and determines the diversity of recreation opportunities that the protected and natural area settings can provide and consists of six steps to help determine the expected recreational opportunity.	 success is highly dependent on agreement made with protected area managers on opportunities spectrum, setting indicators and their criteria requires an appropriate level of interpretation on standards and data managers' misperception towards ROS as prescriptive rules limited focus on ecological integrity. 	The aims of a ROS framework are not considered a primary issue in KNP and therefore ROS does not suit the requirement of this assessment.					

Details	Limitations	Applicability					
Visitor Activity Management Process (VAMP)							
VAMP is built on ROS principles and could easily incorporate VIM, LAC and VERP principles. It adopts marketing and social science concepts and techniques with a strong emphasis on visitor opportunities and a focus on integrating heritage management with visitor management. It consists of seven general steps of the management planning process. Application has been limited to national parks Canada and not widely adopted in other countries.	 framework only well-developed at service planning level but not at management planning level lack of technical capability in the park management planning process less attention to ecological integrity or condition. 	While less suited to established areas, VAMP has potential applicability due to the opportunities created by the Snowy Mountains SAP regarding Strategic planning within KNP.					
Tourism Optimisation Management Model (TO	OMM)						
TOMM was initially developed as a community- based initiative responsible for monitoring and managing the long-term sustainability of tourism on Kangaroo Island. Emphasises on optimal performance, borrowing strengths from both VIM and LAC methodologies.	 fails to specifically mention management objectives potential risk of compromising the underlying resources due to its focus on maximising tourism opportunities lack of scientific rigour from expert knowledge. 	The TOMM model is not considered suitable for KNP.					
Comfortable Carrying Capacity (CCC)							
CCC developed by some US ski resorts at the Environmental Impact Assessment or master planning level to enhance recreational experiences without overburdening resort infrastructure.	 requires several assumptions which can be subjective in nature individual ski resorts have varying methodologies/models to determine/ calculate the CCC focuses on the amenity of the ski resort for users, and not on the direct ongoing environmental outcomes and impacts. 	There is potential to incorporate aspects of CCC to the Alpine resorts in KNP, particularly around the measuring and monitoring of resort amenity, and managing on mountain capacities.					

Appendix B

Existing regulatory and environmental management framework



B1 Regulatory and environmental framework

Appendix B provides a summary of the existing legislation that drives planning, development, and environmental management within KNP, and examines the current mechanism of determining the existing carrying capacity, and requirements for amendments to this carrying capacity.

B1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Commonwealth Environmental Protection and Biodiversity Conservation Act* (EPBC Act) 1999 and Regulations 2000 provide the Commonwealth legislative framework for the protection of the Australian environment. Broadly, in relation to KNP, the Act objectives are to protect the environment and heritage, promote ecologically sustainable development and conservation of biodiversity and promote a co-operative approach to the protection and management of the environment with the government, the community, landholders, and indigenous peoples.

The National Heritage List established under the EPBC Act is Australia's list of natural, historic, and Indigenous places of outstanding significance to the nation. Listed places are protected from actions that have, will have or are likely to have a significant impact on the National Heritage values of a National Heritage place. The Australian Alps National Parks and Reserves were listed on the National Heritage List in 2008 as being part of a unique Australian mountainous region, and the alpine resort areas reside within this heritage listed area.

B1.2 National Parks and Wildlife Act 1974

The principal legislation underpinning the management of Kosciuszko National Park is the NSW *National Parks and Wildlife Act 1974*. Under this act the Secretary of the Department of Planning and Environment (DPE) is accountable for the management and control of all national parks in NSW.

The primary objectives of the act are:

- 1 The conservation of nature, including, but not limited to, the conservation of:
 - a habitat, ecosystems, and ecosystem processes, and
 - b biological diversity at the community, species, and genetic levels, and
 - c landscapes and natural features of significance including wilderness and wild rivers, and
 - d landforms of significance, including geological features and processes, and
- 2 The conservation of objects, places, or features (including biological diversity) of cultural value within the landscape, including, but not limited to:
 - a places, objects, and features of significance to Aboriginal people, and
 - b places of social value to the people of New South Wales, and
 - c places of historic, architectural, or scientific significance.
- 3 Fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation.
- 4 Providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation.

B1.3 Environmental Planning and Assessment Act 1979

Developments within the Alpine Management Units (AMU) are subject to environmental impact assessment and approvals under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The main planning instrument applicable to the AMUs is the *State Environmental Planning Policy (Kosciuszko National Park—Alpine resorts) 2007* (Alpine SEPP) (now chapter 4 of the Precincts-Regional SEPP). The Minister for Planning is the consent authority for most private proponent works (note that public authority works generally do not require consent).

Any development outside of the AMUs, but within the boundary of Kosciuszko National Park must be approved by NPWS in accordance with the *National Parks and Wildlife Act 1974* and assessed under Part 5 of the EP&A Act.

B1.4 State Environmental Planning Policy (Kosciuszko National Park – Alpine resorts) 2007

The aim of the Alpine SEPP (now Chapter 4 of the Precincts-Regional SEPP and currently under amendment) is to protect and enhance the natural environment of the Alpine resorts, in the context of the park, by ensuring that development in those resorts is managed in a way that considers the conservation and restoration of ecological processes, natural systems and biodiversity, as well as other principles of ecologically sustainable development.

The Alpine SEPP applies to the alpine resort areas in KNP. This includes major resort areas (Thredbo, Charlotte Pass, Mount Selwyn and Perisher Range) as well as minor resort areas (which provide accommodation only with no ski facilities (Ski Rider, Sponars Chalet, Kosciuszko Mountain Retreat) (further discussed in Section B1.6).

The objectives of the SEPP are:

- 1 To encourage the carrying out of a range of development in the Alpine resorts (including the provisions of services, facilities and infrastructure, and economic and recreational activities) that do not result in adverse environmental, social or economic impacts on the natural or cultural environment.
- 2 To put in place planning controls that contribute to and facilitate the carrying out of ski resort development in KNP that is ecologically sustainable in recognition of the fact that this development is of state and regional significance.
- **3** To minimise the risk of environmental hazards to the community, particularly geotechnical hazards, bushfire and flooding, but generally requiring development consent on land to which this policy applies.

Under the Alpine SEPP, all development within resort areas must undergo environmental assessment as part of the development application to protect the unique alpine environment.

Clause 14 of the Alpine SEPP outlines matters to be considered by the consent authority including geotechnical, earthworks, stormwater drainage, visual impact and protection of native flora and native fauna. Perisher Range Resorts Master Plan and Perisher Blue Ski Resort Ski Slope Master Plan are listed in Clause 14 of the SEPP as matters for consideration. Clause 15 of the SEPP outlines assessment requirements to be considered for buildings, including building height, building setback and landscaped areas.

Assessment requirements are merit based, as there are no prescriptive development controls in Clause 14 and 15 of the Alpine SEPP and no development control plan (DCP) related to the SEPP. Assessment of developments is based on existing character, built form and amenity impacts such as privacy, overshadowing noise and cultural heritage. It should be noted a draft DCP was prepared in 2019 to guide development within Alpine resorts, however the this was not completed during this period. As part of the Snowy Mountain SAP an Alpine DCP will be prepared by DPE (in collaboration with NPWS) following the adoption of the Snowy Mountains SAP Master Plan.

B1.5 Kosciuszko National Park Plan of Management

The Kosciuszko National Park Plan of Management (KNP PoM) is the principal document that provides the foundation of environmental management within the boundaries of the Kosciuszko National Park. The KNP PoM has been prepared in accordance with requirements of Part 5 of the *NSW National Parks and Wildlife Act 1974* (refer to Section B1.2) to provide a framework of objectives, principles, and policies to guide the long-term management of the park and its values.

In accordance with section 81(4) of the National Parks and Wildlife Act it is mandatory for all operators within KNP to operate in accordance with the KNP PoM, which describes several key provisions including management zones, units, and strategies to achieve the desired NPWS outcomes.

B1.6 Management Zones

Table B.1 provides a summary of designated Management Zones as outlined in Chapter 5 of the KNP PoM. A list and description of appropriate activities as they apply for each zone is included in Seclude 4 of the KNP PoM (Appropriate Recreational Activities).

Management Zone	Description
Wilderness Zone	Wilderness areas declared under the wilderness Act 1987.
Backcountry Zone	Areas of the park without public road access and not within the wilderness zone, with a focus on passive recreational activities such as camping, rock-climbing and ski touring.
Minor Road Corridors	Corridors along minor public roads and associated visitor developments.
Major Road Corridors	Corridors along major sealed and unsealed roads and associated visitor developments.
Visitor Services Zone	Alpine resorts of Perisher, Charlotte Pass, Thredbo, and Selwyn, and development nodes and operational centres including Diggers Creek, Wilsons Valley, Sawpit Creek and the Waste Point Precinct.

Table B.1 Management Zones as outlined in the KNP PoM



Figure B.1 Summary of KNP Management Zones

B1.7 Areas of exceptional recreational significance

In addition to the management zones outlined in Table B.1, the KNP PoM identifies seven management units which contain significant natural and cultural values that are highly vulnerable to human induced disturbance, and thus contain specific management measures to ensure their protection.

Four of these management units (as outlined in Chapter 10 of the KNP PoM) are identified as 'Areas of Exceptional Recreational Significance'. These are the Alpine resort areas at Perisher, Thredbo, Charlotte Pass and Selwyn (Alpine Ski Resorts) (shown in Figure B.2), which collectively make up around 27 square kilometres or 0.4% of KNP.

The 'Areas of Exceptional Recreational Significance' areas are primarily managed for snow-based recreation and are the most popular seasonal recreational destinations in the park. They also contain most of the recreational facilities, and are thus the most developed areas, containing ski lift infrastructure, a variety of retail outlets, sporting facilities and municipal services. Accommodation is also provided in three of the four areas (Thredbo, Perisher and Charlotte Pass). Outside of the winter season, some resorts (mainly Thredbo) attract visitors for non-snow-based activities including hiking, mountain biking and fishing.

The four Alpine resorts operate under a system of leases granted to private organisations in accordance with the *NPW Act*. Responsibilities for the administration and planning of the alpine resort areas, known as Alpine Management Units (AMUs) lie with NPWS (DPE) (leases, commercial agreements, some municipal services, natural and cultural values, public health etc) and Planning (DPE), who control the strategic and statutory planning framework to guide development within these areas.

More specifically three of the four alpine resort areas operate under head lease with the NPWS and are responsible for all waste, water, and sewer management. The Perisher alpine resort does not currently operate under a head lease. Within this area, the NPWS Perisher Team provide municipal services such as waste, water, and sewer management. Many of the lodges and other commercial operations within the Perisher alpine resort are leased directly with NPWS and operate independently of the ski resort operator. The NPWS Perisher team is also responsible for municipal services within the Saw pit creek precinct as it contains NPWS infrastructure.

Table B.2 provides a full summary of the roles and responsibilities as outlined in chapter 10.2 of the KNP PoM. Sections B1.7.1 to B1.7.4 describe the characteristics of each AMU.

Table B.2 Summary of Roles and Responsibilities in Alpine Management Units

NPWS (DPE)	Planning (DPE)			
Strategic operational planning for KNP	Strategic planning for the Alpine resorts e.g. DCPs			
Protection of the Park's natural and cultural values	Responsibilities under the Environmental			
Lease compliance e.g. environmental performance, rental and health inspections	<i>Planning and Assessment Act 1979</i> for all levelopments and building matters under Ports 3.4.844 e.g.			
Responsibilities for environmental protection under the <i>Protection of the</i> <i>Environment Operations Act 1979</i>	 pre-application liaison referral of development applications 			
Law enforcement e.g. skidoo use	— advertised development			
Municipal services e.g. water, sewage, and waste disposal for articular resorts	 land use permissibility accommodation capacity beritage conservation and 			
Public health e.g. pool/spa testing and kitchen/food stall inspections	 specific development control measures 			
Responsibilities under the <i>Environmental Planning and Assessment Act</i> 1979 for certain activities carried out by, or on behalf of, public authorities under Part 5	for each alpine resort.			

B1.7.1 Charlotte Pass Alpine Management Unit

The Charlotte Pass AMU covers 165 hectares and is located at the headwaters of Spencers Creek. The resort is accessed via Kosciuszko road and consists of a small resort offering a village-type atmosphere. During the winter season, road access between Perisher and Charlotte Pass is closed to the public, with access (for visitors, freight, and waste) to Charlotte Pass via an on-demand snow transport service from Perisher Valley Skitube terminal. The management unit contains significant cultural and natural values including the Kosciuszko Chalet and a number of threatened species habitats, including populations of Endangered Mountain Pygmy Possums, *Burramys parvus* (TSSC, 2018).

B1.7.2 Thredbo Alpine Management Unit

The Thredbo AMU covers an area of 960 hectares and provides year-round resort operations. The area is located adjacent to Alpine Way which provides a major sealed road through the park providing a link between NSW and Victoria. The Thredbo AMU provides for both day and overnight parking, in designated overnight parking areas. During the winter season, Thredbo offers a shuttle bus service to assist guests in moving around the village and accessing accommodation, ski lifts and parking areas. All resort operations, accommodations and services are managed under a single head lease agreement between NPWS and Thredbo.

B1.7.3 Selwyn Alpine Management Unit

The Selwyn AMU covers an area of 203 hectares and is in the northern portion of the KNP. Its primary focus is to provide day visitors with low-cost opportunities for skiing and snow activities. Due to its relatively low altitude and aspect, it is more likely to be impacted by climate change than other resorts. The Selwyn management unit does not contain accommodation, however, does contain other services such as food outlets and ski facilities. The Selwyn management unit was impacted by the 2020 bushfire season which severely damaged or destroyed much of the resort facilities and infrastructure.

B1.7.4 Perisher Alpine Management Unit

The Perisher AMU is the largest of the four management units, covering an area of 1598 hectares. It includes the resort areas of Perisher Valley, Smiggin Holes, Blue Cow, Guthega, and the Bullocks Flat Ski Terminal. All land occupied by club and commercial lodges, as well as resort operators within the management unit is managed under a system of leases and licences administered by the NPWS. Access to the Perisher AMU is via Kosciuszko Road, or the Skitube, which was established in 1988 to provide access to the Perisher valley and Blue Cow from Bullocks Flat. The two-way train service (mostly underground) operates during the winter season and provides an alternative to driving up Kosciuszko Road from Jindabyne. As discussed above, no visitation data is available, however NPWS car counter data (2010–2018) shows peak access on Kosciuszko Road in the months of June – September, with uniform visitation outside these months.

The focus on the AMUs as part of this review is a result of provisions within the KNP PoM which establish limits on visitor capacities. These limits are further discussed in Section B2. WSP notes there are additional management objectives that apply to the ski resort areas, however for this assessment, this section will focus on Chapter 10 of the KNP PoM.



Figure B.2 Location of areas of exceptional recreational significance – Alpine Resort Areas

B1.8 Environmental Management requirements

Chapter 10 of the KNP PoM contains the general provisions that apply to all four of the AMUs, and site-specific prescription that relate to each area. In accordance with management objectives 10.3.1 to 10.6.1 of the KNP PoM, each AMU is required to develop and implement an Environmental Management System (EMS). The requirements of which are outlined in Section 12.1 of the KNP PoM and summarised in Table B.3. Management objective 12.1.1 is the overarching objective that guides the development and maintenance of the EMS.

Manager	nent objective
12.1.1	The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.
Policies a	nd Actions
1	Ensure all operations and authorised uses in the park are consistent with the provisions of this plan of management and are undertaken through a lease, license or other formal consent or agreement. Create and maintain a park register of all leases, licenses, and agreements.
2	Ensure all infrastructure located in the park is appropriately documented within the Service's geographic information system.
3	Require all lessees, licensees and other authorities operating in the park to develop and implement an environmental management system for the management of their activities and infrastructure. All environmental management systems would be required to be approved by the NPWS.
4	Environmental management systems would include, but not be limited to:
	 all legislative requirements, and those stipulated in all relevant codes of practice and industry standards relevant prescriptions as set out in the KNP PoM
	 objectives, key performance indicators, ideal status goals and environmental targets for air, water and noise pollution
	 strategies and targets for water conservation, energy conservation, waste minimisation and reducing light spillage (as relevant)
	— communication and reporting protocols
	 monitoring regimes to measure performance against objectives, key performance indicators (KPIs) (refer to Section B1.9) and targets: and
	 training standards and schedules for relevant personnel.
5	Establish minimum environmental performance standards with the assistance of independent scientific advice commissioned by the Service, in association with its lessees and other relevant authorities.
6	NPWS and lessees/licensees would be accountable for annual environmental performance monitoring of their activities against performance standards.
7	Require all lessees and licensees to provide an annual report to the Service on their environmental performance.

Manager	nent objective
8	Report annually on environmental quality based on reporting associated with all environmental management systems that apply to the park. With respect to environmental quality, include in the report:
	 water quality monitoring results measures applied to reduce air and noise pollution and improve scenic quality water conservation, energy conservation, waste minimisation, reduction in light spillage and scenic quality enhancement results
	 human waste volumes treated at each of the sewage treatment plants in the park quantities of rubbish and recyclable material collected and its ultimate destination remediation progress at contaminated sites; and information relating to the nature of pollution incidents, how they were managed, and the corrective action taken to prevent their recurrence.
9	The management of environmental quality in relation to all sites and operations of Snowy Hydro Limited would be in accordance with the Environmental Management Plan for the Snowy Mountains Hydro-electric Scheme (section 12.5).
10	Establishing means by which members of the community can be involved in a voluntary capacity in 'clean- up' or other environmental improvement programs in the park.

The EMS requirement also applies to all agencies that undertake essential operations within the park. These include agencies such as Transport for NSW (TfNSW) and Snowy Hydro Limited. In general, the activities of these agencies are outside the alpine management units, and therefore fall under their own EMS.

B1.9 Environmental performance indicators

In accordance with the EMS system requirements outlined in Table B.3, each alpine resort have developed their own, NPWS approved, individual EMSs. The current environmental performance measures, which are based on a total of 9 core objectives and 33 KPIs and were agreed to in 2012 between NPWS and alpine resort stakeholders.

