Belleayre Mountain Ski Center UMP-DEIS

Appendix B
Snowmaking Engineers Report

April, 2011

Prepared by:

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Belleayre Mountain Ski Center
Unit Management Plan

Snowmaking Engineers Report

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INTRODUCTION

A modern ski area in the Northeast region of the United States typically has a man made snowmaking system covering a high percentage of the skiable terrain. Snowmaking helps to ensure to the extent possible continuous operation through the ski season, as well as ensuring a high quality and safe skiing surface that customers have come to expect. Perhaps the proposed NYS Assembly Bill A05392 states the need for modern snowmaking equipment in NYS best:

NYS Assembly Bill A05392 - *"New York State ranks fifth in the nation in skier visits per year despite the fact that the state is the second highest when compared to the percentage of their population that skis. New York State currently exports a number of skiers and their families to the New England states. In order to remain competitive with our neighbors to the east which aggressively campaigns for our skiers and those whom visit New York, this state needs to upgrade equipment and maintain state of the art snowmaking systems".*

The existing snowmaking system at BMSC currently makes snow on approximately 150 of 155 acres or 97% of the skiable terrain including novice, intermediate, expert trails, teaching areas and skiable connectors. In the proposed snowmaking system is designed to with the capacity to cover approximately 203 acres.

The purpose of this report is to determine the requirements to expand and upgrade the existing snowmaking system at Belleayre Mtn. Ski Area to provide for the proposed expansion of skiable terrain as indicated in the Belleayre UMP 2009.

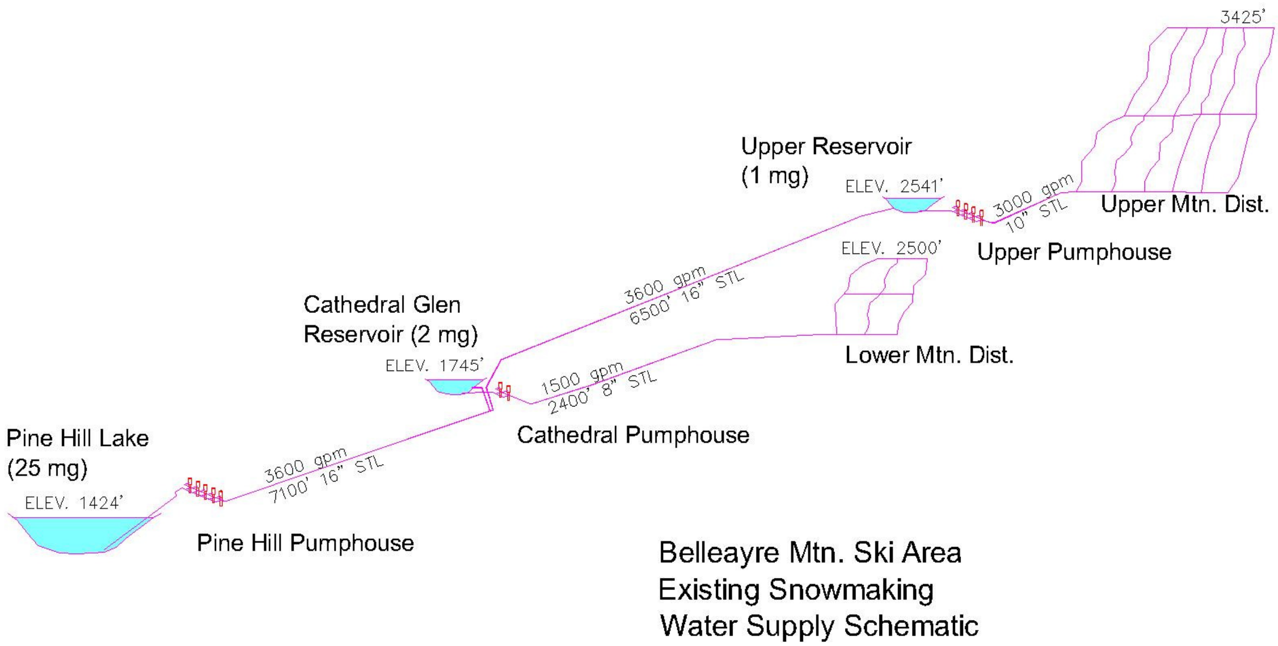
This report includes the following:

