Snow Making at Australian Ski Resorts

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Introduction

This booklet is intended to provide skiers and snowboarders with a brief overview of Snowmaking operations in Australian Ski Resorts.

History of Snowmaking

Snowmaking was accidentally discovered in the 1950's when a citrus farmer in California was spraying his crop with water to prevent frost damage. It was sufficiently cold enough for the water to turn to snow.
Snowmaking was first conducted as a demonstration exercise in Australia at Perisher in 1967, with
systematic snowmaking being introduced to Australian Ski Resort slopes a couple of years later. Most Australian resorts installed significant snowmaking systems during the 1980's and 1990's.

Importance of Snowmaking

Snowmaking is now a common practice and an increasingly important function at Australian ski resorts, for the following reasons:

- to ensure seasonal length and viability;
- to improve and maintain the quality of the slopes during the season by topping up natural snow in areas which have poor cover, either because of intensive use by skiers and snowboarders or because of inadequate natural snowpack;
- to overcome restrictions on skier and snowboarder circulation caused by inadequate levels of natural snow.

There are two types of situations in which snowmaking is important for resort operation. One is in providing snow early in the season to get skiing and snowboarding started, if only in limited areas of the slopes. The other is in supplementing natural snow in locations where it is most prone to melting later in the season.

Proposed Snowmaking at Australian Resorts

The proposed snowmaking coverage for the resorts has been determined primarily by identifying the best opportunities for repeat skiing which could be supplied with man-made snow early in the season and linking these with suitable trails for skier and snowboarder circulation.
Environmental conditions are generally also an important consideration influencing the preferred repeat skiing areas, the staging of their development and the location of snowmaking mains. Water supply and maintaining environmental flows in resort creeks is also a major planning consideration.

Objectives of a Snowmaking System

A snowmaking system generally has four main objectives:

1. to maximise the amount of snow that can be made within a season;
2. to minimise the amount of energy required to make this snow;
3. to ensure environmental flows in streams are maintained or improved; and
4. to minimise the operating costs required to make this snow

What is snow?

Natural snow forms when water vapour in a cloud formation condenses into a raindrop. Given cold atmospheric conditions the raindrop freezes and forms an ice crystal with six tiny arms (called dendrites). This is the classic snowflake. On the other hand, man-made snow forms a compact six-sided structure more like an ice cube.

When is snow made?

The programming of snowmaking is largely determined by weather conditions. About 20 percent of the snow is typically made during the three weeks preceding the opening of the season, with 40 to 50 percent made by the end of June. Most of the remaining snow is made during July, with a small amount of remedial snowmaking extending to mid, to late August, after

which conditions generally are relatively too warm for snowmaking, or when cold periods during the night are too short in time to allow snowmaking to commence.

Overview of Snowmaking Systems

Snowmaking involves a significant level of infrastructure in terms of water storage, pump stations compressors, pipe-work, electricity supply, hydrants and weather stations.
Snowmaking machines or ‘snow guns' as they are normally described, make snow by breaking water into small particles, cooling the water by causing the particles to move through cold air, nucleating the particles and distributing the resulting snow on a surface.
The efficiency of snowmaking is strongly influenced by meteorological conditions. In particular, efficiency is increased at low temperature and low humidity. Temperature limitations means that snowmaking is practicable mainly during the early to middle part of the season (typically mid-May to mid-August), which means that snow which is required to extend the end of the season must be made early in the season. Efficiency can be enhanced by snowmaking additives which promote nucleation of the snow. These additives have been subject to several scientific studies both in Australia and overseas which have shown no environmental concerns. In NSW, the National Parks & Wildlife Service authorises additive use.

Water

The snowmaking process utilises water that is eventually returned to the catchment. Studies show that about 93% of the water used for snowmaking in Winter is returned to the catchment during the Spring thaw. Water for snowmaking is "borrowed" from the catchment rather than "used".
Given the importance of environmental flow maintenance in local streams, the provision of a large water storage has become a core facility in any modern ski resort that is reliant on snowmaking. Many Australian ski resorts used

recycled waste water for snow making operations further improving the sustainability of snow making.