The aim of this agreed framework was for NPWS to work collaboratively with resort operators to monitor key aspects that could lead to improved environmental outcomes and ensure environmental values remain an important consideration in ongoing resort operations and management. The result of this framework is a mix of both quantitative and qualitative indicators (such as those pertaining to cultural heritage), and varying levels of responsibilities and monitoring across both NPWS and individual Alpine resorts. Two examples of this include:

- small mammal threatened species monitoring is undertaken by NPWS, management can be co-ordinated with Alpine
 resorts, i.e. they undertake cat trapping
- responsibilities for water quality between NPWS and Alpine resorts varies based on lease agreements and responsibilities for water management and sewage.

The results of KPI monitoring forms the basis of the Annual Environmental Performance Report (NPWS, 2017) which have been completed since 2012.

A summary of existing key performance indicators used by NPWS to assess the performance of each AMU is included in Table B.4. The table includes identification of quantitative indicators and where KPI targets are legislatively required or considered voluntary. It also provides an indication of where the responsibilities for each KPI sit. AMU refers to general resort areas, where specific responsibilities are present, specific resorts are named.

Value	Objective	Key Performance Indicator	ID	Requirement	Quantitative	General responsibility
Water Quality	To protect the environmental health and aquatic ecosystems of alpine streams from resort activities.	Biological, physical and chemical indicators of resort stream health compared to ANZECC guidelines (physical and chemical measurements) and AUSRIVAS KNP model (biological condition).	W1	Legislated	X	Thredbo / NPWS
		Compliance with water extraction licenses.	W2	Legislated	Х	AMUs / NPWS Perisher Team ²
		Water consumption in accommodation premises compared to industry benchmark (220 Litres/Visitor Night).	W3	Voluntary	X	AMUs / NPWS Perisher Team ²
		Total water consumption.	W4	Voluntary	Х	AMUs / NPWS Perisher Team ²
PollutionTo prevent and managementprevention andleaks, spills andincidentunlicensed dischargesmanagementof potentially harmfulsubstances to theenvironment.	To prevent and manage leaks, spills and	Timely management of environmental incidents in Alpine resorts.	P1	Legislated		AMUs / NPWS Perisher Team ²
	unlicensed discharges of potentially harmful substances to the environment.	Compliance with EPA discharge licenses for Sewage Treatment Plants (STPs).	Р2	Legislated	X	NPWS Perisher Team ²
		Compliance with POEO Act 1997, UPSS Regulation 2008.	P3	Legislated	Х	AMUs / NPWS ¹
		Education of staff in environmental incident management and response.	P4	Voluntary		AMUs

 Table B.4
 Existing Alpine Management Unit Environmental Management key performance indicators

Value	Objective	Key Performance Indicator	ID	Requirement	Quantitative	General responsibility
Biodiversity	To protect flora, fauna and ecological communities, prevent	Threatened species population: Mountain Pygmy Possum (MPP). (note: threatened species monitoring in the resorts is linked to broader monitoring programs in KNP)	B1	Legislated	Х	NPWS
	loss of biodiversity and	Threatened species population: Broad-toothed Rat (BTR).	B2	Legislated	Х	NPWS
	ecosystem functions to previously disturbed areas.	 Small mammal management: Mountain Pygmy Possum, Burramys parvus (Endangered) Broad-toothed Rat, Mastacomys fuscus (Vulnerable) Dusky Antechinus, Antechinus swainsonii Agile Antechinus, Antechinus agilis Southern Bush Rat, Rattus fuscipes. 	B3	Legislated	Х	AMUs / NPWS
		Pest control programs.	B4	Voluntary		NPWS / AMUs
		Loss of natural areas as a result of development (no net loss of biodiversity values).	В5	Voluntary		NPWS
		Weed management programs.	B6	Legislated		AMUs / NPWS
		Rehabilitation of previously disturbed areas.	B7	Voluntary		AMUs / NPWS
		Riparian restoration.	B8	Voluntary		AMUs / NPWS
		Natural heritage research projects supported, initiated or undertaken in Alpine resort areas.	B9	Voluntary		NPWS
		Environmental education and awareness programs.	B10	Voluntary		AMUs / NPWS
Cultural Heritage	To conserve and promote the cultural heritage values of the alpine resort areas	Education, awareness and promotion of resort cultural heritage values.	C1	Voluntary		AMUs / NPWS
		Protection of heritage sites, items and historic assets.	C2	Legislated		AMUs / NPWS

Value	Objective	Key Performance Indicator	ID	Requirement	Quantitative	General responsibility
Air Quality and CO ₂ Emissions	To improve local air quality and reduce or offset carbon dioxide	Amount of CO ₂ emissions.	A1	Voluntary	Х	AMUs
		The percentage of renewable energy used.	A2	Voluntary	Х	AMUs
	(CO ₂) emissions	The percentage of visitors using the Skitube.	A3	Voluntary	Х	AMUs
Energy	To improve the efficiency of energy consumption and	Total energy consumption.	E1	Voluntary	Х	AMUs
Conservation		Energy consumption in accommodation premises compared to 'EarthCheck' benchmark.	E2	Voluntary	X	AMUs
	renewable energy.	Energy efficiency initiatives.	E3	Voluntary	Х	AMUs
Waste	To minimise waste, maximise resource recovery and prevent environmental harm from waste disposal.	Amount of domestic waste.	G1	Voluntary	Х	AMUs
Management		The percentage of domestic waste recycles including paper, cardboard, tins, glass and plastics.	G2	Voluntary	X	AMUs
		Waste composed – including the biosolids from Sewage Treatment Plants (STP).	G3	Voluntary	X	AMUs / NPWS Perisher Team ²
Sustainable recreation	To ensure the recreational opportunities and facilities of the Alpine resorts are provided and managed sustainably.	Education, awareness and promotion of sustainable recreation in resorts.	R1	Voluntary		AMUs / NPWS
		 Monitoring of key recreational activities snow play at Selwyn mountain biking and walking at Thredbo snow tubing at Perisher. 	R2	Voluntary		AMUs / NPWS (downhill mountain biking only)
Resort Amenity	To conserve and enhance the existing amenity of the Alpine resorts.	Education, awareness and promotion of resort amenity.	Am1	Voluntary		AMUs
		Measures to protect the visual and acoustic environments within resorts and minimise impacts to the surrounding areas.	Am2	Voluntary		AMUs

(1) NPWS are the regulatory authority under the POEO Act for all non-scheduled activities (all non-licenced activities) meaning some activities are self-regulating with oversight from the EPA for some matters. The responsibilities of the NPWS Perisher Team (Municipal Services) include the Perisher Valley Sewage Treatment Plant.

B2 Review of existing capacity mechanism

Chapter 5 builds on the Regulatory and Environmental Management Framework chapters and provides a summary of the current capacity management mechanisms used in KNP to manage visitors in the Alpine Management Units. It includes a summary of recent state government agency reviews on the capacity mechanism, and outlines considerations that are required for any future amendments to these limits.

B2.1 Existing capacity mechanism

The current mechanism for managing visitor numbers within each AMU is set limits on overnight accommodation via bed limits. Table B.5 outlines the current maximum number of beds allowed for each AMU (10.2.1(14-24) of the KNP PoM). This bed limit was set and modelled in consideration of key service infrastructure such as sewer, waste and water capacities. The bed limits are also used by NPWS to determine market land value and leasing premiums across some resort areas.

Alpine Management Unit	Maximum bed numbers
Perisher Range AMU	4,952 ¹
Thredbo AMU	4,820 ²
Charlotte Pass AMU	611
Selwyn AMU	50 ³
TOTAL	10,433

Table B.5	KNP PoM maximum be	d numbers by AMU
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(1) Information provided by NPWS in June 2020 indicated that 863 beds remain unallocated

(2) Information provided by NPWS in June 2020 indicated that 464 beds remain unallocated

(3) Provision for staff accommodation only, no visitor accommodations are available in the Selwyn AMU

The KNP PoM also identifies several additional visitor services zones (discussed in Section B1.6) located nearby existing AMUs which provide accommodation services. The locations and bed limits are specified in schedule 8 of the KNP PoM, and include:

- Wilsons Valley (Ski Rider Motel) 339 beds
- Diggers Creek (Sponars Chalet) 100 beds
- Sawpit Creek Precinct (Kosciuszko Mountain Retreat) 72
- Waste Point Lodge (Creel Bay) no bed limits established.

The objective (section 8.19.1 of the KNP PoM) of these zones is to limit visitor accommodations to existing capacities and levels specified in the existing leasing agreements. Thus, there is no provision for modifying these numbers for this report, as these beds are located outside the AMUs and are, therefore, not considered further as part of this current assessment.

B2.2 NPWS bed limit/carrying capacity review

Since 2016, OEH have completed several papers (two remain unpublished) in relation to the review of carrying capacity within KNP.

The initial background paper, (OEH, 2016) examined the appropriateness of the method of determining carrying capacity within the Alpine resorts of KNP. The review identified that while bed numbers were a straightforward and easily understood method for controlling the number of people within an area (overnight visitors only), and their impact. It did not necessarily provide a strong indication of overall environmental outcome of each resort operation. The review identified limitations of using a fix bed number approach to manage visitor capacity (as supported by section of this report). The limitations identified included:

- it assumes a stable and unchanging natural system, and does not account for complex environmental, social and economic factors
- different carrying capacities may be required for different times and places, undermining the practical utility of using a single number as a cap
- in many recreational management situations, impacts may be more a function of visitor behaviour or type of infrastructure development than just numbers
- it is a technical approach to addressing issues rising from competing values, and may provide little scope for public engagement and understanding
- in a built environment, the relationship between visitation and environmental conditions is difficult to discern
- the bed number approach is not able to control the impacts of day visitors.

The review highlighted the evolution of the combination of bed numbers and the tracking of key issues (such as water quality, pests and threatened species) to measure and monitor impacts. Currently the ongoing day to day environmental impacts of operations are managed through resort areas implementing individual EMS (refer to Sections B1.5 and B1.9). The results of which are published in annual performance reports in line with the requirements of the KNP PoM.

Potential shortcomings of the bed limit carrying capacity methodology were recognised during the development of the KNP PoM in 2006, by including provisions for further investigations. These are highlighted in section 10.2.1 (6) of the KNP PoM which identified the policy action to:

Coordinate a program designed to investigate alternative mechanisms for measuring and regulating carrying
capacity of each resort. Liaise with DoP (Department of Planning), resort lessees and licensees and other relevant
organisations on the design and implementation of the program.

The OEH review identified the need for resorts to evolve, as new opportunities emerge, to provide a high-quality visitor experience, deliver enhanced economic outcomes, and meet current and future environmental standards and visitor expectations.

Follow up (unpublished) papers by OEH in 2017 and 2018 outlined several future options for the consideration of carrying capacity within the context of the existing KNP regulatory and environmental framework, including:

- developing a standalone CCF or a framework based on a published model, to be regulated from lease conditions
- developing strategic long-term visions to guide future development
- improving resort environmental management systems, with an environmental monitoring and response system
- continuing with the status quo of bed numbers with the addition of strengthening the existing system
- a combination of multiple options to achieve the best fit for purpose.

Most options included a modification to the existing visitor capacity management method of bed numbers and identified the need to consider the improved management of day visitation, which is currently unlimited and thus a potential source of environmental issues.

B2.3 Plan of management requirements for any modification to the bed numbers approach to capacity

Management objective 10.2.1 (22) of the KNP PoM outlines the following requirements for the consideration of an increase accommodation limits for AMU's.

- the potential impacts of the increase on the natural and cultural values of the park
- the impact of climate change on the proposed increase
- the consistency of the proposal with the Alpine resorts Environmental Planning Instrument and other relevant strategies and plans
- alternative measures of carrying capacity have been assessed
- there is demonstrated demand for additional overnight accommodation in the resort that cannot be provided elsewhere in the park or by adjacent communities
- the resort management unit where the accommodation increase is proposed has an environmental management system in place and can demonstrate improvements in environmental performance over a period of at least five years
- the physical capacity of existing infrastructure servicing the resort management units can meet the demand of additional visitors without adversely impacting on park values, and
- there is an economic benefit to local communities within and adjacent to the park.

Any proposal and resulting increase to bed numbers requires a formal amendment to the KNP PoM in accordance with the statutory processes set out in Part 5 of the NPW Act.

As mentioned, NPWS have previously recognised short comings in this approach to changes in bed numbers, including a lack of a consistent guide on how the carrying capacity assessment should be undertaken. The KNP PoM does not provide such guidance.

A summary of a draft coordinated approach considered by NPWS since the KNP PoM publication in 2006 to address this issue is included in Appendix C. In addition, Appendix C also includes a summary of NPWS recommendations to improve the existing report EMS. It should be noted that both these approaches were not formally adopted or put into practice.

Appendix C NPWS Carrying capacity reviews



C1 Development assessment and plan of management coordinated guideline

In response to a lack of clarity on the assessment requirements to modify bed numbers, and in anticipation of the bed number continuing to be the main method of limiting capacity in AMUs, NPWS prepared the unpublished *Development Assessment and Plan of Management Coordination Guideline* (NPWS, 2018). The purpose of which was to facilitate a consistent approach in the documents prepared to support major development proposals, particularly around increases to accommodation. The document aimed to promote a coordinated approach with relevance to both the KNP PoM and the Alpine SEPP (now Precincts-Regional SEPP), by assisting applicants in:

- understanding the relevant requirements of the KNP PoM and the Alpine SEPP
- understanding the assessment processes undertaken by both NPWS and DPE
- preparing documentation that can support both an application to amend the KNP PoM and the development application required under the Alpine SEPP (now Precincts-Regional SEPP) or the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP)
- identifying any other approval, permit, licence, authority or consent from another government body that may apply.

Table C.1 provides a summary of the guidance provided in the document in relation to the assessment required to enable NPWS to allow modifications to bed number limits (ahead of standard EIA process). Any future modification to the bed limits should consider these assessment requirements. Guidance has only been provided for four of the eight assessment considerations identified in Appendix B, Section B2.3.

Assessment	Considerations	Relevant legislation & guidelines
Natural and cultural values of the park	 Consideration under the Alpine SEPP potential impacts on natural and cultural values The EIA should clearly outline the following: impact of the development ton the natural human and built environment the methodology used to identify impacts the measures outlined to protect the environment or reduce potential environmental harm. 	 EP&A Act National Parks and Wildlife Act 1974 Biodiversity Conservation Act 2016 Heritage Act 1977 Alpine SEPP (now Precincts- Regional SEPP) Kosciuszko National Park Plan of Management 2006 Guidelines for Developments Adjoining Lands Managed by the Office of Environment and Heritage (NPWS 2013) Guidelines for Preparing a Review of Environmental Factors: How to assess the environmental impacts of activities within national parks and other reserves (Section 3 only) (NPWS 2016)

Table C.1 Modification to bed limits – assessment requirements

Assessment	Considerations	Relevant legislation & guidelines
Infrastructure and services	 The proposal must ensure: it is consistent with industry best practice provisions of mechanisms to reduce emissions, energy, waste, and water an EMS is in place Consideration under the Alpine SEPP impacts of the proposal on both natural and built environments, and social and economic impacts in the locality impacts of the development on capacity of existing transport, effluent management systems, waste disposal and water supply. 	 Alpine SEPP (now Precincts- Regional SEPP) <i>EP&A Act</i> 1979 KNP PoM Guidelines for Developments Adjoining and Managed by OEH
Climate change	The assessment should consider the impacts of projected climate change conditions including operational impacts associated with reductions in snowfall, diversification of activities and future flora and fauna species. The proposal should also consider the minimisation of greenhouse gasses. Consideration under the Alpine SEPP — cumulative impacts of the development — precautionary principle and intergenerational equity — principles of ecologically sustainable development.	 KNP PoM Guidelines for Developments Adjoining Lands Managed by the OEH, which outline NPWS policy position to increase the resilience of the area to counter potential impacts of climate change
There is an economic benefit to local communities within and adjacent to the park	 The proposal should consider: quality of the economic activity in both summer and winter quantity of regional benefits identification of broader social and recreational benefits to the Alpine resorts. Consideration under the Alpine SEPP impacts of the proposal on both natural and built environments, and social and economic impacts in the locality encouragement of a range of development types extent of development connected to a significant increase of activities outside ski season. 	 <i>EP&A Act</i> Alpine SEPP (now Precincts- Regional SEPP) KNP PoM

Source: OEH, Unpublished 2018

C2 Improving the existing environmental management system

One potential pathway for modifying the capacity methodology, as identified by OEH reviews outlined in Section C1, was to strengthen the existing EMS. As a part of their capacity reviews, NPWS outlined an initial working list of environmental conditions for a future system. The list flagged several themes and conditions, and their potential for inclusion in a monitoring and response system, or improved EMS to support a modified carrying capacity methodology. Table C.2 outlines the working list as provided by NPWS.

Theme	Condition	Possible indicator candidate	Why	How
Soil	Soil disturbance – ski slopes	Soil disturbance – ski slopes	Hard to define and manage a measurable standard	Ensure minimum snow cover guidelines are followed in non-super groomed areas
Vegetation	Condition of zones – native	Condition of zones – native	Native vegetation is critical for NP context and habitat connectivity	Basic plots/transects
Vegetation	Condition of zones – natural	Condition of zones – natural	Native vegetation is critical for NP context and habitat connectivity	Basic plots/transects
Vegetation	Overall weediness	Overall weediness	Native vegetation is critical for NP context and habitat connectivity	Biannual walk over
Pests	Rabbit presence	Rabbit presence	Rabbit numbers are elevated in cleared areas, ski runs and footprints	Needs to be flexible for seasonal variations
Pests	Foxes	Foxes	Resorts can attract foxes, but this is a landscape issue also	EMS/NPWS & Resort partnership
Pests	Cats	Cats	Resorts attract cats, but this is a landscape issue also	"see a cat catch a cat" continues in built areas with NPWS support
Amenity	Cleanliness	Cleanliness	Resort visitors are the main source of litter within resorts areas	Prevention, collection, education, fines?
Water	Quality	Abiotic/ biotic conditions	Directly relate to resort impacts, monitoring already occurring	Look at long term trend, choose appropriate standards, biotic only

 Table C.2
 Working list of environmental conditions and potential for inclusion in a monitoring and response system

Theme	Condition	Possible indicator candidate	Why	How
Threatened species	Plants – Bog & Snowpatch EECs/ Other spp.	Veg condition (link to veg zone management)	Some areas can be defined, but many factors involved	Delineate no-go areas and monitor.
Visitor experience	Staff have ability to respond to issues	% of all resort staff enviro trained	Fundamental way of protecting and promoting park values	Already happening mostly. Resorts are self-reliant, NPWS can value-add
Resource efficiency	Waste & recycling	Level of recycling; volume	Standard mostly already exists, behaviour is the biggest issue	EMS reporting
Resource efficiency	Biosolid removed from STP water	% of removal of bio- solids	Already agreed, already happening so should be straight forward	EMS reporting

Appendix D Existing Kosciuszko National Park management objectives



Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Water Quality	11.6.1 Management Objective Environmental quality is maintained or improved.	Biological, physical and chemical indicators of resort stream health compared to ANZECC guidelines (physical and chemical measurements) and AUSRIVAS KNP model (biological condition).	W1	This objective address multiple policies and actions around water quality including utilising water quality monitoring results to inform decision making. The KPI aligns with the objective which is aimed at protecting the environmental health and aquatic ecosystems of alpine streams from resort activities. The essential nature of this value and the long and consistent history of data capture makes this an important KPI to regulate. The standards are from guidelines not regulations, so legislation is unable to provide the protection required.
Water Quality	 6.6.1 Management Objective The environmental condition of all watercourses and waterbodies is maintained or improved. Policies and actions (No. 19). 12.1.1 Management Objective The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities. 	Compliance with water extraction licenses.	W2	The water extraction licenses compliance requirement on the resorts is a way to ensure the environmental condition of watercourses are maintained and demonstrate their accountability for minimising impacts to watercourses. This KPI therefore aligns with these two objectives. For statutory KPIs the EMS is only required to ensure the required actions are triggered and does not set standards nor choose the methods not the penalty as these are already set by regulations.