- A description of the existing water supply sources utilized in the existing snowmaking system.
- An analysis of the existing water demand, pump capacities, compressed air facilities capacity, annual fuel consumption, and energy management.
- The anticipated increase in water demand based on the expanded trail system.
- Identifies the proposed source of additional water and additional storage required for the expanded system.
- Evaluates the proposed operational scenarios including early mid and late season.
- An evaluation and recommendation of optimal snow gun selection for the various operating scenarios on the proposed trail system.
- Determines the required peak on mountain water and air flow capacities based on the snow gun selections and operating scenarios.
- Evaluation and recommendation of the fuel source for the proposed water and air system components considering issues such as fuel cost, and air emissions, and the requirements of petroleum bulk storage requirements.
- Evaluates the use of diesel powered generators to reduce peak electric demand.
- Provides system Energy Management system performance criteria recommendations.

- Evaluates replacing existing equipment with more efficient and environmentally friendly equipment.
- Conceptual snowmaking expansion plans including water supply schematic design, snowmaking reservoir design, existing water pumphouse modification conceptual plan, proposed water pumphouse conceptual plan, proposed compressed air conceptual plans.

EXISTING SNOWMAKING WATER SUPPLY SYSTEM

The existing water supply for snowmaking at Belleayre Ski Center comes from 2 sources. One source is the Cathedral Glen Reservoir, located on ski area property, which stores approximately 2 million gallons. The Cathedral Glen Reservoir is located on the Cathedral Glen stream and has a small drainage area of appx. 0.9 sq miles. The existing Cathedral Glen Pumphouse pumps water to the lower mountain distribution system at appx. 1500 gpm. The other source of water is the Pine Hill Lake Reservoir, located off of Rte 28 near the village of Pine Hill, which stores a usable capacity of appx. 25 million gallons. The Pine Hill Reservoir is located of Birch Creek and has a drainage area of appx. 7.9 sq. miles. The Pine Hill Lake is located off-line of Birch Creek, and is currently designed to be able to take water from the creek when flows are in excess of 5 cfs. The Pine Hill Pumphouse pumps water to the Upper Reservoir at a rate of appx. 3600 gpm. The transmission line from Pine Hill to the Upper Pumphouse can also



discharge water into the Cathedral Glen Reservoir with the operation of a manual valve. The Upper Pumphouse pumps water to the upper mountain distribution system at up to appx. 3000 gpm.

Pine Hill Lake Pumphouse Pumping Equipment
4 - 400 hp Vertical Turbine Pumps, total capacity 3,600 gpm to Upper Reservoir (#1 & #2 installed 1991, #3 & #4 installed 1999).
1 - 200 hp Vertical Turbine Pump, capacity 2,000 gpm to Cathedral Glen Reservoir, installed 1989.
4 - 40 hp Submersible Pumps in lake to prime Vertical Turbines, installed 1989.

Cathedral Glen Pumphouse Pumping Equipment
2 - 250 hp Vertical Turbine Pump total capacity 1500 gpm (#1 installed 1973, #2 installed 1980).

Upper Pump House Pumping Equipment
1 - 500 hp Vertical Turbine Pump with VSD, capacity 1,480 gpm to Upper Distribution System installed 1992.
2 - 350 hp Vertical Turbine Pumps, total capacity 1500 gpm to Upper Distribution System installed 1973.

EXISTING SNOWMAKING COMPRESSED AIR SYSTEM

The existing compressed air supply for Belleayre Ski Area consists of three sources, the 3 – 1500 cfm stationary Ingersoll-Rand electric powered air compressors, installed in 1983 & 1985, at the upper pumphouse location, and appx. 12 -1600 cfm portable diesel powered rental compressors located at the upper pumphouse,. All of these compressed air sources discharge into one connected buried pipe network that extends throughout the upper and lower mountain trail systems. The overall capacity of the compressed air system is appx. 23,700 cfm. The heated compressed air is cooled with aftercoolers before if goes into the distribution system to allow for more efficient snowmaking. There are compressed air aftercoolers located at the upper pumphouse and at the Barneyville location.