Pipework

To supply the snowmaking operation with compressed air and high pressure water, an extensive system of steel piping is required through separate pipes, to the snowmaking hydrants on the ski slopes. At the other end of the reticulation system is a pump house which produces the compressed air and has high pressure pumps to supply the water.

Plant Rooms

Plant rooms contain the "heart" of the snow making system including water pumps and air compressors.

Snow guns

The snow guns that are used are generally of two types, air-water guns and fan guns (or fans). Air-water guns use a jet of compressed air reticulated from a central compressor to break up a stream of water into fine particles and propel these into the atmosphere under conditions which causes them to freeze as particles of snow. Fan guns achieve a similar effect by passing a stream of water into an airlfow produced by a fan.
Fan guns are slightly more efficient in energy terms than air-water guns, but produce snow in a broad, dispersed band which is relatively difficult to direct, particularly in high wind situations.
Air-water guns produce a more concentrated stream of snow, which can be readily directed along confined trails or accumulated in a large pile for distribution by grooming machines.
Both types of snow guns can be mounted on a tower to increase the amount of time (hang time) the water droplets are in the air. This increases the amount of snow that can be produced.

Snow Quality

Snow quality is determined by the snowmaker or by computer software in automated snow making. Snowmakers will make either wet, medium or dry snow depending on the condition of the ski slope and the prevailing weather conditions.
Adjustment of the snowguns allows optimum snow production for the prevailing weather conditions, which includes temperature, humidity, wind speed and direction. These adjustments are performed every ½ to 1 hour throughout the snowmaking period. While adjusting the snowgun, the snowmaker may make the quality of snow wetter or drier depending on the ski slope needs.
Increasing water flow to a gun will result in a wetter snow and alternatively, decreasing water flow will result in a drier snow.

Wet Snow

In making snow, the general objective is to make it wetter than fresh, natural snow. This is because natural snow becomes denser with age. Snowmakers seek to make snow similar to three-day-old natural snow because it lasts longer, wears traffic better, resists wind scour, grooms more easily and is more energy-efficient to make. Wetter snow is most efficient because more can be made than dry snow with the same amount of equipment, the same energy and the same staff.

Medium Moisture Snow

Medium moisture snow is made when a run has adequate snow depth. Fresh, medium quality snow is easier to ski on than wetter snow. If snowmaking continues after slope grooming has taken place, medium snow quality is made so as not to destroy the groomed surface.

Dry Snow

Dry snow is generally made just before the snowmaking operation finishes and leaves a lighter, powdery cover on the ski slope which is easy to ride.

How snow quality is checked

Each gun is checked for snow quality in two ways:

1. by grabbing a handful of snow and squeezing it; and
2. by letting the snow from the gun fall onto the snowmakers jacket sleeve. (Some snowmakers prefer to use a plastic hand piece instead of clothing.)

	Hand	**Jacket**	**Plastic**
Wet	No more than 1 – 2 drops of water. Will stick together and will be slightly translucent.	Some will bounce off jacket, about 5 – 10 mm. Some will stick to the jacket.	Will stick to the plate and be slightly white when pushed together
Medium	No water drops. Mainly white in colour. Will stick together if crushed.	Some will bounce off jacket, about 10 – 15 mm. Some will stick to the jacket when crushed.	Will stick to the plate and be mainly white when pushed together.
Dry	No water drops. Will be powdery. Completely white in colour.	Some will bounce 20 mm plus. Some will fall off jacket.	May not stick to the plate and will be all white when pushed together. Probably fall off plate.

Snow deposited by the snowguns is groomed flat by the groomers to produce a rideable slope before opening each morning. On very cold nights (-10oc or colder), it can be quite a job because of the amount of snow that can be produced.

The Snowmakers

Snowmaking is predominantly a night operation consisting of two shifts, the first commencing at 4 p.m. and running until midnight, and the second from midnight until mid morning. If snowmaking conditions allow, these shifts may each operate up to 12 hours, producing snow for 24 hours. For example, the record for making snow at Perisher Blue Ski Resort is 223.5 hours (9 days) continuous operation.

We hope this information helps you understand more about the challenges of snowmaking in Australia as well as the goals that are strived for. The snowmakers will be out there working all night seeking to provide the best surface for the best experience.

Enjoy