Table D.1 Summary of existing KNP PoM management objectives and their relevance to existing KPIs

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Water Quality	6.6.1 Management Objective The environmental condition of all watercourses and waterbodies is maintained or improved. Policies and actions (No. 19).	Water consumption in accommodation premises compared to industry benchmark (220 Litres/Visitor Night).	W3	One of the policies and actions of this management objectives is to ensure the ongoing protection of watercourses through the implementation of EMS for all operations.
				This aligns with the KPI as this KPI focuses on keeping track of water consumption in accommodation premises which help maintain the environmental condition of waterbodies.
				Water consumption is a simple and straight forward calculation and meets both sustainability as well as biological objectives. The standard is a guideline and the issue is critical for environmental flows.
Water Quality	6.6.1 Management Objective The environmental condition of all watercourses and waterbodies is maintained or improved.	Total Water consumption.	W4	Policies and actions of this management objectives include ensuring the ongoing protection of watercourses through the implementation of EMS for all operations.
	Policies and actions (No. 19).			This aligns with the KPI as this KPI focuses on keeping track of water consumption of total water consumption in resorts which help maintain the environmental condition of waterbodies.
				Water consumption is a simple and straight forward calculation and meets both sustainability as well as biological objectives. The standard is a guideline and the issue is critical for environmental flows.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Pollution prevention and incident management	11.6.2 Management ObjectiveEnvironmental accidents, pollution events and contamination are responded to rapidly and effectively to protect park values and visitor safety.	Timely management of environmental incidents in Alpine resorts.	P1	The goal of this KPI is to ensure resorts manage any pollution incidents rapidly and effectively which aligns with this objective. All statutory compliances are critical. The role of the EMS is to ensure ongoing management and reactive actions are triggered to avoid an event. In this case the standard would be zero pollution events.
Pollution prevention and incident management	<i>12.1.1 Management Objective</i> The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.	Compliance with EPA discharge licenses for Sewage Treatment Plants (STPs).	P2	Being compliant with discharge licenses shows the commitment of resort operators to minimising impacts of their activities. This KPI aligns with the objective. It should be noted the designation of responsibly to the Perisher NPWS team in the Perisher AMU.
				All statutory compliances are critical. The role of the EMS is to ensure ongoing management and reactive actions are triggered to avoid an event. In this case the standard would obviously be zero non compliances. In this case the standard would be zero breaches of license.
Pollution prevention and incident management	11.6.1 Management Objective Environmental quality is maintained or improved.	Compliance with POEO Act 1997, UPSS Regulation 2008.	Р3	The goal of this KPI is to prevent any leaks, spills and unlicensed discharges of substances potentially harmful to the environment, thus aligning with the objective to maintain environmental quality.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Pollution prevention and incident management	12.1.1 Management Objective The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.	Education of staff in environmental incident management and response.	P4	Educating resort staff about environmental incident management and response helps raise staff awareness on reporting and managing incidents. This shows the resorts' commitment to minimise impacts of their activities by educating staff on the potential impacts and management of potential impacts. A measure of the adequacy of staff training would be easy to obtain and include in the EMS. Regulation of this KPI may not be justified as it is likely to be a shared objective of NPWS and resorts.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Biodiversity	6.2.2 Management objective The effects of all other threats on plant and animal species and communities under stress from climate change are minimised. Policies and Actions (1,2).	Threatened species population: Mountain Pygmy Possum (MPP). Threatened species population: Broad-toothed rat (BTR).	B1 B2	This objective aims to address the threats from climate on animal species and plant communities. The threatened Mountain Pygmy Possum and Board toothed rat populations are likely to be under threat from climate change in the future. With increasing climate change it is important that all suitable habitat and connectivity between habitat is maintained and ongoing threats such as fire and pests which may be exacerbated by climate change are well managed. Other threatened species are present and could/should be included as KPIs e.g. those added in the next column. Where specialist skills are required for monitoring this is the domain of NPWS programs but with contributions from resorts in the AMU being essential. A measurable KPI around this issue is difficult to develop. Direct impacts on threatened species and their habitat are regulated under the BC Act. Indirect impacts are more difficult to allocate responsibility for since populations go up and down routinely for many and various reasons some of which are unknown and some of which are because of universal conditions.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Biodiversity	 Section 6.8 PoM including 7 management objectives around native animals. 6.8.1 – Viable populations of all native animal species that currently occur in the park are maintained or restored. 6.8.2 – Viable populations of all native animal species that currently occur in the park are maintained or restored. 6.8.3 – The cultural values of native animal species are identified, assessed and managed appropriately. 6.8.4 – Research informs the management of the native animals of the park. 6.8.5 – The diversity of native species found in the park is maximised at a regional scale. 6.8.6 – Visitors and other stakeholders appreciate the values of the native animals of the park and their responsibilities in protecting them. 6.8.7 – Community support and involvement in wildlife conservation measures are strengthened. 	 Small mammal management: Mountain pygmy possum, Burramys parvus (Endangered) Broad-toothed rat, Mastacomys fuscus (Vulnerable) Dusky antechinus, Antechinus swainsonii Agile antechinus, Antechinus agilis Southern bush rat, Rattus fuscipes. 	Β3	 Objectives under Section 6.8 relating to resorts are to: minimise harm to animals by using non-harmful control techniques within resort dwellings e.g. Elliot Traps minimise impacts the threatened species habitats within and adjoining the resorts such that local populations are not impacted increase biodiversity awareness with resort visitors. Where specialist skills are required for monitoring this is the domain of NPWS programs but with contributions from resorts in the AMU being essential.
Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
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Biodiversity	12.2.1 Management objectiveService operations are undertaken in ways that minimise adverse impacts upon park values.Policies and Actions (No. 17,24).	Pest animal control programs.	B4	Most management objectives related to pest control are at a landscape scale achieving strategic level outcomes. Relevance to AMUs comes in the form of strict waste management (to reduce attractants) and feral animal control measures in high use areas. Management objectives related to AMUs could be strengthened and be more specific to AMU expectations. The two policies and actions under this objective focus on maintaining a trail system for pest species management and the use of horses for introduced animal control programs. These are related to some of the pest control work targeted cat, fox and rabbit undertaken by NPWS in coordination with resort lessees. For example, the 'see a cat catch a cat' program. Smaller species with a smaller home range such as rabbits and cats and to a lesser extent foxes are seen as a responsibility of resorts, whereas larger more widely roaming species such as horses, deer and pigs much less so.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Biodiversity	 6.7.1 Management objective Native plant species and communities are maintained and/or rehabilitated and include a representative range of successional stages and age classes. 10.2.1 Management objective The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park. 	Loss of natural areas as a result of development (no net loss of biodiversity values).	B5	Objective 6.7.1 relates to rehabilitation which is usually addressed during the development approval. Objective 10.2.1 lists out the conditions required for activities which involves the provision of visitor facility or services. These are usually being captured during the development approval. Therefore, the applicability and actions from these management objectives need reconsideration or strengthening specifically for AMUs. For example, further protection of TEC bogs within resort boundaries is warranted high use areas adjacent to bogs are quite problematic.
Biodiversity	13.2.1 Management objective Encourage community cooperation and involvement in the management of the park.	Weed Management programs.	B6	Weeds and pests in the resort areas are key issues. As a core component of addressing this KPI is the collaboration between NPWS staff, community volunteers, NGO and other stakeholders during weed management. However, ultimately resorts need to be responsible for their contribution. Simple survey methods and standards are available. The early reporting and intervention on new weeds could be a KPI along with various standards set for existing weed presences. There are various simple measures of weediness that could be applied. Pests can be more complex and potentially resorts fair financial contribution to NPWS programs is a suitable approach.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Biodiversity	 6.3.2 Management Objective Rehabilitation and construction works are undertaken in ways that protect significant rocks, landforms and geological processes. 10.2.1 Management Objective The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park. 	Rehabilitation of previously disturbed areas.	B7	These two KPI (B7, B8) involves rehabilitating previously disturbed area such as mountain bike trails, rabbit eroded areas and the restoring riparian vegetation to ensure habitat connectivity for small mammals. Both these two objectives are relevant as objective 6.3.2 involves rehabilitation and objective 10.2.1 involves element of development application including the potential impacts of certain development. New development is unlikely to be made responsible for repair work that is not a result of that development. If areas from past related resort developments have not been ameliorated and cannot be addressed in the conditions of approval, then a KPI in the EMS may be useful for addressing this situation. Noting that a standard could be difficult to apply. Previously damaged riparian areas are of interest to NPWS.
Biodiversity	As B7 above	Riparian restoration.	B8	As B7 above
Biodiversity	<i>15.1.1 Management Objective</i> Research contributes to the effective and strategic management of the values of the park.	Natural heritage research projects supported, initiated or undertaken in Alpine Resort Areas.	В9	Objective is applicable to KPI as both relate to environmental research within KNP. Resorts generally pay a levy for research or provide access and information to researchers. It could be difficult to apply a standard to this value.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Biodiversity	 13.1.1 Management Objective Engender appreciation, enjoyment and understanding of the park's values and support for their ongoing protection. 13.2.1 Management Objective Encourage community cooperation and involvement in the management of the park. 	Environmental education and awareness programs.	B10	These two objectives are applicable to the KPI as the focus on both objectives is around communication and cooperation around park values. It could be difficult to apply a standard to this value.
Cultural Heritage	 12.1.1 Management Objective The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities. 7.0.6 Management Objective Staff, visitors and other stakeholders understand and appreciate the cultural heritage values of the park and their responsibilities in helping to protect those values. 	Education, awareness and promotion of resort cultural heritage values.	C1	The cultural awareness training run by each resort helps promote the cultural heritage values of the alpine resort areas, demonstrating a commitment to conserving cultural heritage values, which align with the objective to improving environmental standards. It could be difficult to apply a standard to this value.
Cultural Heritage	7.0.6 Management Objective Staff, visitors and other stakeholders understand and appreciate the cultural heritage values of the park and their responsibilities in helping to protect those values.	Protection of heritage sites, items and historic assets.	C2	Impacts to areas of significance are dealt with in the planning stage of projects and managed throughout the works to ensure the protection of cultural heritage values, align with this objective.
Air Quality and CO ₂ Emissions	6.2.4 Management Objective All operations and activities associated with the park are undertaken in ways that minimise the production of greenhouse gas emissions.	Amount of CO2 emissions.	A1	This KPI helps track resort CO2 emissions which contributes to reducing CO2 emissions. This aligns with the objective. A general level of emissions will be estimated in the development proposal but after approval a KPI may be required to ensure such an achievement is continued.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Air Quality and CO ₂ Emissions	6.2.4 Management Objective All operations and activities associated with the park are undertaken in ways that minimise the production of greenhouse gas emissions.	The percentage of renewable energy used.	A2	This KPI helps track percentage of renewable energy used which contributes to minimising the production of greenhouse gas emissions. This aligns with the objective. A general level of emissions will be estimated in the development proposal but after approval a KPI may be required to ensure such an achievement is continued.
Air Quality and CO ₂ Emissions	Unclear	The percentage of visitors using Skitube.	A3	N/A. Data has not been provided due to commercial sensitivities. Alternative measures should be considered to gain information.
Energy Conservation	12.1.1 Management ObjectiveThe Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.Policies and action (No.8).	Total Energy consumption.	E1	This KPI directly addresses the annual reporting requirement related to energy conservation as stated in the policies and action (no.8) under the objective. A general level of energy consumption will be estimated in the development proposal but after approval a KPI may be required to ensure this achievement is continued.
Energy Conservation	12.1.1 Management ObjectiveThe Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.Policies and action (No.8).	Energy consumption in accommodation premises comparted to 'EarthCheck' benchmark.	E2	This KPI directly addresses the annual reporting requirement related to energy conservation as stated in the policies and action (no.8) under the objective. A general level of energy consumption will be estimated in the development proposal but after approval a KPI may be required to ensure this achievement is continued.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Energy Conservation	 12.1.1 Management Objective The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities. Policies and action (No.8). 	Energy efficiency initiatives.	E3	This KPI directly addresses the annual reporting requirement related to energy conservation as stated in the policies and action (no.8) under the objective.
Waste Management	 10.2.1 Management Objective The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park. Policies and actions (No. 27, 28). 	Amount of domestic waste.	G1	This KPI tracks the amount of domestic waste in order to help minimise waste produced by each resort. These align with the two policies and actions aiming to manage the disposal of waste and develop waste avoidance target.
Waste Management	 10.2.1 Management Objective The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park. Policies and actions (No. 27, 28). 	The percentage of domestic waste recycles including paper, cardboard, tins, glass and plastics.	G2	This KPI tracks the percentage of domestic waste recycles which help achieve the policy and actions aiming to develop waste avoidance and resource recovery targets for each alpine resort management unit.
Waste Management	 10.2.1 Management Objective The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park. Policies and actions (No. 29). 	Waste composted – including the biosolids from Sewage Treatment Plants (STP).	G3	This KPI helps manage the discharge effluent and wastewater which align with the objective of effluent, wastewater and stormwater management. It could also be beneficial to re-use to enable other uses such as land application.

Value	KNP PoM management objective and description	KNP PoM key performance indicator	KPI#	Relevance of KPI
Sustainable recreation	12.1.1 Management Objective The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.	Education, awareness and promotion of sustainable recreation in resorts.	R1	Environmental educations are carried out by resorts to ensure the recreational opportunities and facilities of the Alpine resorts are managed sustainability. This aligns with the objective of showing a commitment to minimise potential impacts of activities.
Sustainable recreation	8.1.1 Management Objective Opportunities are provided for visitors to undertake a wide range of recreational activities at places and in ways that optimise the quality of the experiences available, while minimising adverse impacts upon the values of the park and conflicts with other users.	 Monitoring of key recreational activities snow play at Selwyn mountain biking and walking at Thredbo snow play at Perisher. 	R2	This KPI aims to monitor the key recreational activities which help identify issues such as erosion and drainage, weeds, vegetation damage etc. This aligns with the objective to minimise the adverse impacts upon the values of the park.
Resort Amenity	<i>11.6.3 Management Objective</i> Scenic quality within the park is maintained and, wherever possible, enhanced.	Education, awareness and promotion of resort amenity.	Am1	Resorts staffs are trained to raise awareness towards promoting resort amenity and reduce environmental impacts. This aligns with the objective to help maintain scenic quality within the park.
Resort Amenity	<i>11.6.3 Management Objective</i> Scenic quality within the park is maintained and, wherever possible, enhanced.	Measures to protect the visual and acoustic environments within resorts and minimize impacts to the surrounding areas.	Am2	This KPI helps conserve and enhance existing amenity of the Alpine resorts by ensuring potential visual impacts have been addressed during development approval stage. This aligns with the objective.

Appendix E

A Carrying Capacity Framework in Kosciuszko National Park



E1 A CCF in KNP

This appendix provides a summary of the carrying capacity review and outlines why the development of the CCF is considered suitable for implementation in KNP, under the provisions of the Snowy Mountains SAP Master planning process. The review is a culmination of the early assessments, draft Snowy Mountains SAP technical studies, previous engagement with NPWS, DPE, RGDC and the enquiry by design workshops undertaken in Thredbo in November 2020.

E1.1 Early assessment

Consistent with previous investigations undertaken by NPWS, and the literature review outlined in Appendix A, the most relevant existing CCF considering the context of KNP is the VERP model. However, as discussed there is no 'one size fits' all approach, and the application of any CCF should be developed specifically for the protected area, or zone in which it is being applied. Thus, most frameworks implemented are hybrid frameworks where relevant steps and stages are incorporated to develop a 'fit for purpose' methodology.

Figure E.1 provides a summary of the key inputs and preferred outcomes of any framework and the challenges involved in achieving effective results, and a high level of value protections.