INVENTORY OF EXISTING SNOWMAKING EQUIPMENT

571 Air/Water Snow gun Towers (352 high-energy and 219 low-energy compressed air guns)

20 Air/Water snow gun sleds

840 Water hydrants
813 Air hydrants

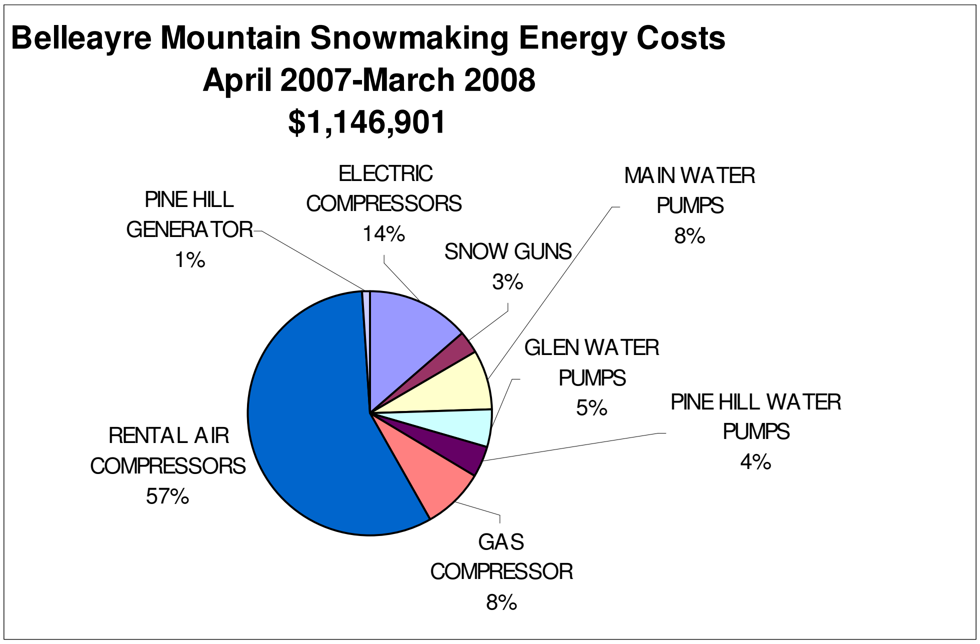
81 SMI Fan Gun snowmaking machines

153,000 Feet of air/water pipe (6" - 16" diameter), various valves, fittings, and Controllers

10,000 Feet of air/water supply hose

EXISTING ENERGY CONSUMPTION

A facility wide Energy Audit was conducted at Belleayre Mtn. Ski Center by energy experts at Ecology and Environment Inc. (E & E). The following table was taken from the Energy Audit and represents the energy costs associated with the snowmaking system at Belleayre for the 2007-2008 season.



From the E & E report it should be noted that Snowmaking represents at least 72% of the total energy costs at Belleayre Mountain, and that the air compression system itself represents 79% of the snowmaking energy.

PROPOSED TRAIL SNOWMAKING EXPANSION

Proposed New Snowmaking Trails

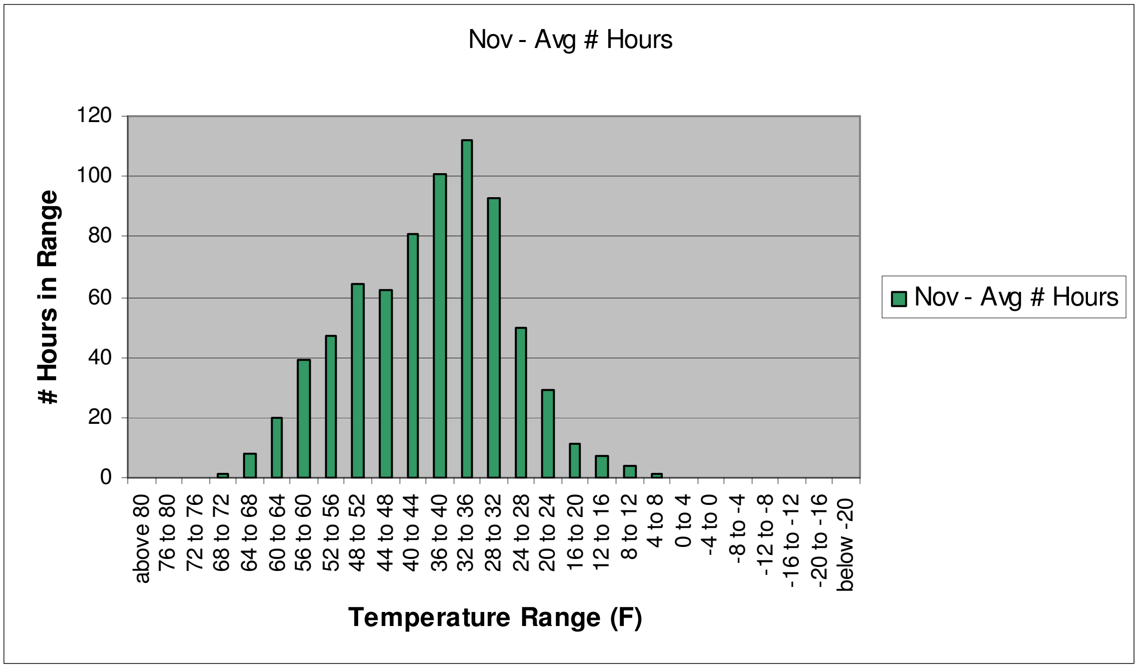
The proposed snowmaking trail expansion includes additional trails on the primarily on the upper mountain located to the west of the existing trail system. Snowmaking is planned for all of these areas. The new Belleayre West Lift, Highmount Lift, include proposed trails and a connector as indicated in these tables, as well as providing snowmaking on the existing Upper Utsyantha trail.

