Snowmaking with Reclaimed Water
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Reclaimed Water Use for Snowmaking
While recreational use of reclaimed water is most often associated with irrigation of golf courses, winter sports venues can also benefit from reclaimed water use as an alternate or supporting water source in the seasonal production of engineered snow. The practice of snowmaking by large ski resorts is increasing, especially with recent changes in weather patterns and a need to provide an adequate snow base to attract skiers throughout the ski season.

Snowmaking in Maine
The use of reclaimed water for snowmaking is a relatively new practice, but the potential for its use to replace groundwater or stream-flow that could otherwise support domestic water supplies and aquatic habitat is increasingly attractive to many ski resorts. In the United States, the use of reclaimed water for snowmaking developed in New England as a means to allow for continued discharge of treated effluent from zero discharge lagoons and land application systems during the winter.

The Carrabassett Valley Sanitary District (CVSD) in Maine operated a state permitted lagoon and land application site serving the Sugarloaf Mountain Ski Resort area. By the early 1990’s, the treatment system was receiving 50 million gallon (189,000 m³) of wastewater per year, mostly during the winter months, filling the seven storage lagoons. Because cold climates and varied topography can limit land applications of treated effluent during the colder months, in the spring of 1994 CVSD investigated use of the Snowfluent™ developed by Delta Engineering of Ottawa, Canada. Snowfluent™ is essentially snowmaking during winter months with treated wastewater effluent as the water source for snow. Testing was conducted by the Maine Department of Environmental Protection (MDEP) during the 1994 ski season; with no adverse impacts observed during the testing period, the MDEP permitted a permanent system which was installed in 1995 (Nelson, 1992).

Following the first successful year of operations that included treatment and use of 28 million gallons (106,000 m³), CVSD acquired three additional snowmaking towers (Figure 1) and a diesel generator, and later added SCADA controls to more effectively manage the system. Operationally, CVSD has found that by beginning snowmaking as freezing weather starts, the ground does not freeze, which aids the infiltration of melting snow in spring through early summer (Maine Lagoons online, 2012).

Figure 1
CVSD District employee Joseph Puleo checks the nozzles atop a snow gun tower. (Photo credit: David Keith)

Another Maine site, the Chick Hill Pollution Control Facility serving the town of Rangeley, was completed in fall 1996. Seven snow guns were added in 1998 for winter operation with construction of the winter effluent storage and disposal facility. The system treats over 14 million gallons (53,000 m³) annually with one 28 million gallon (106,000 m³) lagoon and 40 ac (16 ha) of application fields. The Mapleton Sewer District (Figure 2) formed in 1965 upgraded its treatment facility in 2004 by adding a 5 million gallon (19,000 m³) facultative lagoon, 14.5 million gallon (55,000 m³) storage lagoon, and snowmaking system on its land.
application site, converting to a zero-discharge system and eliminating recurring discharge permit violations to the North Branch of the Presque Isle Stream. The use of snowmaking with spray irrigation allowed year-round operations using a smaller storage lagoon facility.

Snowmaking in Pennsylvania
Two ski resorts in Pennsylvania are starting to include reclaimed water as a portion of their snowmaking water supply. Seven Springs Mountain Resort uses diluted recycled wastewater to augment the collected surface water it uses to make snow. The executive director of operations says "It's been treated, it's filtered, it's probably better than the pond water" (Nasaw, 2011). Seven Springs has developed a virtually closed-circuit water system for snowmaking and developed a potable water system that recycles water by treating and returning it back to drainage areas to recharge its sources. The water used for snowmaking is captured in a series of collector ponds at the base of the mountain, which are filled by rain, run-off and melting snow. During the snowmaking process, the water is pumped to the top of the mountain and then with the help of gravity, which minimizes energy use, it is supplied to more than 900 snowmaking towers on the mountain. Water is stored on the slopes in the form of snow until the melting process returns it through channels to the collector ponds for the process to begin again (Seven Springs, 2009).

The Bear Creek Mountain Resort general manager hopes to begin using recycled wastewater to make ski snow in the 2012 season, at a 9 to 1 ratio with untreated fresh water (Nasaw, 2011). The on-site wastewater treatment system uses biological treatment processes to produce reclaimed water that is also used for irrigation and ground water recharge.

Western Snowmaking
In the western U.S. states, reclaimed water is viewed as a resource. In California, Donner Summit Public Utilities District in Soda Springs has a wastewater discharge permit that allows stream discharge, land application and snowmaking at Discharge Point “REC-1.” Reclaimed water must meet California Title 22 standards that include a median concentration of total coliform bacteria in the disinfected effluent that shall not exceed 2.2MPN/100mL. This permit includes a provision (IV.C.12) that requires chlorine disinfection with a chlorine concentration/contact time of 450 mg-min and average NTU of 2 (CRWQCB-CVR, 2009). Title 22 requirements for disinfected tertiary recycled water allow use of demonstrated, alternative disinfection processes with filtration; however, only chlorination is allowed under this permit.

In Cloudcroft, N.M, severe drought has caused water shortages that required trucking of potable water to the community at up to 20,000 gpd (76 m³/d). In response to this shortage, the community moved forward with development of an integrated water conservation plan that includes indirect potable reuse. Cloudcroft implemented membrane technology to produce highly treated reclaimed water that would be used to supplement the existing spring and well water sources. The reclaimed water, produced using an ultrafiltration (UF) membrane bioreactor and chloramine disinfection, is stored in a small reservoir. A portion of the water is diverted for non-potable purposes (golf course and athletic field irrigation) with 100,000 gpd (380 m³/d) further treated with reverse osmosis (RO) through a three stage, single-pass system using high rejection, low pressure thin film composite membranes. The RO permeate is treated with hydrogen peroxide and UV, and stored in two covered, lined reservoirs, prior to blending with spring flow and groundwater. The final stage in the water treatment process is ultrafiltration of the blended water source.
GAC filtration, and disinfection with sodium hypochlorite prior to distribution in the potable water system.

The two streams from the water treatment process, the RO concentrate and UF backwash are diverted to a 250,000 gallon (950 m³) reservoir that stored water used for road dust control, construction, snowmaking for the ski area, gravel mining operations, forest fire fighting, and other beneficial purposes (Government Engineering, 2008).

**Snowmaking in Australia**
The Mt. Buller and Mt. Stirling Alpine Resort are located 3 hours northeast of Melbourne. An expanded wastewater treatment plant can provide an additional 503,000 gpd (2,000 m³/d) of Class A recycled water for snowmaking per day. Class A is the highest achievable standard in recycled water in Australia and is allowed for use on food crops. The production of artificial snow requires large volumes of water and with global climate change induced forecasts for decreasing snowfalls in the future, ski resorts worldwide are increasing reliance on snowmaking. Mt. Buller has invested in this technology in order to provide a better, longer ski season.

Prior to 2008, when use of reclaimed water for snowmaking was implemented, water was drawn from Boggy Creek. Treatment of Mt. Buller’s recycled water also provides benefits to the local environment by improving the quality of run-off that enters surrounding areas and waterways. Mt. Buller management advises skiers that if snow made from recycled water is ingested, it will not have any significant health implications; however, just like natural snow, once it hits the ground it is vulnerable to contamination by animals, vehicles and other skiers, so snow should not be eaten. In addition, Mt. Buller management plans to also use this reclaimed water for household use in new developments and for irrigating open spaces to deliver further benefits to the local alpine environment (Mt. Buller, 2012).

**References**

California Regional Water Quality Control Board Central Valley Region (CRWQCB-CVR, 2009), Order No. R5-2009-0034 NPDES No. CA0081621, April 24, 2009