Figure E.1 Key framework requirements, challenges and outputs

E1.2 Opportunities and considerations

In consideration of the early assessments and literature review (Appendix A), the existing regulatory and environmental frameworks (Appendix B), and coupled with the Snowy Mountains SAP process provides, an opportunity exists to develop and implement a CCF and methodology that provides these many of these key inputs, processes and governance with the ability to overcome the common challenges involved in the CCFs. For example:

- Many of the aspects of the framework are established or partly established through the details and operator requirements of KNP PoM. These would be refined, enhanced, or modified as part of the SAP process, including:
 - the identification of key values and values objectives which are linked to the strategic direction of management topics, issues of or key processes
 - established EMS by key operators
 - established KNP zones where visitor impacts are most intensive, and
 - existing governance and supporting procedures though the Regional Precincts SEPP and various legislation and guidelines.
- The Snowy Mountains SAP process has included extensive stakeholder engagement that has allowed for high level aspirations to be established, and concepts such as considering modifications to existing bed limits, or a new carrying capacity method introduced to the community, and key stakeholders. It has also allowed for a collaborative development process with government agencies and technical specialists. There are also strong existing relationships between NPWS and Alpine resorts, along with a long history of co-operation and aligned understanding of issues and expectations of each.
- Frameworks can be costly to develop, implement and monitor, and can be limited by the availability of data and technical expertise. The combination of the existing technical expertise of NPWS, Alpine resort operators, and SAP technical specialists, can assist to overcome technical and cost associated challenges.
- NPWS, other government agencies, and operators have a long history of implementing environmental management requirements in KNP, which has generally resulted in general environmental outcomes. There is therefore a strong commitment from operators and other stakeholders to maintain and protect key values of KNP. This commitment continues through the development of the Snowy Mountains SAP, and is likely to continue, especially as operators become more responsive to their social licences to operate.
- The Snowy Mountains SAP provides additional support to the use and expansion of existing strategic goals set out by the KNP PoM. Particularly goals which have not traditionally been the focus of NPWS, such as establishing net zero emissions precincts or working towards establishing more climate resilient communities. It also allows the consideration of strategic master planning development, such as identifying areas considered most appropriate for future development opportunities or areas which are appropriate for limited infill developments.
- The Snowy Mountains SAP provides the ability to consider the physical capacity aspects that can be addressed by engineering (albeit with cost implications). i.e. the number of people that can be transported, sheltered, fed and washed in a facility or area as per Australian guidelines. These features can be designed, costed and fixed up-front in a development approval process. It also provides a process by which physical constraint issues such as areas of high biodiversity values, areas of bushfire risk, and buildings design (with aspirations around amenity) can be included. This allows for the front-end loading of some value protections in accordance with relevant legislation and guidelines.
- Consideration of the development of a Snowy Mountains SAP Precinct EMS to ISO,14001 certified standards to manage and regulate environmental management related issues. The EbD workshop identified the need to consider amenity control and a Comfortable Carrying Capacity as part of the CCF framework to manage and regulate some of these amenity values protections and guide any development opportunities which involve on-mountain activities.

E1.3 Specific implementation challenges in Kosciuszko National Park

In consideration of the early assessment, opportunities and considerations, there are still several challenges that remain regarding the implementation of an effective CCF in the Snowy Mountains SAP areas of KNP. This includes modifications or clarifications on responsibilities and governance arrangements, compliance, establishment of monitoring values, and alignment with the KNP PoM.

E1.3.1 Responsibilities, governance arrangements and compliance

The following issues have been considered as part of the Snowy Mountains SAP Master and thus the development of the planning framework which includes this CCF:

- Currently, each AMU has individual governance arrangements, resulting in a complicated distribution of resources and responsibilities. This limits the capacity and influence of stakeholders in managing key values. Regulatory powers are split within AMUs. NPWS (DPE) responsible for compliance and leasing under the NPW Act and regulations. Planning (DPE) are responsible for development planning and consents, and various other NSW government agencies regulate specific items such as water resources. To address these complexities, a simplification of governance arrangements is required for a CCF to function effectively in the Snowy Mountains SAP precincts in KNP.
- A CCF requires strong monitoring, and compliance to work effectively, and result in a high level of value protections. It needs to be recognised that the Alpine resorts, have, and do comply with environmental standards, and it has always been in their best interest to maintain these standards to be competitive and profitable. More widely though, there are times and events when good conditions are not maintained. Mostly these involve the difficulties of managing large numbers of visitors and their vehicles in winter, but also the technically complex situations associated with managing pests, weeds and erosion in a mountain environment. More productive partnerships and more consistent monitoring and compliance is required to strengthen protections. An important aspect of the CCF is simply to standardise what is considered good performance, and strong monitoring, and compliance is seen as an important factor. This is also component of the public interest consideration required as an objective of the *National Parks and Wildlife Act* (s2A(3)(b)).

E1.3.2 Establishment of monitoring values

The establishment of monitoring values and KPIs is one of the most challenging aspects of the CCF development. As discussed in Appendix A monitoring indicators can be divided into physical, ecological / environmental and social. Physical indicators can generally be managed though engineering solutions whereas the ecological and social capacities are maintenance issues which usually result from 'wear and tear' and over-use of resources. Although it is important to note that they are not mutually exclusive.

Making a general distinction between classifying indicator types in this way recognises that the engineering and design aspects of a development's impacts on the environment may be most effectively dealt with up front via the sustainability and environmental impact assessment requirements in a development approval process. Separating these indicators also makes it possible for the narrowing of the operational aspects of a CCF to one of maintaining environmental standards following post-development i.e. after the approval process has closed. This approach also enables the possibility of further narrowing the focus by putting aside environmental issues which are regulated by other statutes. Examples of these are impacts on threatened species, cultural heritage, pollution, noise, and water extraction. It should be noted, this does not negate the requirements for operators and developers to continue to monitor these values, as they continue to inform the CCF.

Resorts currently successfully work within the existing regulatory framework and may have concerns regarding any changes to their requirements. It will be important to consider operator inputs and for government and resorts to partner in the development of specific assessment, monitoring and response processes of values. Both these groups have significant experience in alpine resort management operations which should be capitalised on.

E1.3.3 Alignment with the existing KNP PoM

The KNP PoM is a far-reaching and complex document. The management objectives of the KNP PoM must be aligned with the final objectives of the CCF as well as in consideration of the Snowy Mountains SAP aspirations. In its current state, Chapter 10 of the KNP PoM forms the basis of environmental management requirements, however, does not include all provisions which would apply to alpine resorts. To address this, NPWS is undertaking an amendment of the KNP PoM in response to the Snowy Mountains SAP planning process.

E1.4 The final CCF

This report suggests that the key aspects for an effective CCF already exist or are in development. With some additional actions and control mechanisms, a framework could be established that optimises development activities, manages environmental objectives and provides certainty into the future. This report recommends a CCF that:

- retains a bed limit based on the Master Plan, to provide certainty for stakeholders, but allows for modification of the existing limit to an appropriate level based on the physical constraints identified during master planning.
 Establishing a new bed limits based on these physical constraints requires a series of assumptions on aspects such as accessibility, the ability to provide the infrastructure required to accommodate these new limits, and the design and amenity of any developments
- considers how the impacts of day visitation is managed and uses the Snowy Mountains SAP master planning process
 to determine infrastructure requirements to manage those day visitors based on growth projections
- considers ski resort capacities and includes the requirement for alpine resort operators to incorporate a ski slope master plan to manage future on mountain visitation which ensures visitor experience and amenity are maintained and enhanced
- establishers a tiered approach to the protection of environmental, cultural and social values via appropriate planning, monitoring and response provisions. Specifically, it implements:
 - the Snowy Mountains SAP Master Plan to set strategic and high-level visions, aspirations and principles for development opportunities and constraints
 - the Alpine DCP which would provide detailed planning and design guidelines for future developments, as well
 as detailed strategies for cultural heritage protections, environmental protection and management, amenity
 controls, infrastructure and services and staging of future developments
 - the requirement of an ISO 14001 certified Environmental Management System (EMS) for alpine resorts to ensure ongoing operational management is appropriate and monitoring and response procedures are in place, and
 - provides alternative management approaches for smaller operators, utilising site specific, environmental management site plans (EMSPs) to protect important values in areas alpine precincts.
- use monitoring and compliance methods (such as utilising surrogates and select KPIs regulated through the appropriate SEPP/future Alpine DCP or by lease and license conditions) that are easy to implement and understand
- allows for changing circumstances and adaptive management
- is based on outcomes to allow flexibility in how operators achieve standards
- forms part of the conditions of development approval within the SAP framework.

Appendix F Snowy Mountains SAP technical paper outcomes



The Snowy Mountains SAP has investigated the need for and recommends the implementation of a carrying capacity framework within the Snowy Mountains SAP alpine precincts. This would allow the current bed limits established in the KNP PoM to be raised to meet aspirations and development opportunities, as well as implement outcomes which help to manage visitation to 2061.

The assessment outcomes in this appendix have been included in Stage 5 of the CCF. Specifically, as part of the Snowy Mountains SAP Master Plan (Section 4.5.1), and the Alpine DCP (Section 4.5.2), Operator EMS (Section 4.5.3), and Environmental Site Management Plans (Section 4.5.4).

F1 Biodiversity

F1.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Special Activation Precinct – Biodiversity Assessment of Alpine Sub-Precincts* (Biodiversity Study) (WSP, 2022).

F1.2 Assessment outcomes

The following performance criteria should be implemented in Snowy Mountains SAP alpine precincts to ensure the protection of biodiversity values:

- development is to avoid TEC and threatened species habitat to minimise impacts to areas of high ecological value.
 Areas of high value vegetation should not be removed. Development may occur in these areas if it is for essential infrastructure
- development should be concentrated in and around already disturbed areas. Where possible, development should
 provide a buffer between areas of high ecological values and buildings and structures
- development should be focused on co-location and re-development to minimise the impact to biodiversity valued land
- development should minimise its impact to the environmental and natural landscape, implement sustainable development and consider the impacts of the bushfire asset protection zones (APZ's)
- development must offset any impact to biodiversity through direct management measures within KNP and should be related to the biodiversity impact
- Riparian corridoes must be preserved and revegetated where possible. Setback to corridors are to be provided in accordance with the Guidelines for Controlled Activities on Waterfront Land (2018, NRAR)
- any revegetation or planting in alpine precincts should utilise native species.

In addition, design guidance should be provided to identify how these areas will be protected during short-term construction phase of development an in the long-term use of the area. Design guidelines for each alpine precinct identifying how biodiversity aims will be addressed, including:

- the retention and maintenance of existing native vegetation and areas of high ecological value
- additional planning and areas for new public open space, publicly accessible areas or paths, including appropriate management strategies for these areas
- Riparian corridor, set back and design objectives for development interfacing with watercourses
- planting along road reserves that addresses visual amenity, public amenity consideration and road safety
- client ready species which are locally endemic to the alpine region
- site based setbacks, landscaping, and public domain requirements
- how vegetation clearing and biodiversity offsets will be managed (either across each precinct, or on a developmentby-development basis.

F2 Traffic, transport and access

F2.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Special Activation Precinct Technical Study Report: Engineering – Transport* (Transport Study) (WSP, 2022a). A full summary of assessed approaches to alleviate traffic and access constraints is included in Chapters 9 and 10 of the Transport Study.

F2.2 Assessment outcomes

F2.2.1 Key transport actions

The key recommendations for transport initiatives to achieve the Snowy Mountains SAP vision for the alpine precincts are summarised in Table F.1.

Solutions			stom	ners		Key factors	
		Visitors	Families	Athletes	Touring		
Connection Initiatives							
Infrastructure – Improved public transport facilities (road priority, stop infrastructure, etc.)	~	~				Journey time reliability, comfort, convenient trips	
Services – Create a frequent and rapid Mountain Shuttle service linking key destinations	~	✓				Service options, modal choice, frequent and convenient trips	
Infrastructure – Implement real time information to manage parking capacity		~	~		~	Informed choice, communicated service options	
Infrastructure – Introduce ITS to alert drivers to conditions and improve road safety	~	~	~		~	Road safety, informed choice, improved customer experience	
Place Initiatives							
Infrastructure – Improved place making at transport hubs both in alpine precincts and at hubs including Jindabyne	~	•	~		~	Comfort, high quality customer experience, destination – retail opportunities	
Policy – Maintain visual amenity and preserve the unique natural environment by capping parking supply to existing/approved levels	~	~	~	~	~	Enhanced experience - quality	
Policy – Promote Kosciuszko National Park as a year- round destination with emphasis on Mountain bike, hiking and altitude training		✓	~	~	~	Choice, convenience, alternate experiences	

Table F.1	Kosciuszko National	Park Access	Plan – Key Initiativ	es
			<u>,</u>	

Solutions			stom	ers		Key factors
	Residents	Visitors	Families	Athletes	Touring	
Sustainability Initiatives						
Policy – Encourage a transport modal shift away from cars and support travel demand management	~	~	~		~	Choice, service reliability, convenience
Policy – Equitable access to alpine precincts for all with competitive transport pricing for sustainable modes	~	~				Equitable, service quality
Policy – Priority access given to Mountain Shuttles and other high occupancy vehicles	~	~		✓		Enabling a frequent service, convenience, allows for journey time reliability
Policy – Transport solutions that target employment in the region	~					Quality of services, regional employment

F2.2.2 Integrated transport network, timing and delivery

Table F.2	Infrastructure and service improvements	(specific to KNI	P)
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Solutio	ons	Area	Timeframe ¹	Agency responsible	Commentary				
Access Initiatives									
A.9	Infrastructure – Improved public transport facilities (road priority, stop infrastructure, etc.)	Access to alpine precincts	Short to Medium-term	Transport for NSW	Coordinated with revision of bus network				
A.10	Services – Create a frequent and rapid Mountain Shuttle service linking key destinations	Access to alpine precincts	Short-term	Transport for NSW	Coordinated with Southern Connector Road and Park and Ride				
A.11	Infrastructure – Implement real time information to manage parking capacity	Access to alpine precincts	Short-term	Transport for NSW, NPWS	Coordinated with Park and Ride and Shuttle Bus service				
A.12	Infrastructure – Introduce ITS to alert drivers to conditions and improve road safety	Access to alpine precincts	Short-term	Transport for NSW	Introduced early to gain maximum benefit from project				
Place l	Initiatives								
P.2	Infrastructure – Create new roadside lookouts	Access to SAP	Short to Medium-term	Transport for NSW, SMRC	Road safety, tourism				
P.4	Infrastructure – Create bus hub in town at Information centre	Access to Jindabyne	Short-term	Transport for NSW, SMRC	Supports Shuttle Bus service and network review				

Solutions		Area	Timeframe ¹	Agency responsible	Commentary
P.5	Infrastructure – Improved place making at transport hubs both in KNP and at hubs including Jindabyne	Access to alpine precincts	Short-term	SMRC, NPWS, Perisher, Thredbo	Supports Shuttle Bus service
Sustainability Initiatives					
S.1	Infrastructure - Upgrade parts of Kosciuszko Road between East Jindabyne and the Jindabyne Dam	Access to alpine precincts	Short-term	Transport for NSW	Addresses existing issues and provides for future growth

(1) Short-term = before 2031, Medium-term = before 2041, Due to peak population by 2039, no long-term projects

F2.2.3 Shuttle bus

The shuttle bus service is a key element of the travel demand management strategy. Early delivery will assist create a convenient service that attracts people back to use it each year.

- Shuttle bus to be operational within 4 years with Jindabyne to Thredbo and Perisher implemented first. Headway of 10 minutes to each of Thredbo and Perisher, 60 minutes to Guthega, and a fleet of 24 buses.
- By 2031 Headway of 1.9 minutes to each of Thredbo and Perisher, 30 minutes to Guthega, and a fleet of 116 buses
- By 2039 (peak) Headway of 0.9 minutes to each of Thredbo and Perisher, 30 minutes to Guthega, and a fleet of 238 buses.
- Following the peak, services can be matched to changes in passenger demand. After each year, passenger numbers should be reviewed to tailor the balance of Perisher, Thredbo and Guthega services.

F2.2.4 Park and Ride

It is recommended that the land for the Park-and-Ride be secured. The Park-and-Ride can be built in one go or staged to meet the changing demand, providing the land is secured initially. The delivery of the Park-and-Ride facility should be timed with the Southern Connector Road. The shuttle bus can operate only from stops in Jindabyne in the short-term, moving to the Park and Ride once completed. Provision for 250 carparking spaces is expected to be operational on Day One with the estimated peak by 2039, and there is potential to further expand the Park and Ride facility if the demand increases.

F2.2.5 Skitube

The current lease for the land on which the Skitube operates is due to expire in year 2030. This provides a useful horizon for an investigation and decision for the continuation of the service. Planning for the Skitube should commence well before the 2030 lease expiry to provide sufficient time for investigation, design and procurement of any system upgrades.

If patronage grows with Perisher visitation, it is estimated that 2,200 passengers during the peak hour (2039) can be achieved by running 4 car sets with a 15-minute headway with existing rolling stock or upgrade rolling stock based on design life. Further liaison is required with Vail Resorts to confirm that the increase from the existing capacity can be achieved.

A review of ticket prices in combination with NPWS park access fees should be undertaken in conjunction with planning for the shuttle bus service.

F3 Housing and accommodation

F3.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Special Activation Precinct Technical Study Report: Housing and Accommodation Study* (Ethos Urban, 2022). It should be noted this report includes an assessment of housing and accommodation within the greater Snowy Mountains SAP area, and includes specific details on housing and accommodations in alpine precincts. As such only the outcomes as related to the supply of short-term accommodation is considered further in the CCF.

F3.2 Assessment outcomes

F3.2.1 Visitor accommodations

The need for visitor accommodation is projected to increase as peak visitation increases as a result of the SAP economic outcomes. Visitation is projected to grow across all seasons, and the largest monthly peak in visitation is predicted in the middle of the forecast period, and in the winter months. Over the longer term, seasonality is predicted to reduce, with visitation continuing to increase in the non-winter months and stabilising or declining in winter. The recommendations below for visitor accommodation are aimed at accommodating the long term (2061) peak overnight visitor numbers.

The higher peak numbers in winter in the middle of the forecast period will be addressed through supply of flexible housing that can be adapted to cater for tourist, seasonal worker or permanent resident demand as growth in these different segments peaks at different times in the forecast period. The earlier peak in visitor accommodation (around 2036-2041) could be catered for through accommodation types like serviced apartments, hostels, group home and holiday houses that are able to transition to use as worker or permanent accommodation as demand for those segments peaks later (the permanent population peaks in 2051).

Increasing the supply of purpose-built tourist accommodation will assist to reduce the influence of visitor accommodation on housing supply and prices. Continued supply of visitor accommodation that is flexible and can be adapted to other uses is also important for the long-term supply of accommodation to meet all projected needs in the SAP study area.

- delivery an additional 2,327 short term accommodation units to meet the forecast visitor needs by 2061
- increase bed capacity in alpine precincts to meet short term to medium term demand, with any increase in capacity carefully planned for and with concern for public safety and environmental impact. This would also require a review of existing framework to permit flexibility for providers to expand properties and increase bed numbers.

F3.2.2 Seasonal worker housing and accommodations

Providing sufficient and suitable supply of accommodation for seasonal workers will remain an important consideration throughout the forecast period. While the economic initiatives recommended through the SAP Structure Plan will increase non-winter tourist related activity and create a more year-round economy, strong growth in winter visitation is projected to continue through to 2041 and will drive ongoing demand for seasonal jobs and for some workers to spend a relatively short period living in the study area. In the long-term, demand for seasonal workers is expected to reduce as the economy strengthens and the differences between peak and low seasons reduce. Winter peaks are however forecast to remain the busiest times for tourist visitation, and much higher visitation in January compared to other non-winter months will also produce secondary peaks. These peak periods will likely mean that some businesses continue to employ additional staff for short periods. The number of seasonal workers is forecast to decline after peaking in 2041 and by 2061 is estimated to be less than current numbers. However, catering for the accommodation needs of seasonal workers will remain important.