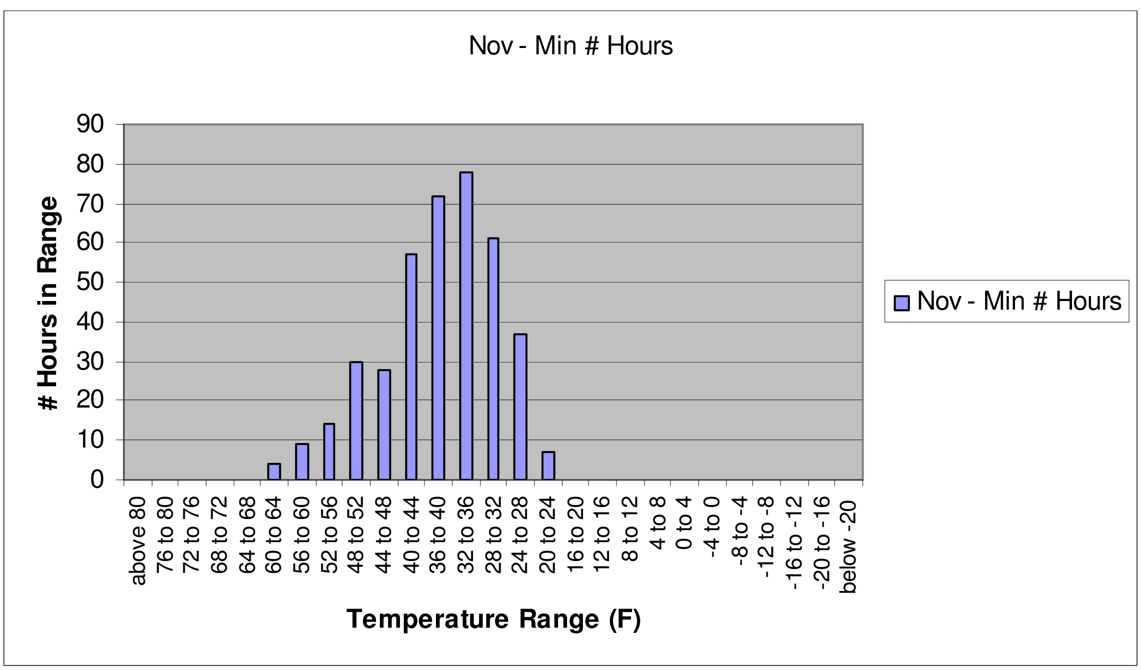
DEER RUN EXT.	2160	119954	2.8	56
HMT-1	1204	102375	2.4	85
HMT-2	1437	128553	3.0	89
HMT-3	1189	75216	1.7	63
HMT-4	838	90639	2.1	108
HMT-5	1390	146978	3.4	106
HMT-6	784	62423	1.4	80
HMT-7	1358	125895	2.9	93
HMT-8	3411	129454	3.0	38
HMT-9	3164	144120	3.3	46
CONNECT PR 1	2228	118840	2.7	53
CONNECT PR 2	289	8694	0.2	30
Ex. Upper Utsyantha			1.2	
		Sub-Total	47.9	
		Allowance	5	
		Total	52.9	