Some seasonal worker accommodation demand could be met through the market delivering more housing however, affordability will remain a significant issue as seasonal workers are generally on lower incomes. A range of accommodation options are potentially suitable for seasonal workers including group homes, hostels, caravan park style cabins or on-site vans, and short-term rental of dwelling stock. Availability of suitable rental accommodation at the right price is likely to require intervention as the rental market is unlikely to provide affordable and reasonable standard accommodation to provide for the comfort and safety of seasonal workers. Overseas examples typically rely on the large tourism operators providing dedicated worker accommodation; however, this is often poorly located.

Providing seasonal worker accommodation that is suited to singles, groups, and couples in or near Jindabyne (the station resort is a good example) would mean that tourism operators can cater for the short to medium term growth in seasonal worker demand (particularly in winter months) and that accommodation can potentially transition to use as tourism accommodation as more non-winter tourism attractors are established in and around Jindabyne and seasonal worker demand reduces.

Additional staff accommodation should also be provided at the alpine resorts (Thredbo and Perisher in particular) as these attractors will be the key drivers of demand for seasonal workers in the winter peak periods to 2041. Consideration should be given to the use of modular, prefabricated and temporary structures that have a minimal environmental footprint and which can be removed, relocated or repurposed to provide other accommodation or facilities if seasonal worker demand reduces.

Over-crowding is likely to remain an issue while the cost of accommodation is high relative to wages. There is a need for intervention through either government or tourist operator delivery of purpose-built seasonal worker accommodation. Ideally this accommodation would also be suited to other uses outside peak seasonal worker periods, for example school camp accommodation for non-winter group visitation by schools, sporting, or community groups:

 provide an additional 451 units for seasonal workers to meet peak demand in 2036, with flexible accommodation that can be re-purposed or removed as seasonal worker demand declines from 2036 to 2061.

F4 Visitor experience/amenity

F4.1 Basis of assessment

This section is based on an analysis of visitor experience and amenity. As outlined in Section 4.4.5, the assessment used the surrogate of ski pass scans to gain an understanding of current, and future visitor experience.

F4.2 Assessment outcomes

The results of the assessment show a 30–40 per cent increase in winter visitation above existing levels by 2041. This increase in visitors would result in significant pressure on ski infrastructure resulting in crowding and a decline in visitor experience and resulting alpine resort amenity. In consideration of a comfortable carrying capacity assessment, given the existing information, visitation would exceed a presumed comfortable carrying capacity in alpine resort areas.

While this assessment focuses on the surrogate measures of 'busy' days, and focuses on the alpine resort areas, by default this increase in visitation would also place pressure on many other aspects of carrying capacity constraints in alpine precincts, where exceedances of a similar magnitude would be experienced. Recommendations as related to these aspects are outlined in other technical report summaries, such as:

- the availability of visitor accommodation in alpine resort areas and how to manage overflow requirements outside alpine resort areas, within TOAs or outside of the national park
- the capacity of infrastructure and infrastructure requirements and the constraints associated with upgrades to meet demand
- the capacity of transport and access solutions to allow for the safe and efficient movement of visitors to and from alpine resort areas.

Addressing these impacts is one aspect of visitor experience/amenity. It also needs to consider the quality of the experience which can be influenced by (among other factors) village amenity, the quality and value of accommodations, water quality, recreational activities, biodiversity quality, nature-based opportunities, and sustainability. To address these key issues, the Snowy Mountains SAP master planning process has investigated key aspects with relation to development within the alpine precincts, which would ultimately influence visitor experience.

The outcomes, as related to alpine precincts, are summarised in the structure plans (Jensen Plus, 2022) discussed in Stage 5 of this CCF. The structure plans include increases to bed limit in alpine precincts, which have been developed based on the key constraints in each area. It should be recognised that these bed limit increases represent capacity constraints in themselves based on developable space, urban design, and biodiversity, heritage and bushfire constraints.

As related to on mountain experiences (the predominant drawcard for visitation to the alpine precincts), the following recommendations to manage visitor experience (with a focus on mountain activities and areas) include:

- require all alpine resorts to develop ski slope master plans (in Partnership with the NSW Government) to ensure
 resorts are well balanced, crowding is managed appropriately and areas and infrastructure no longer in use are
 rehabilitated or decommissioned appropriately. These master plans should consider the projected future growth in
 visitation as well as the predicted impacts of climate change
- require all alpine resorts to implement an amenity management system or monitoring program to ensure protection
 of visitor experience and amenity values within the alpine precincts are maintained and enhanced
- ensure records of public complaints are kept and reviewed annually
- ensure alpine resort operators provide a range of activities for visitors to undertake.

F5 Flooding and water quality

F5.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Special Activation Precinct Technical Study Report: Engineering – Flooding and Water Quality* (Flooding & Water Quality Technical Study) (WSP, 2021), and *Snowy Mountains Special Activation Precinct – Salt Impact Management Plan* (SIMP) (WSP, 2021b).

F5.2 Assessment outcomes

The KNP PoM already include planning conditions for maintaining water quality and managing development on flood liable land. It is recommended that the Snowy Mountains SAP planning documents incorporate additional requirements to meet the aspirations of the Snowy Mountains SAP. These requirements include:

- integrated water cycle management collection of stormwater, treatment of stormwater and more natural flow release, capture of rainwater and reuse, stormwater is a resource
- rainwater tanks but ensure piping and pumps are protected from freezing, provide information on tips to manage rainwater tanks during freezing temperature periods
- point source pollution control as best as possible manage stormwater runoff at the source, such as along the edges
 of road and carparks, within new developments use the green spaces to treat stormwater runoff
- climate change projected rainfall reusing stormwater through capture and reuse on site will reduce the dependence on potable water supplies which in turn could ensure more water is available in Lake Jindabyne for hydro power and Snowy River environmental flow releases
- stipulate flood compatible building design including types of materials, fencing types around overland flow paths
- define and maintain riparian zones around all waterways.

F5.2.1 Flood management

Recommended performance criteria have been developed based on utilising the existing planning directions and incorporation of additional best practice conditions. The recommended performance criteria for flood risk management include:

- adopting a flood planning level of 1% Annual exceedance probability plus 0.5 m freeboard
- all structures to have flood compatible building components below 1% AEP flood level plus 500 mm freeboard
- all emergency and evacuation infrastructure to have flood compatible building components below PMF flood level plus 500 mm freeboard
- all structures are to be designed to withstand the forces of floodwater, debris and buoyancy up to 1% AEP flood plus 500 mm freeboard
- all emergency and evacuation infrastructure structures are to be designed to withstand forces of floodwater, debris and buoyancy up to PMF flood plus 500 mm freeboard
- development must be sited, designed and located to avoid or mitigate the flood risk to people, property and infrastructure
- development should mitigate the impacts of local overland flooding through the provision of adequate site drainage systems
- development must consider and plan for emergency evacuation situations to ensure the safety of all areas within the Probably Maximum Flood extent.

F5.2.2 Water quality

The recommended performance criteria for water quality include:

- promoting integrated water cycle management
- capturing and reusing stormwater from roofs at the source
- implement stormwater quality treatment at the source
- water quality discharge should aim to meet the targets of:
 - Total Suspended Solids: 85% reduction
 - Total Phosphorus: 60% reduction
 - Total Nitrogen: 45% reduction
 - electrical conductivity levels to be maintained below the 30 µS/cm ANZG 2018 Guideline Value for upland rivers of south-east Australia
- consider future climate change projections for rainfall in planning growth areas
- erosion and sediment control should be managed during construction to ensure impacts to waterways are minimized.

F6 Geotechnical

F6.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Mountains SAP Technical Study Report: Engineering – Geotechnical* (Geotechnical Study) (WSP, 2021c).

F6.2 Assessment outcomes

Based on the geotechnical features and associated risks, several mitigation options have been identified in the Snowy Mountains SAP Geotechnical Report, they are based on priority projects identified during the SAP structure planning such as the development of park and ride facilities at Thredbo, Perisher and Bullocks Flat, Water Treatment Plant and STP facilities at Perisher Village, and expansion and infrastructure works at Thredbo Ranger Station and Perisher Village.

In general risks are low and can be adequately mitigated. Further mitigation of geotechnical risks would be required depending on type and location of the proposed development.

F7 Groundwater

F7.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Special Activation Precinct Technical Study Report: Hydrogeology (*Hydrogeology Study*)* (WSP, 2021d).

F7.2 Assessment outcomes

Given the poor groundwater resource in the Alpine regions, no further assessment on future approaches to groundwater has been considered. It is recommended that any operator intending to progress evaluation or development of groundwater as a water source consider the financial and hydrogeological risks and seek technical advice to identify and mitigate risks where possible.

F8 Aboriginal cultural heritage

F8.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Special Activation Precinct Technical Study Report: Aboriginal Cultural Heritage Assessment Report* (Aboriginal Heritage Study) (OzArk Environment & Heritage, 2022), which includes consideration of the *Snowy Mountains SAP Preliminary Aboriginal Cultural Values Assessment* (Donaldson, S, 2021).

F8.2 Assessment outcomes

F8.2.1 General management principles

Appropriate management of Aboriginal cultural heritage values is primarily determined based on their assessed significance, as well as the likely impacts of the proposed development. As precise impacts are not known at this stage, the following management options are general principles, in terms of best practice and desired outcomes, rather than mitigation measures against individual site disturbance. General management principles are based on:

- avoid impact by altering the development proposal or in this case by avoiding impact to a recorded Aboriginal site
- if impact is unavoidable then approval to disturb sites under the authority of an approved permit must be sought. An AHIP application would require a specific impact assessment, possibly including additional survey and/or test excavation, and further specific consultation with the Aboriginal community when impacts are known. Alternatively, as is recommended in this report, Aboriginal cultural heritage should be managed through an Aboriginal Cultural Heritage Management Plan (ACHMP) that would become the statutory instrument to manage Aboriginal cultural heritage in the SAP precincts.

F8.2.2 Management of recorded Aboriginal cultural heritage values

The Aboriginal cultural heritage assessment has concluded:

- substantial areas are classified as 'disturbed land' where impacts in these areas are unlikely to harm Aboriginal cultural heritage values. However, Aboriginal objects are still possible to exist in 'disturbed lands' particularly in subsurface deposits, however such deposits are unlikely to be significant due to past disturbances
- despite extensive consultation, there are no identified intangible cultural values in the survey areas that may be harmed
- based on the surface survey, there are very few known Aboriginal objects in the survey areas. At this stage of the investigation, this suggests that Aboriginal objects will not be harmed if impacts can be designed to avoid known Aboriginal objects. Where appropriate this would need to be confirmed through targeted test excavation
- large areas of the survey area have been assessed as having low archaeological potential. While this does not
 preclude the presence of low-density artefact scatters or isolated artefacts in these areas, it is highly unlikely that
 significant sites will be recorded. Therefore, any future work in these areas is unlikely to impact significant
 Aboriginal cultural heritage values.

While targeted survey and/or test excavation would be required to confirm the findings of this study, it would seem, prima facie, that there are ample opportunities to conserve Aboriginal cultural heritage values in the design phase of the Snowy Mountains SAP planning process.

F8.2.3 Management of potentially impacted Aboriginal cultural heritage values

While the survey was comprehensive that there is still the possibility for Aboriginal objects to be present in all landforms of the survey areas. Therefore, following the precautionary principle, it is recommended that some form of further investigation take place at the time when specific impacts are known. This recommendation is made due to:

- test excavation has not been undertaken to inform these conclusions
- no survey can ever hope to record all instances of Aboriginal objects
- there was generally low GSV due to thick ground covers at the time of the survey. This low GSV may have obscured surface artefacts
- artefacts can move in the landscape either known artefacts can wash downslope or new artefacts may emerge from fresh erosion
- when specific impacts are known, the assessment can concentrate on a smaller area and ensure that Aboriginal cultural heritage values are conserved as much as is possible by suggesting design changes and or other management measures
- to confirm whether new sites have been recorded after this assessment (any registered individual may register objects on AHIMS and there is no way of knowing if someone has registered a site without undertaking a current AHIMS search).

F8.2.4 Development controls

It is recommended that an ACHMP be developed to manage Aboriginal cultural heritage in the SAP precincts. The ACHMP would be the primary instrument to conserve Aboriginal cultural heritage within the precincts, as well providing the statutory mechanism to manage Aboriginal cultural heritage should impacts to Aboriginal objects be unavoidable. Development controls relating to heritage in the ACHMP should ideally follow the heritage conservation objectives set out in the Precincts-Regional SEPP. These objectives should include:

- if development is planned in any landform identified in this report as 'unsurveyed', Aboriginal cultural heritage assessment should take place following relevant guidelines. At a minimum this would include the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW. This assessment may involve a visual inspection of the impact area, test excavation if warranted, and the involvement of the Aboriginal community
- if development is planned on land in which an Aboriginal object is located, a heritage impact assessment should be
 prepared that assesses the extent to which a proposed development would harm Aboriginal objects. If impact to an
 Aboriginal object is unavoidable, the procedures contained in the ACHMP would be followed. The ACHMP
 procedures would include further consultation with the Aboriginal community if Aboriginal objects were to be
 harmed.
- a proposed development in the survey areas should be assessed against the mapped zones of archaeological potential.
 Such provisions could be written into the ACHMP:
 - works within areas defined as 'disturbed land' (as defined by Section 58 of the *National Parks and Wildlife Regulation* 2019) can generally proceed without further Aboriginal cultural heritage investigation. However, the 'disturbed lands' would require a due diligence assessment to determine if the need to undertake test excavation has been completely removed by previous development. As Aboriginal objects are still possible in 'disturbed lands' any work in these areas should follow an unanticipated finds protocol to manage the unlikely event that Aboriginal objects are noted during work. This would include a 'stop work' provision and the requirement to assess the significance of the find with the Aboriginal community
 - works within areas defined in 'ACH low potential' should be assessed at a time when the impacts are known by following the appropriate assessment guidelines, currently the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW. This assessment may involve a visual inspection of the impact area, test excavation if warranted, and the involvement of the Aboriginal community

 works within areas defined as 'ACH moderate potential' or ACH 'high potential' should have an impact assessment undertaken. This assessment would include a visual inspection, possibly test excavation if warranted, and participation from the Aboriginal community. At the two previously recorded PADs at Perisher Village (61-3-0097 and 61-3-0112) test excavation would be required to determine the nature of the subsurface deposits.

Any Aboriginal objects recorded because of further investigation would be managed through the ACHMP. ACHMP provisions would include an assessment of significance for any newly recorded Aboriginal objects and further consultation with the Aboriginal community about their management.

F8.2.5 Broader archaeological recommendations

The broader archaeological recommendations set out include, the following items, however it should be noted this includes areas outside alpine precincts due to the nature of the recommendations:

- Aboriginal consultation is a critical element in the protection of Aboriginal heritage. Although done with the best of intentions, LALC boundaries stablished under the NSW Aboriginal Land Rights Act 1983 do not recognise the Ngarigo people. Although in Ngarigo country, much of the Snowy Mountains SAP area is within LALCs with offices on the coast, and with strong connections to the coast. Since it is unlikely that LALC boundaries will be changed, consideration should be given to either renaming the land councils that extend from the coast to the highlands to include Ngarigo or form a Ngarigo representative group
- after decades of investigations in the Snowy Mountains SAP Investigation Area, the archaeological heritage is well researched and well known; however, this is not reflected in any of the populist or academic literature. If areas of archaeological significance are to be identified and set aside for the future, a detailed synthesis of all the literature should be carried out, from which would emerge a new set of questions to guide future investigations. The collated information could also be useful for production of brochures and interpretive material about the Aboriginal heritage of the region
- the proposed new cultural centre at Jindabyne could be the repository for displays and interpretation of regional Aboriginal heritage, including some of the 5,000 artefacts excavated from Kunama Ridge estate. Furthermore, it may be feasible for the new cultural centre to house the valuable and highly significant kangaroo tooth necklace and other grave goods found near Cooma in 1991
- avoid and protect all burial grounds, known and yet to be discovered
- ensure archaeological investigations are inclusive of Ngarigo people, who may not be a RAP or members of a LALC
- complete the inventory of the artefact collections held in the old NPW office at Sawpit Creek and liaise with Ngarigo
 people regarding potential repatriation or use of the artefacts in displays in a potential cultural centre.

F8.2.6 Locations for potential subsurface investigations

It is likely that archaeological test excavation will be required should ground disturbing impacts be planned at the two registered PADs at Perisher Village (61-3-0097 and 61-3-0112).

F8.2.7 Fate of artefacts

Based on the wishes of some RAPs, any artefacts that may be moved through activity associated with the Snowy Mountains SAP should be returned to Country in a timely manner. This could involve housing the artefacts at a suitable keeping place or reburying the artefacts close to where they originated.

F8.2.8 Interpretation strategies

Interpretation opportunities should be explored across the alpine precincts.

F8.2.9 AHIMS corrections

This assessment notes that site 62-1-0174 (Thredbo Terrace 1) plots to a highly modified landform in central Jindabyne and probably has the wrong coordinates in the Aboriginal Heritage Information Management System (AHIMS) register. OzArk undertakes to investigate this further and update the AHIMS register with the correct coordinates should this be possible from available information.

It has also been noted that some supposedly 'valid' AHIMS sites plot to modified landforms. The actual status of these sites should be confirmed prior to any impact. They may have, for example, been previously salvaged under permit but the AHIMS register has not been updated.

F9 Shared heritage

F9.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Special Activation Precinct Historic Heritage Assessment* (Historic Heritage Study) (OzArk Environment & Heritage, 2022a).

F9.2 Assessment outcomes

Based on the results of the heritage survey undertaken as part of the Historic Heritage Study, and the updated historic heritage mapping, recommendations to conserve heritage values in the survey areas are presented below. These recommendations are high-level as specific impacts are not known at this stage, although it is expected that historic heritage will be managed through an amended Precincts-Regional SEPP:

- if development is planned in any landform identified in the heritage report as 'unsurveyed', historic heritage
 assessment should take place following relevant guidelines. This assessment may involve a visual inspection of the
 impact area to ensure significant historic heritage items are not harmed
- it is recommended that targeted heritage studies be undertaken, particularly within the alpine village, to identify current heritage values at areas included in the Alpine DCP. Such a study would help inform the recommendations that are set out in this report by identifying and documenting the heritage values of individual buildings. Such a study would update Lucas 1997, Freeman 1998, and Tropman 1998.

F9.2.1 Development in areas administered by the Precincts-Regional SEPPs

- Development controls relating to heritage should follow the heritage conservation objectives set out in the Precincts-Regional SEPP. These objectives include:
 - a heritage impact assessment should be undertaken if development activity (other than except development) is proposed
 - (a) on which a heritage item is situated, or
 - (b) that is a heritage item, or
 - (c) adjacent to land referred to in paragraph (a) or (b).
 - it is emphasised that development adjacent to a listed heritage item can also have a detrimental impact on the heritage values of the item and that these impacts require assessment (as per paragraph (c)) prior to the development proceeding
- development within the alpine resorts to or near all items listed in table 5.1 of the historic heritage report as having 'high' or 'likely' heritage values should be considered as warranting a heritage impact statement

- development in any of the identified heritage precincts (confined to the Thredbo Alpine Resort, Charlotte Pass Alpine Resort, and the Perisher Range Alpine Resort) must consider the impact on the identified heritage values of that precinct (Section 5.2 of the historic heritage report). Consideration of the scale, the use of sympathetic fabric, the retention of open space, and the use of sympathetic architectural styles of any new development on the existing heritage values of the precinct must be made
- development within the Thredbo Alpine Resort, Charlotte Pass Alpine Resort, and the Perisher Range Alpine Resort must consider the overall heritage values of the villages (Section 5.3 of the historic heritage report). Any new development in these villages must consider the existing scale and character of the villages, the need to preserve existing open spaces, and the need to preserve significant existing view lines to important heritage items within the villages
- the NSW Heritage Council must be informed of any development that plans to demolish an item on the NPWS s170 Heritage & Conservation Register.

F9.2.2 Strategic mapping

The strategic mapping presented in section 7 of the historic heritage report should be used as a guide for future development. The following principles should be followed:

- development within areas defined as 'disturbed land' can proceed without further historic cultural heritage investigation, except the impact of any new development on neighbouring heritage items or precincts should be considered
- development within areas defined as 'low potential' should be assessed at a time when the impacts are known. This
 assessment may involve a visual inspection of the impact area and due diligence research to ensure that historic
 heritage values will not be harmed. In particular, the impact of any new development on neighbouring heritage items
 or precincts should be considered
- development in areas defined as 'high risk', 'moderate risk' or are located in an identified heritage precinct (identified in section 5.2 of the historic heritage report), requires further heritage assessment where the development is likely to materially have a major effect on a heritage item or its value.

F9.2.3 Development controls

- The following development controls should be applied to development to or near any areas assessed as having 'high' or 'moderate' risk (identified in section 7 of the historic heritage report):
 - development is considered to have a materially major effect if it involves:
 - the full or partial demolition of a building
 - major alterations or additions
 - major adverse impacts, such as the removal of significant fabric, obscuring key views or dominating a heritage item, or the removal of evidence of significant historical associations
 - impact to significant archaeological deposits

- development in areas defined as 'high risk' or 'moderate risk' (identified in section 7 of the historic heritage report) requires further heritage assessment where the development is likely to materially have a minor effect on a heritage item or value. Development is considered to have a minor affect if it involves (but is not limited to):
 - repairs or restoration to fabric
 - installation of fire safety equipment
 - installation of disabled access
 - replacement of awnings, balconies, etc
 - installation of signage or fencing
 - excavation of areas without archaeological potential
 - erection of temporary structures
 - installation of safety and security equipment
- activities that do not harm the heritage values of an item in areas defined as 'high risk' or 'moderate risk' would not require further assessment. Such activities may include:
 - cleaning and maintenance
 - painting
 - replacement of existing elements following the like-for-like principle
 - gardening and minor landscaping. This would exclude the removal of mature trees
- where development is likely to materially have a major effect on a heritage item or value, further heritage assessment is required. This heritage assessment includes:
 - a visual inspection to determine the existing heritage values
 - an archaeological assessment (if appropriate)
 - preparation of a Statement of Heritage Impact
- where development will have minor effect on a heritage item or value, a heritage assessment may be required. This heritage assessment may include:
 - a visual inspection to determine the existing heritage values
 - an archaeological assessment (if appropriate)
 - use of a previously prepared heritage study if applicable
- a heritage assessment for any development that is likely to have a materially major or minor effect on a heritage item or its value must:
 - identify the impacts to the heritage values of an item or place
 - demonstrate the need for the impact and how alternatives to the impact have been considered
- demonstrate how the adverse impacts will be minimised or mitigated.

F10 Infrastructure

F10.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Special Activation Precinct Technical Study Report – Engineering – Infrastructure* (Infrastructure Study) (WSP, 2021e).

F10.2 Assessment outcomes

Table F.3 provides a summary of the infrastructure requirements to meet future demand and delivery of the snowy Mountains Master Planning. The implementation of these upgrades would allow for the modifications (increases) to the current capacities (bed limits) within the alpine precincts and to appropriately manage the expected growth in visitation.

 Table F.3
 Snowy Mountains SAP infrastructure considerations

	Thredbo	Perisher	Others
Water Infrastructure	 upgrade the existing water treatment plant to increase capacity from an approximate 481 kl/d peak day demand to of 911 kl/d, considering practicality, economics and environmental feasibility significant network upgrades will also be required to extend the network services to the new development areas within Thredbo. 	 upgrade the existing water treatment plant to increase capacity from an approximate 352.6 kl/d peak day demand to of 821.6 kl/d significant network upgrades will also be required to extend the network services to the new development areas within Perisher. 	 it is understood (based on anecdotal information only) that Charlotte Pass has no reservoir storage and relies on storage in the weir/river source, which is unreliable in summer. It is recommended that a new storage reservoir is installed to enable the expansion of Charlotte Pass in both Winter and Summer season. (note: the feasibility of this has not been investigated).
Wastewater infrastructure	major upgrade (assumed complete replacement) of the existing STP and amendment of effluent discharge license arrangements is required to cater for the proposed level of growth. Investigation is required to understand the required timing for this this upgrade and possible staging	 the current discharge license limit and STP capacity of 2000 kL/day will be reached. Upgrades required (constrained by space) significant network upgrades will also be required (subject to further investigation) use of recycled water for snowmaking should be considered (refer to section 6.1.3.3 of the Infrastructure Study) consider privatisation of wastewater treatment facilities. 	 Sawpit creek (Kosciuszko tourist Park requires new discharge to be created direct to Sawpit Creek (subject to EPA approval) Charlotte Pass STP is aging and requires further assessment or replacement Ski Rider resort requires onsite STP consider privatisation of wastewater treatment facilities.

	Thredbo	Perisher	Others
	 significant network upgrades will also be required (subject to further investigation) use of recycled water for snowmaking should be considered (refer to section 6.1.3.3 of the Infrastructure Study) consider privatisation of wastewater treatment facilities. 		
Stormwater Infrastructure	 sealing of unsealed roads with concrete pavement develop plan to increase the amount of kerbed road and construct piped drainage system. 	 continuation of the sealing of all internal roads between resort areas develop plan to increase the amount of kerbed road and construct piped drainage system. 	 Sponars Chalet and Kosciuszko tourist park require an additional 1.6 MVA to support development.
Electricity	 additional 1x5 MVA transformer to provide capacity for future demands new 11 kV reticulation will likely be required to the new growth areas as the capacity of these distribution feeders are unknown at this stage consideration of renewable energy technologies. 	 additional 1x20 MVA transformer to provide capacity for future demands expansion of substation to accommodate a new transformer potential new 11 kV feeder to the development site of the car park relocation of 11 kV line at car park to accommodate development proposal or location of solar farm replacement of existing switchgear in the substation by September 2022 consideration of renewable energy technologies. 	 Sponars Chalet and Kosciuszko tourist park require an additional 1.6 MVA to support development an upgrade of 5 MVA to the distribution transformer to accommodate the additional demand at the Bullocks flat substation consideration of renewable energy technologies.
Gas	 no upgrades have been proposed. 	 no upgrades have been proposed. 	 no upgrades have been proposed.
Telecommunications	 no upgrades have been proposed. 	 no upgrades have been proposed. 	 fibre connection to be established throughout the SAP area targeted towards growth areas.

F11 Sustainability

F11.1 Basis of assessment

This section provides a summary of the outcomes of the *Snowy Mountains Special Activation Precinct: Ecologically Sustainable Development (ESD) Plan* (ESD Plan).

F11.2 Assessment outcomes

Table F.4 provides a summary of the key ESD outcome which have been incorporated into the Snowy Mountains SAP Master Plan and would be incorporated into the Alpine DCP and EMS. Due to the characterises of the ESD themes, some themes are covered in greater detail in other sections of this report.

Table F.4 ESD principles to be embedded in the design and implementation of the Snowy Mountains SAP

ESD themes	ESD opportunities
Climate resilience	 transition alpine resorts most vulnerable to climate change to alternatives to snow-based tourism, by developing year-round growth scenarios for the resorts implement urban design, infrastructure and building standards to increase climate resilience.
Emissions	 develop a framework for reducing emissions with options for energy efficiency, renewable energy and circular economy opportunities incorporated emissions calculators are used to test development scenarios to plan zero emissions pathways for development.
Energy	 develop opportunities for 100% renewable Power Purchase Agreement (PPAs) to enable redevelopment projects to be powered by renewable energy and to enable existing developments to be decarbonised over time support solar PV and battery storage systems on a smaller scale to support individual development where viable integrate energy efficiency and productivity into development design guidelines, with whole of lifecycle emissions considered.
Environment	 touch the ground lightly is the overarching theme for new buildings and infrastructure green infrastructure embedded into urban design develop existing buildings and previously developed sites consider the environmental impacts of all proposed new infrastructure and building development and develop sustainable design principles and benchmarks for the region.
Society	 priorities community and visitor health and wellbeing through inclusion of wellbeing principles in all development develop opportunities for 'wellness' tourism and eco-tourism create opportunities for social infrastructure celebrate heritage, inclusion and diversity.
Mobility	 work towards a fully integrated transport model prioritising Park and Ride facilities for access to alpine precincts promote zero emissions transport and infrastructure, prioritising public transport options.
Circular Economy	 support waste management and recycling infrastructure develop promote circular economy relationships between Snowy Mountains SAP businesses.

ESD themes	ESD opportunities
Water	 an integrated water cycle is established based on water sensitive urban design (WUSD) principles, including better management of stormwater quality and quantity new water infrastructure and urban planning should incorporate water sensitive urban design wastewater treatment systems in the alpine areas should be upgraded to closed loop systems with no pollution to alpine streams build capture and reuse infrastructure should be included in all new developments.
Leadership	 develop an overarching EMS for all development within alpine precincts, which is integrated with the CCF, KNP PoM and alpine resort EMS encourage new developments within the Snowy Mountains SAP to develop an EMS to control the environmental aspects of the development develop a framework for sustainable design and certification of new development and building assets.

Appendix G

Assessment of climate change risks to Kosciuszko National Park values



G1 Background

Climate change is projected to create significant challenges for the NSW Alpine Region, some of which may contribute to strains on the carrying capacity¹ of the Kosciuszko National Park (KNP) within the Snowy Mountains SAP region. The purpose of this Appendix is to:

- summarise relevant climate change projections for Snowy Mountains SAP Region and KNP
- identify climate change risks that may impact the carrying capacity of the KNP and analyse how these might influence existing Environmental Management System (EMS) Key Performance Indicators (KPIs)
- investigate the implications of changes in climate variables, such as increases in temperature and reduced natural snowfall, on the demand for artificial snowmaking and estimate flow on impacts to energy and water demand of Alpine resorts where snowmaking is conducted
- provide recommendations for how climate change and its potential impacts could be considered in the development
 of future guidelines for managing visitor impacts and the carrying capacity of KNP.

G2 Climate change projections

In 2018/2019 the NSW Department of Planning, Industry and Environment (DPE) carried out a detailed study of models produced as part of the NSW/ACT Regional Climate Modelling (NARCLiM) project. The purpose of the study was to provide annual, monthly and seasonal future climate projections specifically for the Alpine Region and surrounds.

Climate projections are based on different scenarios reflecting how future anthropogenic greenhouse gas emissions may change over time. The NARCLiM simulations align with the Intergovernmental Panel on Climate Change (IPCC) *Fourth Assessment Report* (AR4, published in 2007) which was the latest set of emissions scenarios at the time NARCLiM commenced in 2010. The NARCLIM project adopted a single emissions scenario, the Special Report on Emission Scenarios (SRES) A2 scenario, to inform their simulations. This scenario was considered the most likely scenario based on the trajectory of global emissions.

The more recent *IPCC Fifth Assessment Report* (AR5) uses Representative Concentration Pathways (RCPs) to illustrate different emissions scenarios. For the latter half of the 21st century SRES A2 has a similar trajectory to that of the high emissions scenario, RCP 8.5, which aligns most closely with the current trajectory of global emissions (Adapt NSW, 2020).

Table G.1 summarises the climate change variables relevant to this assessment, as well as baseline conditions (average over years 1990-2009, i.e. 2000), and projections for the near future (2030) and far future (2070) for the Snowy Mountains SAP Region. This data has been collated from written content and the interpretation of mapping within the DPE Climate Change Impacts in the NSW Alpine Region reports. Ranges in baseline and projection data have been provided due to the spatial extent and variability in altitude within the region, which influences baseline and projection data.

Further detail on the projections are available from the listed source reports.

¹ The definition of carrying capacity can be found in Section 3.1 of the Kosciuszko National Park Plan of Management – Carrying Capacity – Framework Development.

Table G.1	Climate Change Projections for the Snowy SAP Region	
	Chimate Change i Tojections for the Chowy CAL Region	

Climate variable	BaseLine (2000)	Near future (2030)	Far future (2070)
Temperature			
Mean Maximum Temperature (°C) – Annual ¹	10 to 13	+ 0.5 to 1	+2 to 2.5
Mean Max Temperature (°C) – Summer ¹	16 to 20	+0.5 to 0.75	+2 to 2.5
Mean Max Temperature (°C) – Autumn ¹	10 to 14	+ 0.5 to 0.75	+2 to 2.5
Mean Max Temperature (°C) – Winter ¹	< 8	+ 0.5 to 0.75	+2 to 2.5
Mean Max Temperature (°C) – Spring ¹	10 to 14	+ 0.5 to 0.75	+ 2.5 to 3
Days over 35 °C ¹	0 to 5	0 to 1	+0 to 2
Mean minimum temperatures (°C) ¹	< 2	+ 0.5 to 0.75	+1.5 to 2
Cold nights (below -2 °C) ¹	>110 days	- 13	-20
Precipitation and Snowfall			
Mean Precipitation Change (%) – Annual ¹	1200 to 1800 mm	0 to -5	-5 to -10
Mean Precipitation Change (%) – Summer ¹	300 mm	0 to -5	-5 to 5
Mean Precipitation Change (%) – Autumn ¹	250 mm	0 to 5	+5 to 10
Mean Precipitation Change (%) – Winter ¹	>450 mm	0 to -10	-10 to -20
Mean Precipitation Change (%) – Spring ¹	400 mm	-5 to -10	-20
Snowfall (%) ²	2-5 mm/d	-13	-60
Fire			
McArthur Forest Fire Index (FFDI) (%) ³	0 to 2 (unitless)	+5	+ 5 to 10
Wind			
Mean maximum daily wind speeds (%) ¹	>20 m/s	0 to -4	0 to -6

(1) DPIE, 2018a, Climate Change Impacts in the NSW Alpine Region – Projected Climate in the NSW Alpine Region. Department of Planning, Industry and Environment, Sydney, 2018.

(2) Di Luca, A. Evans, J. Ji, F. Australian Snowpack: NARCLiM ensemble evaluation, statistical correction and future projections, Climate Change Research Centre, UNSW, Sydney, 2017.

(3) DPIE, 2019, Climate Change Impacts in the NSW Alpine Region – Impacts on fire weather. Department of Planning, Industry and Environment, Sydney, 2019.

Key observations from Table G.1 include:

- increase in mean maximum temperatures in the near and far future across all seasons
- large decreases in the number of cold nights (-2°C) and increases in mean minimum temperatures
- more dry days with large reductions in precipitation in winter and spring
- projected reduction in precipitation is greatest in winter and spring and significant reductions in natural snowfall are expected during the snow season
- increases in the annual mean Forest Fire Index.

G3 Climate change risks to Kosciuszko National Park values

To inform the development of a carrying capacity Framework for the Kosciuszko National Park Plan of Management – Carrying Capacity, WSP has carried out a preliminary climate change risk identification process to highlight the ways in which climate change may affect the carrying capacity of the KNP in future. These risks have then been linked the existing Environmental Management System (EMS) Key Performance Indicators (KPIs) used to manage environmental, social and cultural impacts from visitor use of Alpine Resort Areas.

The purpose of this process is to highlight how these climate change risks could influence existing KPIs, either by altering KPI baselines or influencing the ability for these KPIs to be achieved by alpine resort management and/or National Parks and Wildlife Services (NPWS). This process would assist in driving a more detailed consideration of climate change impacts in the establishment of future guidelines for managing visitor impacts and the carrying capacity of KNP.

The following documents have been used to inform this process:

- DPIE, 2019, Climate Change Impacts in the NSW Alpine Region Projected changes in snowmaking conditions. Department of Planning, Industry and Environment, Sydney, 2019.
- DPIE, 2019, Climate Change Impacts in the NSW Alpine Region Impacts on fire weather. Department of Planning, Industry and Environment, Sydney, 2019.
- DPIE, 2018a, Climate Change Impacts in the NSW Alpine Region Projected Climate in the NSW Alpine Region. Department of Planning, Industry and Environment, Sydney, 2018.
- DPIE, 2018b, Climate Change Impacts in the NSW Alpine Region Water availability. Department of Planning, Industry and Environment, Sydney, 2018.
- DPIE, 2018c, Climate Change Impacts in the NSW Alpine Region Impacts on biodiversity. Office of Environment and Heritage, Sydney, 2018.
- DPIE, 2020, Summary of the condition of the values of Kosciuszko National Park 2006-2016, Department of Planning, Industry and Environment, Sydney, 2020.
- Note it was not the aim of this process to conduct an overarching climate change risk assessment for the KNP in accordance with AS5334:2013 Climate change adaptation for settlements and infrastructure—A risk based approach. This forms part of the Ecologically Sustainable Development (ESD) analysis being undertaken by DSquared Consulting.
| Risk id | Risk identification | | | Timeframe for impact | | | Potential for impact to carrying capacity Key
Performance Indicators | | |
|------------|--|--|---|----------------------|--|--|---|--|--|
| Risk
ID | Climate variable or hazard | Impact category | Summary of climate related risk | Current | Near
future | Far
future | Relevant carrying
capacity indicator(s) | Description of potential impact on carrying capacity | |
| 1 | TemperatureEconomic/financialIncreased temperatures,
particularly in winter,
and changes to
precipitation patterns are
projected to result in
reduced natural snowfall.
To maintain the existing
ski season conditions,
substantially more
artificial snow will need
to be produced, resulting
in increased water and
energy demand, as well
as increased greenhouse
gas emissions associated
with the energy source. | X | X | X | Water quality and
aquatic ecosystem (KPI
W 2,4 related to water
consumption and
extraction). | An increase in alpine resort water
consumption could result in extraction
license limits being breached. | | | |
| | | | reduced natural snowfall.
To maintain the existing
ski season conditions,
substantially more
artificial snow will need
to be produced, resulting
in increased water and | | | | Energy conservation
(KPI E1 related to total
consumption of energy). | An increase in Alpine resorts' energy
consumption would likely occur. This
increases the importance of monitoring
energy consumption in the region.
New KPI with associated targets could
be developed to drive energy
efficiency. | |
| | | as increased greenhouse
gas emissions associated
with the energy source. | | | | Resort amenity (KPI
Am2 related to visual
impacts). | Reduced snowfall is likely to have a negative impact on visual amenity which would impact the baseline of Am2. | | |
| | | | | | | Air Quality and CO ₂
Emissions (KPI AQ1
related to CO ₂
emissions). | CO ₂ emissions associated with Alpine
resorts would likely increase, unless
renewable energy sources are used to
meet additional snowmaking
requirements. New renewable energy | | |

Table G.2 Climate change risks to Kosciuszko National Park values

KPI with associated targets could be

developed to drive emission

reductions.

Risk id	Risk identification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators		
Risk ID	Climate variable or hazard	Impact category	Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity	
2	Temperature	Tourism/visitor experience	Increased temperatures may impact the numbers of hours per year where artificial snowmaking can occur. Current technology can make snow at slightly warmer temperatures; however, at an increase in energy demand, cost and impact to snow quality.		X	X	Energy conservation (KPI E2,3,4 related to energy consumption and energy efficiency initiative). Air quality and CO2 emissions (KPI 2 related to renewable energy).	As per risk 1 above	
3	Precipitation	Ecosystems and biodiversity	Changing precipitation patterns are projected to result in a decrease in surface runoff and groundwater recharge, particularly in the alpine region, predominantly during the winter and spring months. This could result in reduction in water levels in waterways.		X	X	Water quality and aquatic ecosystems (KPI W1 related to resort stream health and biological conditions of waterway).	Changes to water levels could alter waterway flow rates, impacting water quality and biological conditions and the baseline of W1.	

Risk id	lentification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators	
Risk ID	Climate variable or hazard	Impact category	Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity
4	Precipitation	Water availability	Changing precipitation patterns are projected to result in a decrease in surface runoff and groundwater recharge particularly in the alpine region, this could impact the amount of water available for extraction for agriculture, snowmaking and industrial, commercial and domestic water supply.		X	X	Water quality and aquatic ecosystems (KPI W2, W4 related to water extraction licences and water consumption).	Extraction licenses may need to be reduced over time due to reduced water availability which could impact Alpine resorts' ability to produce enough artificial snow to meet their needs. Reduction in extraction licenses could also restrict potential to accommodate future developments.
5	Precipitation	Ecosystems and biodiversity	The alpine areas of NSW are typically considered to have low or very low salinity levels. Changing rainfall patterns, resulting in less runoff, may result in lower salinity dilution, especially in the alpine region.		X		Water quality and aquatic ecosystems (KPI W1 related to resort stream health and biological conditions of waterway). Biodiversity (KPI B8 related to riparian restoration).	Increased salinity levels could impact baseline salinity levels in waterways. The increased salinity could potentially impact the success of riparian restoration projects.

Risk id	Risk identification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators		
Risk ID	Climate variable or hazard	Impact category	Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity	
6	Precipitation	Ecosystems and biodiversity	The projected decrease in surface runoff due to changing rainfall patterns could increase the vulnerability of NSW's Alpine wetlands such as Blue Lake, which is a Ramsar listed wetland.		X	X	Water quality and aquatic ecosystems (KPI W1 related to resort stream health and biological conditions of waterway). There is no existing Biodiversity KPI that deals with wetlands or certain native vegetation communities.	The potential impacts of reduced surface run-off on wetland could be captured either as an additional element of existing KPI or development of new KPI.	
7	Temperature	Ecosystems and biodiversity	Increasing average and extreme temperatures and other secondary effects may cause a shift in vegetation species composition in alpine areas (a 21% to 70% change in composition is anticipated). High altitude species are expected to decrease in area with low altitude species considered likely to expand into high altitude areas.		X	X	Biodiversity (KPI B1, B2, B3 related to threatened species population and small mammal management). *There is no existing Biodiversity KPI that deals with specific native vegetation communities.	This risk would likely reduce habitat availability for several endangered and threatened fauna species and could cause other species to become threatened. This would impact the ability to protect species listed under B1, B2 and B3 and could cause more species to be added to this list, therefore management approaches to protect these species should be reviewed. Additional element under existing KPI or new biodiversity KPI could also be developed if required.	

Risk id	lentification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators	
Risk ID	Climate variable or hazard	Impact category	Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity
8	Temperature	Ecosystems and biodiversity	Increases in temperatures may result in some species and their habitats migrating to higher altitudes. This may result in fauna species competing for resources as they migrate into areas already inhabited by high altitude species that are unable to migrate further.		X	X	Biodiversity (KPI B1, B2, B3 related to threatened species population and small mammal management). *There is no existing Biodiversity KPI that captures species migration or vegetation species and communities.	This could impact the ability to protect species listed under B1, B2 and B3 and could cause more species to be added to this list, therefore management approaches to protect these species should be reviewed. Additional element under existing KPI or new biodiversity KPI could also be developed if required.

Risk id	Risk identification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators		
Risk ID	Climate variable or hazard	Impact category	Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity	
9	Temperature	Ecosystems and biodiversity	Increases in temperatures may result in some species and their habitats migrating to higher altitudes. The rate of change is projected to be slower for alpine areas compared to other parts of NSW, which would provide species more time to adapt and migrate. However, for some species, increased clearing for new roadways, accommodation and other facilities may reduce connectivity corridors required to enable the migration.		X	X	Biodiversity (BPI B1, B2, B3 related to threatened species population and small mammal management and KPI B5 related no net loss of biodiversity value as a result of development). *There is no existing Biodiversity KPI that captures species migration and protection of connectivity corridors.	Future developments/infrastructure proposed for the SAP region could result in loss of biodiversity value. Additional elements under existing KPI 5 or new development controls could be developed to address maintenance of connectivity corridors.	

Risk id	Risk identification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators		
Risk ID	Risk Climate variable Impact category Summary of related risk		Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity	
10	Temperature/ Rainfall/Bushfire	Ecosystems and biodiversity	Warmer and drier conditions are projected to increase the severity and frequency of bushfires within low altitude species such as Grassy Woodlands and Dry Sclerophyll Forests.		X	X	Biodiversity (KPI B1, B2, B3 related to threatened species population and small mammal management). B1 and B2 have the potential to capture post- fire recovery trends. *There's no existing Biodiversity KPI that deals with specific native vegetation communities. There's no existing KPI that deals directly on bushfire.	Damage to habitat and connectivity corridors for native fauna species could impact the ability to protect species listed under B1, B2 and B3 and could cause more species to be added to this list, therefore management approaches to protect these species and their habitats should be reviewed. KPI B1 and B2 have the potential to capture post-fire recovery trends. An additional element under existing KPI or new biodiversity KPI could be developed to capture impacts related to fauna and flora resilience to bushfire conditions.	
11	Temperature	Ecosystems and biodiversity	Climate change is considered likely to exacerbate the presence of weeds, pests and feral animals that impact natural values of the park.		X	X	Biodiversity (KPI B4, B5 related to pest animal control program and weed management program).	KPI B4 and B5 may need to be strengthened in both frequency and intensity of monitoring and control program.	

Risk id	Risk identification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators		
Risk ID	Climate variable or hazard	Impact category	Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity	
12	Temperature/ Precipitation	Tourism/visitor experience	Increasing temperatures and changing rainfall patterns that alter and degrade the natural value of the KNP (vegetation, wildlife and waterway health) may reduce the aesthetic value of the KNP and surrounds.			Х	Resort amenity (KPI Am2 related to visual impacts). *There is no existing KPI that explicitly focuses on visitor experience.	This risk could negatively affect visitor experience across all seasons and in the long-term may influence whether tourists continue to return to the area. If required, a new KPI focusing on visitor experience could be developed to monitor negative impacts in relation to aesthetic values.	
13	Temperature/ Rainfall/ Bushfire	Tourism/visitor experience	Increased risk of bushfire may result in changes to development approval requirements, restricting what can be built and the proximity to wilderness areas.			X	Resort Amenity (Am2 related to visual impacts). *There is no existing KPI that explicitly focuses on visitor experience. There is no existing KPI that directly deals with bushfire risk.	In addition to approvals implications, many visitors to the reason specifically seek accommodation in close proximity to vegetation. Changes to requirements for safety clearance zones could affect the ability to provide for this visitor preference. If required, a new KPI related to visitor experience and consideration of bushfire risk on development approval requirements could be prepared.	

Risk id	Risk identification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators		
Risk ID	Climate variable or hazard	Impact category	Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity	
14	Temperature	Alignment with policy or legislation	State and local council targets to transition towards net zero carbon emissions place more pressure on industries to improve energy efficiency, reduce reliance on fossil fuels and explore opportunities to generate energy. Increased temperatures are likely to result in increased greenhouse gas emissions associated with energy demand for artificial snowmaking in the winter (as discussed above), and cooling for tourist accommodation, local residents and		X	X	Energy conservation (KPI E2,3,4 related to energy consumption and energy efficiency initiative). Air quality and CO ₂ emissions (A2 related to renewable energy).	An increase in energy consumption in the region would affect the region's ability to achieve net zero targets. New KPI with associated targets could be developed to drive energy efficiency. CO ₂ emissions within the SAP region would likely increase, unless renewable energy sources are used to meet additional snowmaking requirements.	

Risk id	entification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators		
Risk ID	Climate variable or hazard	Impact category	Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity	
15	Temperature/ Precipitation	Tourism/visitor experience	Increased temperatures and reduced rainfall could result in more temperate and clear days for summer tourism activities such as		Х	X	Sustainable recreation (KPI R1, R2 related to promotion of sustainable recreations and monitoring of key recreational activities).	Increased temperatures and reduced rainfall could extend the summer tourist season into the shoulder seasons, increasing economic growth during the currently quiet times of the year.	
			kayaking, bushwalking, birdwatching.					KPI R1 and R2 are likely to be able to capture the changes; however, there might be a need to update details to capture more of the summer tourism activities.	
16	Increasing atmospheric carbon emissions	Alignment with policy or legislation	Emissions from transportation comprise a significant percentage of NSW's greenhouse gas emissions. The most common current approach to accessing the SAP involves travelling significant distances by private vehicle, which are currently predominately fuelled by fossil fuels.		X	X	Air quality and CO_2 emissions (A1 related to amount of CO_2 , A2 related to renewable energy and A3 relates to use of ski bus).	Vehicle emissions may become increasingly incompatible with NSW's shift to net-zero greenhouse gas emissions by 2050. It is difficult to predict how this risk will play out in the future due to a range of competing factors, such as the rate of technological advancement (e.g. electric; hydrogen fuel cells), oil prices, and future policy settings. New KPI with associated targets could be developed to drive measures that enable emission reduction, such as electric vehicle charging infrastructure.	

Risk id	Risk identification			Timeframe for impact			Potential for impact to carrying capacity Key Performance Indicators	
Risk ID	Climate variable or hazard	Impact category	Summary of climate related risk	Current	Near future	Far future	Relevant carrying capacity indicator(s)	Description of potential impact on carrying capacity
17	Increasing atmospheric carbon emissions	Alignment with policy or legislation	Emissions from transportation comprise a significant percentage of NSW's greenhouse gas emissions. In the absence of significant technological advances, encouraging additional air travel by the construction of an airport in Jindabyne would likely increase transportation CO ₂ emissions.		X	X	Air quality and CO ₂ emissions (A1 related to amount of CO ₂).	The additional air travel may not align with NSW's planned shift to net-zero greenhouse gas emissions by 2050.

Table G.2 illustrates that a range of climate change risks have the potential to influence the carrying capacity of the KNP, as well as relevant existing EMS KPIs that have been prepared to manage environmental, social and cultural impacts from visitor use of Alpine Resort Areas. There is the potential to integrate more detailed consideration of climate change impacts in the establishment of future guidelines for managing visitor impacts and the carrying capacity of KNP. Key areas of focus for future guidelines could include:

- increased focus on monitoring energy, water, CO₂ emissions and use of renewable energy, with the potential to implement additional KPIs that introduce reduction targets
- additional biodiversity KPIs that address the protection of native vegetation communities, protection of connectivity corridors and resilience of ecosystems to bushfire risk
- stronger focus on KPIs that relate to pest and weed management
- additional focus on the impacts of climate change on visitor/user experience
- consideration of bushfire risk on future development approval
- consideration of alignment with policy and legislation aimed at driving the transition towards net zero carbon emissions.

G4 Implications of climate change on snowmaking and flow-on impacts for energy and water consumption

G4.1 Summary of snowmaking practices

Artificial snowmaking is currently used in Australia and around the world to complement natural snowfall and extend the ski season. Typically, artificial snowmaking in the alpine resort areas commences in early May and continues through to August. Snowmaking may continue into September depending on snow coverage and weather conditions (Thredbo Resort, pers. comm. 19 August 2020).

Snowmakers generally operate from late afternoon through to the early morning, during periods when optimal ambient snowmaking conditions occur (below -2°C wet bulb). Snowmakers may run 24 hours a day if required (Perisher Resort, pers. comm. 20 August 2020).

Snowmaking is an energy and water intensive process and makes up a significant amount of winter energy and water demand at Perisher and Thredbo resorts. The most common snowmaking technologies currently used at NSW Alpine resorts are air/water guns, lance guns and fan guns. A description of each technology and discussion of energy efficiency is outlined below:

- Air/water gun: Pressurised air is used to break a stream of water into fine particles that are then propelled into the air and freeze due to the pressure change as they come in contact with ambient cold air. Useful for producing bulk snow as it produces more concentrated snow. Air/water guns are considered the least energy efficient.
- Lance gun: Uses the same process as air/water guns with an advanced nucleator head to create smaller droplets and a long boom/lance that increases the amount of time the droplets are in the air, allowing more time to freeze prior to falling to the ground ('hangtime'). Lance guns are typically better to use in more marginal conditions, where an increase in hangtime assists in the freezing process. Lance guns can be up to ten times more efficient than traditional air/water guns (Perisher Resort, pers. comm. 20 August 2020).

- Fan gun: A stream of water is fed into an airflow that is produced by a fan that breaks the water into fine particles that are then propelled into the air. Fan guns produce snow across a more dispersed area; however, this can be more difficult to manage on windy days. Fan guns have a longer throw length that increases the hangtime of droplets. These are therefore typically better for use in marginal conditions. Fans guns tend to be more energy efficient that air/water and lance guns.
- Thredbo Alpine Resort currently has 321 automated lance guns, 163 manual hydrants that can take a variety of type of guns and four fan guns in operation (Thredbo Resort, pers. comm. 16 August 2020).
- Perisher Alpine Resort has a mixture of 236 snow guns (Perisher Resort, pers. comm. 20 August 2020) a breakdown to technologies was not provided.

G4.2 How could climate change influence snowmaking?

Projected increases in temperature and changes to precipitation patterns are projected to reduce the amount of natural snowfall in the NSW Alpine Region, as outlined in Table G.1. A reduction in natural snowfall has already been observed and the rates of snowfall are projected to continue to decline in the near and far future, presenting an existential threat to the future of Alpine resorts in the Snowy Mountains SAP. Maintaining existing snow conditions in NSW's Alpine Region would require a significant increase in artificial snow, which may drive an increase in energy and water demand. The snowmaking technologies described above are reliant on ambient temperatures and therefore their performance is susceptible to the effects of climate change.

Figure G.1 illustrates the main climate change influences, identified through desktop review and correspondence with ski fields, that may affect artificial snowmaking and the anticipated flow-on impacts to water and electricity demand.



Figure G.1 Key climate change influences that may impact artificial snowmaking (developed by WSP) The following sections provide some additional detail on the key effects on snowmaking shown above.

G4.2.1 Greater volume of artificial snow required

A reduction in natural snowfall and an increase in snowmelt caused by projected increased ambient temperatures is likely to drive an increase in artificial snowmaking to replace the lost natural snow cover and maintain conditions expected by resort users.

Snowpack, which refers to the mass of snow that is compressed and hardened as snow falls in high altitude regions, forms the foundation of all ski fields. Deluca, Evans and Ji (2017) have calculated projected changes in snowpack based on NARCliM projections. They found that reduced rates of natural snowfall and accelerated snowmelt due to increased temperatures are projected to reduce snowpack conditions including snowpack cover, depth and snow season duration by approximately 20% in the near future (2030) and 60% in the far future (2070) from a baseline period of 1990 to 2009 (2000).

These projections form the basis for calculations of future energy and water demand from snowmaking provided in Section G4.3. However, it should be noted that these snowpack projections are averages for the alpine region – elevation changes can significantly influence climatic factors such as temperature and rainfall. Research by Deluca, Evans and Ji suggests that more significant decreases in snowfall and snowpack may occur in lower elevations. Ski resorts or sections of ski resorts at lower elevations may see more significant reductions in snowfall and snowpack than the averages provided.

G4.2.2 Reduced efficiency in snowmaking equipment

Projected temperature increases are anticipated to reduce the number of hours for optimal snowmaking. Below -2°C (wet bulb) is considered the optimal temperature for artificial snowmaking (DPIE, 2019). Increased temperatures are projected to result in more than a 20% reduction in optimal snowmaking conditions is projected by 2030 and more than 60% by 2070 compared to a 2000 baseline (DPIE, 2019). As with projected changes in snowfall, artificial snowmaking conditions can also vary with elevation, with larger absolute decreases projected in higher elevations due to climate change, whereas larger relative decreases are projected at lower elevations (DPIE, 2019).

Current technology can make snow at slightly warmer temperatures; however, this reduces the efficiency of the snowmakers as the ratio of compressed air to water increases. The creation of compressed air causes the largest energy demand in the snowmaking process. Therefore, increased demand for compressed air increases energy consumption and, depending on the capacity of the compressor network, may limit the number of snow guns that can operate at the same time. The quality of snow is also impacted when producing snow at warmer temperatures using existing technologies (Perisher Resort, pers. comm. 20 August 2020).

A DPIE study outlines that if snow could be made at -1°C in near future and 0.5°C in the far future, opportunities for snowmaking may be able to be maintained at baseline (2000) levels (DPIE, 2019). From correspondence with ski field operators, snowmaking at warmer temperatures typically only occurs under extenuating circumstances due to impacts to efficiency and poor snow quality. It is therefore considered unlikely that existing snowmaking technologies will be viable in the far future to replace the projected reductions in natural snowfall with artificial snow.

Note there is a lack of data from manufacturers or Alpine resorts on the actual impact on water and energy efficiency of operating at higher temperatures. As such, this factor has been excluded from calculations of future energy and water demand from snowmaking in Section G4.3).

G4.2.3 Future shift in snowmaking technologies

Research and development into temperature independent snowmaking technologies, such as the 'Snowfactory' produced by TechnoAlpin, has increased in recent years with the aim of improving the reliability of snow cover at ski resorts. The Snowfactory uses refrigerant technology where a heat exchanger cools the water down to freezing point and breaks the ice into the desired particle size. This technology has been installed at Mt Buller and Mt Baw Baw in Victoria and a development application has been submitted for the implementation of one at Perisher. TechnoAlpin reports that the Snowfactory technology is designed to complement traditional snowmaking technologies, rather than replace them (Techno Alpin, 2020) and can be used to make 'wet snow', a denser snow that lasts longer and is typically used as the foundation of ski fields (Perisher Resort, pers. comm. 20 August 2020).

Data was unavailable to compare the water and energy use of the Snowfactory with technologies described in Section G4.1. Industry research is currently being conducted into the feasibility of recovering the heat energy that is produced by heat pumps used in the refrigerant system of temperature independent snowmaking technologies, which could then be used to heat nearby buildings. This recovered heat could be used to offset some of a resort's energy demands (Noguera, 2018).

An additional consideration for the use of Snowfactory technology is the reported use of salt to increase electrical conductivity in the snowmaking process. The NSW National Parks and Wildlife Service has raised concerns over the potential environmental impacts of this salt being discharged into the environment as this snow melts. It is understood that trials in New Zealand have shown that Calcium-Magnesium Acetate (CMA) to be a viable alternative (NSW National Parks and Wildlife Service per. comms. 24 July 2020).

Given the temperature constraints for the technologies described in Section 3.1, NSW Alpine resorts are likely to adopt temperature independent snowmaking technologies in future, particularly as costs decrease (Perisher Resort, pers. comm. 20 August 2020). Further technological advancements and improvements in capital and operational costs will determine whether temperature dependent and temperature independent snowmaking technologies will be viable to maintain existing snow conditions into the future.

G4.2.4 Water availability and pressure on social licence to operate

In alpine regions, both rainfall and snowmelt are key influences on seasonal waterway levels and recharge of aquifers. Commercial, industrial and residential consumers are heavily reliant on water extracted from waterways and aquifers, with ski resorts extracting a significant amount of water during the autumn and winter months for snowmaking purposes.

Table G.3 outlines the water extraction licenses, annual extraction limits and annual average usage recorded by DPIE for extraction licenses associated with snowmaking at NSW's two largest ski resorts – Perisher and Thredbo. The table also shows total estimated annual water usage for snowmaking as provided by the resorts; note there are some discrepancies between these figures and data recorded by DPIE.

Licence name / number	Annual extraction limit (ML) ¹	Annual average usage recorded by DPIE (2016-2019) (ML) ¹	Estimated usage provided by Alpine resort (ML)
Perisher			
Snowmaking Pump Station 3 (10 SL 57228 / WAL 38553)	137	120	unknown
Smiggin Creek/snowmaking (10 SL 57193)	50	15	unknown
Perisher Range Aqueduct (10 SL 57220)	710	315	unknown
Total	897	450	790 ²

 Table G.3
 Water extraction license limits and annual water usage for snowmaking

Licence name / number	Annual extraction limit (ML) ¹	Annual average usage recorded by DPIE (2016-2019) (ML) ¹	Estimated usage provided by Alpine resort (ML)
Thredbo			
Snowmaking pumping plant (WAL 39982)	260	250	unknown
Diversion channel snowmaking (WAL41189)	345	Not provided / unknown	unknown
Total	605 ML	250 ML	290 ML ³
Grand total	1502 ML	700 ML	1080 ML

(1) Alpine resorts' water extraction/access licenses and usage (2016-2019) data provided by DPIE

Indicative annual water usage for snowmaking provided by Perisher alpine resort for a typical year (Perisher Resort, pers. comm. 20 August)

(3) Annual average water usage for snowmaking provided by Thredbo Alpine resorts for financial years 2017/2018 and 2018/2019 (Thredbo Resort, pers. comm. 16 August 2020).

As shown in Table G.3, if adopting the water usage estimates provided by the alpine resort, Perisher already consumes a significant portion of its annual water extraction license. Similarly, Thredbo's snowmaking pumping plant (WAL 39982) also uses a significant portion of its water extraction license and was recorded as exceeding this in 2018–2019 (refer to Table 4-1, Technical Study Report: Engineering – Infrastructure (WSP, 2020)).

A study conducted by DPIE on climate change impacts to water availability in the NSW Alpine Region outlines that surface runoff and groundwater recharge in the high alpine regions is projected to reduce in the future. An estimated reduction of 40 mm/year in surface runoff and 100 mm/year in groundwater recharge is projected for the far future (2070) (DPIE, 2018b). These reductions have the potential to create a strain on the natural environment as well as on water available for extraction.

The majority of the water consumed for snowmaking returns to the environment as runoff; however, extracting a significant amount of water over a short period of time, particularly on already strained waterways and aquifers, can result in negative environmental impacts. In the mid- to far-future, there is a risk that resorts could lose their social licence to undertake snowmaking if other uses (e.g. agriculture) are seen as more essential.

While future water availability and social licence to operate are important considerations for resorts, they are not considered in future energy and water demand calculations in Section G4.3 below.

G4.3 Future changes to energy and water demand

Table G.4 outlines the existing annual energy and water demand associated with snowmaking at NSW's two largest ski resorts – Perisher and Thredbo – and provides a high-level estimate of near future and far future demands to replace the reduction of natural snowfall with artificial snow. This is based on a simplified assumption that the projected reduction in snowpack equates to the amount of artificial snow that would need to be produced, with a commensurate increase in energy and water demand to create the required artificial snow. The calculations also assume no change in use of snowmaking technology over this period. For the purposes of this assessment the more conservative water usage estimates (data provided by the Alpine resorts outlined in Table G.3) have been used to inform this analysis.

The baseline for the above projections is the year 2000. For the purposes of this analysis it has been assumed that a linear reduction in snowpack would occur over time and therefore 20 years of snowpack reduction has already occurred since the baseline period of 2000 to 2020, resulting in a remaining 7% reduction in snowpack to occur by 2030 and 42% reduction by 2070.

Table G.4Existing and projected energy and water demand associated with artificial snowmaking at NSW's two
largest ski resorts (using self-reported data from resorts)

	Current*	Percentage increase from 2020 (%)	Near future (2030)	Percentage increase from 2020 (%)	Far future (2070)
Energy Demand (MWh)	7,230	7%	7,710	42%	10,270
Water Demand (ML)	1,080	7%	1,150	42%	1,530

*Current estimates are based on present day energy and water consumption data provided by Perisher and Thredbo Alpine resorts.

As shown above, NSWs two largest ski resorts report using approximately 7,200 MWh of energy and 1,100 ML of water for snowmaking during the ski season. Based on these simplified assumptions, it is estimated that energy and water demand associated with snowmaking could almost double in the far future. This would also result in an exceedance of the two resorts combined current water extraction license limits for snowmaking.

G4.4 Recommendations

Future guidelines for managing visitor impacts and the carrying capacity of alpine precincts could assist in creating a framework to monitor and encourage the implementation of measures to improve energy and water efficiency. These measures could include:

- undertaking more detailed research into factors influencing future energy and water demand from snowmaking that could not be quantified in this report due to a lack of data. This includes the influence of temperature on operating efficiency, as well as the efficiency of Snowfactories compared to conventional approaches. This would require collaboration with equipment providers such as TechnoAlpin
- mandating the reporting of:
 - energy demand for artificial snowmaking and other sources of demand
 - the amount of energy supplied by renewable sources (either on site or purchased)
 - water demand for artificial snowmaking and other sources of demand against extraction license requirements.
 As shown in Table G.3 there appears to be some discrepancies between estimated water usage for snowmaking by the Alpine resorts and extraction license data provided by DPIE
- setting targets for energy and water usage, as well as the uptake of renewable energy to assist in NSW's transition to net-zero greenhouse gas emissions by 2050
- tracking data over time to identify trends and areas for improvement
- requiring detailed energy and water balances to be undertaken prior to the implementation of new snowmaking technologies to drive continual improvement.

G5 References

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Appendix H Alpine resort and NPWS performance



Value **Key Performance** ID General **Operator performance** Compliance Indicator responsibility consideration Water Biological, physical and W1 Thredbo AMU / General compliance, some conditions are consistently elevated above guidelines. Ouality chemical indicators of NPWS / resort stream health compared to ANZECC guidelines (physical and chemical measurements) and AUSRIVAS KNP model (biological condition). Compliance with water W2 AMUs / NPWS Resorts are in general compliance, however... monitoring by the agency is poor and some are non-metered making compliance unclear. extraction licenses. Perisher Team² Resorts generally don't extract groundwater (CC meeting). Varies between resorts because of lack of data. Some resorts could not provide the data W3 AMUs Water consumption in accommodation premises (e.g. Selwyn only provides day-use facilities and Charlotte Pass resort does not have compared to industry water meters on overnight accommodation) (OEH, 2017). Perisher potentially achieves benchmark (220 180L per person (CC meeting). Litres/Visitor Night). W4 AMUs / NPWS There have been water conservation campaigns launched by resorts. Thredbo and Total Water consumption. Perisher have implemented initiatives including low flow showers installation. Thredbo Perisher Team² also participated in Waterwise program. Resorts are compliant with requirements. Pollution Timely management of P1 AMUs / NPWS environmental incidents in Perisher Team² prevention Alpine resorts. and incident management Compliance with EPA AMUs / NPWS Multiple non-compliances by resorts in particular Perisher STP. Number of reviews P2 discharge licenses for Perisher Team have been conducted by NPWS in response to Perisher poor performance (EES, 2020). Sewage Treatment Plants Between 2016 – 2019, there has been multiple STP incidents Thredbo Sewage STW, (STPs). Perisher STP, Bullocks Flat STP, Sawpit Creek STP, Charlotte Pass STP (EES, 2020).

Value	Key Performance Indicator	ID	General responsibility	Operator performance	Compliance consideration
	Compliance with POEO Act 1997, UPSS Regulation 2008.	Р3	AMUs / NPWS ¹	Unknown	
	Education of staff in environmental incident management and response.	P4	AMUs	Resorts are generally doing quite well and this is always in their interest to do so. However, sometimes there are contractors that do not comply when delivering building services (CC meeting).	
Biodiversity	Threatened species population: Mountain Pygmy Possum (MPP).	B1	NPWS	Resorts are generally highly involved; however, it is still NPWS responsible for implementing any controls (CC meeting).	
	Threatened species population: Broad-toothed rat (BTR).	B2	NPWS	Resorts are generally highly involved; however, it is still NPWS responsible for implementing any controls (CC meeting).	
	Small mammal management:	В3	AMUs / NPWS	Resorts are generally highly involved; however, it is still NPWS responsible for implementing any controls (CC meeting).	
	 Mountain pygmy possum, Burramys parvus (Endangered) Broad-toothed rat, Mastacomys fuscus (Vulnerable) Dusky antechinus, Antechinus swainsonii Agile antechinus, Antechinus agilis Southern bush rat, Rattus fuscipes. 				

Value	Key Performance Indicator	ID	General responsibility	Operator performance	Compliance consideration
	Pest control programs.	B4	NPWS	Resorts have local responsibilities. It is NPWS responsibility to reduce populations across landscape and controlling pest, which is of concern at a landscape scale.	
				Between 2014 -2016, Thredbo, Perisher and Charlotte Pass have provided assistance with cat trapping in resort areas (OEH, 2017).	
	Loss of natural areas as a result of development (no	В5	NPWS	All developments within the resorts are required to go through a development approval stage before any developments.	
	net loss of biodiversity values).			This KPI is captured as part of the development approval process.	
	Weed Management programs.	B6	NPWS	There are records of Alpine resorts weed management control efforts reported in 2014 - 2016 (OEH, 2017).	
	Rehabilitation of previously disturbed areas.	B7	AMUs / NPWS	Resorts should have this resolved during the development approval stage.	
	Riparian restoration.	B8	AMUs / NPWS	Resorts should have this resolved during the development approval stage.	
Natural heritage research projects supported, initiated or undertaken in Alpine Resort Areas.		B9	NPWS	Resorts generally pay a levy for research. Thredbo also provides access and information to researchers. This is more NPWS responsibility.	
	Environmental education and awareness programs.	B10	AMUs / NPWS	Staff induction has dropped out of reporting framework for now and has not been included from 2016 onwards.	
				Currently unclear on reporting.	
Cultural Heritage	Education, awareness and promotion of resort	C1	AMUs / NPWS	Each resort has their own cultural awareness training and is usually part of the staff induction training (OEH, 2017).	
	cultural heritage values.			NPWS responsibility to establish the best way for acknowledgement of country and first nation people (CC meeting).	

Value	Key Performance Indicator	ID	General responsibility	Operator performance	Compliance consideration
	Protection of heritage sites, items and historic assets.	C2	AMUs / NPWS	No significant Aboriginal heritage sites were identified for protection or threatened by disturbance during 2014–2016 period (OEH, 2017). No data available from the 2016-2019 Environmental Performance Report.	
				This is more of a development approval process.	
Air Quality and CO2	Amount of CO2 emissions.	A1	AMUs	Thredbo have partnered with 'GreenFleet' to offset carbon emissions generated by the resort (EES, 2020).	
Emissions				Perisher also aims to manage air quality through continuous improvements to heating, lighting and EMS throughout the resort (EES, 2020).	
	The percentage of renewable energy used.	A2	AMUs	Perisher and Thredbo both purchased 'GreenPower' (OEH, 2017).	
	The percentage of visitors using Skitube.	A3	AMUs	Date has not been provided due to commercial sensitivities.	
Energy Conservation	Total Energy consumption.	E1	AMUs	Between 2015–2016, Perisher, Thredbo, Charlotte Pass and Selwyn all increased energy consumption during the reporting period (a decline in performance trend compared to 2014–2015).	
	Energy consumption in accommodation premises comparted to 'EarthCheck' benchmark.	E2	AMUs	No data available	
	Energy efficiency initiatives.	E3	AMUs	Ski resorts have put in place a large range of energy conservation measures, displaying their commitment to reducing energy consumption into the future (EES, 2020).	
				There are opportunities to launch more energy efficiency initiatives as snowmaking is likely to increase in the future.	

Value	Key Performance Indicator	ID	General responsibility	Operator performance	Compliance consideration
Waste Management	Amount of domestic waste.	G1	AMUs	The amount of waste generated by resort generally fluctuates every year between 2014–2019 (OEH, 2017; EES, 2020). Each resort reports and monitors their waste production including the final destination of waste produced.	
	The percentage of domestic waste recycles including paper, cardboard, tins, glass and plastics.	G2	AMUs	 Between 2016–2019 (EES, 2020) Perisher and Charlotte Pass Resorts: amount of comingled recycling waste from increase each year. Perisher and Charlotte Pass waste is managed by NPWS through the waste transfer station located at Perisher. Thredbo: amount of comingled recycling fluctuates throughout Selwyn: amount of comingled recycling fluctuates throughout. 	
	Waste composed – including the biosolids from Sewage Treatment Plants (STP).	G3	AMUs / NPWS Perisher Team ²	 The biosolids produced by each STP between 2016–2019 (EES, 2020): increases for Charlotte Pass STP decreases in Perisher STP increases in Sawpit Creek STP decreases in Bullocks Flat STP fluctuates for both Thredbo Village STP and Selwyn STP. 	
Sustainable recreation	Education, awareness and promotion of sustainable recreation in resorts.	R1	AMUs / NPWS	Between 2014–2016, Consistent performance with promotion of sustainable recreation. All resorts except Charlotte Pass continued to provide pre-winter environmental induction training for their staff. Promotion of environmental values is incorporated into several programs (OEH, 2017).	
	 Monitoring of key recreational activities snow play at Selwyn mountain biking and walking at Thredbo snow tubing at Perisher. 	R2	AMUs / NPWS (downhill mountain biking only)	 Insufficient data Consistent performance. Impacts of key recreational activities were monitored across Perisher, Thredbo, Selwyn resorts (OEH, 2017). 	

Value	Key Performance Indicator	ID	General responsibility	Operator performance	Compliance consideration
Resort Amenity	Education, awareness and promotion of resort amenity.	Aml	AMUs	Between 2014–2016: consistent performance. Education and awareness programs were implemented by Thredbo, Perisher and Selwyn. No data available from Charlotte Pass.	
	Measures to protect the visual and acoustic environments within resorts and minimize impacts to the surrounding areas.	Am2	AMUs	 This happens more often during a development approval stage. Consistent performance. All resorts implement measures to protect visual and acoustic environment between 2014–2016 (OEH, 2017). Scenic quality All resorts when making development applications need to consider any visual impact by the proposed development and particularly when viewed from the Main Range. Noise pollution All outdoor events such as concerts or festivals, require a Noise Management Statement as part of the planning process (EES, 2020). 	

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