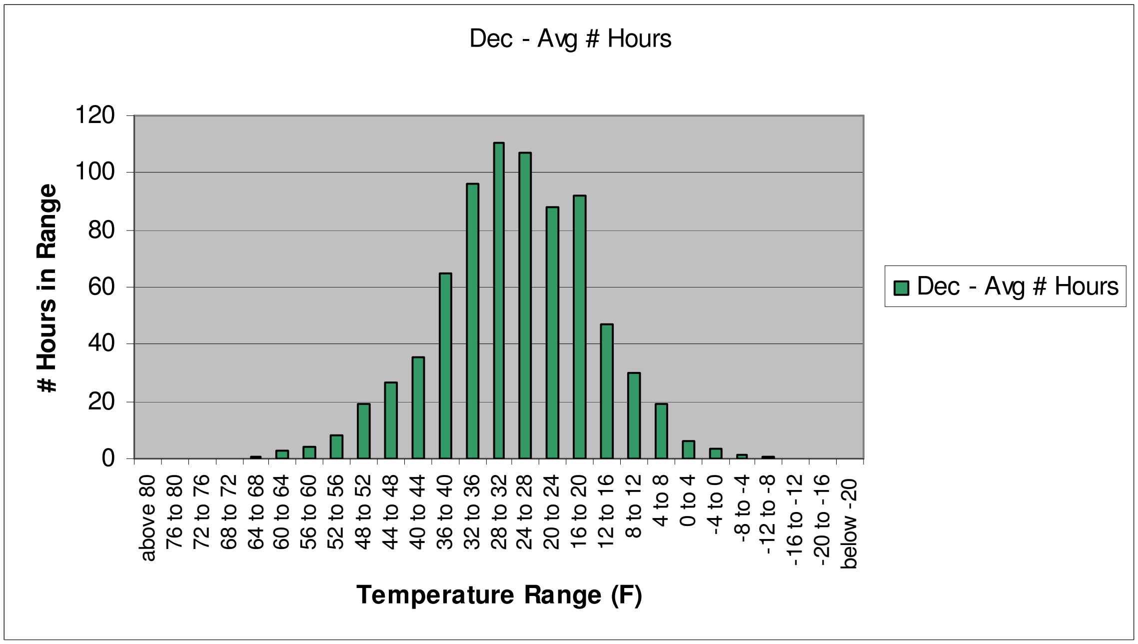
Net Total additional area of snowmaking capacity is 53 acres.

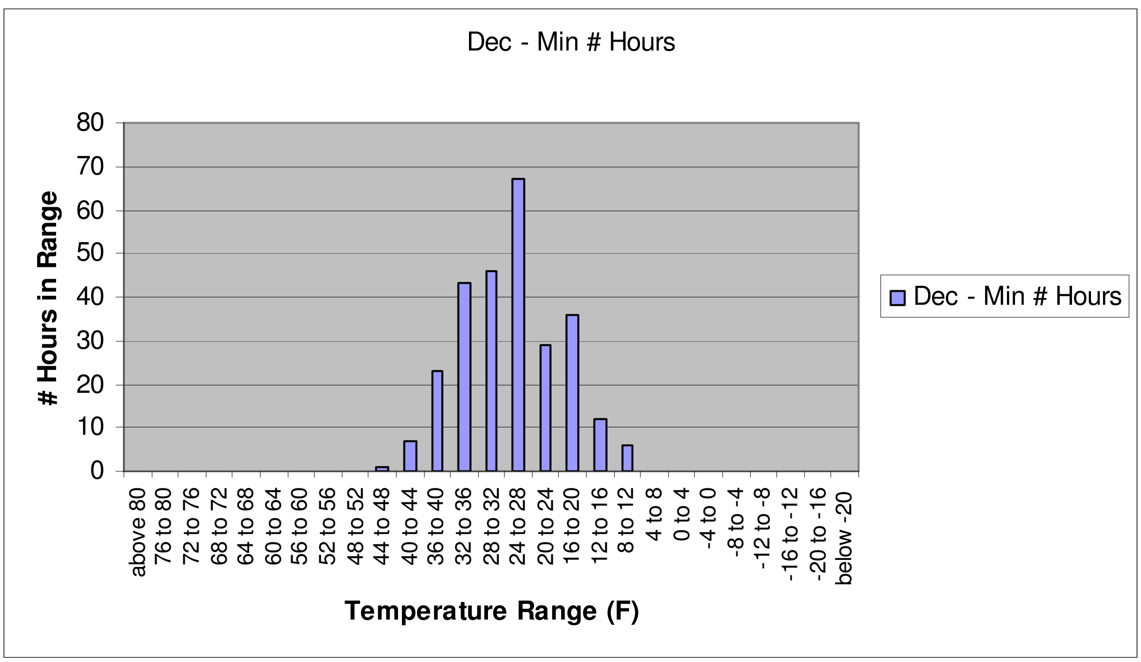
WEATHER DATA

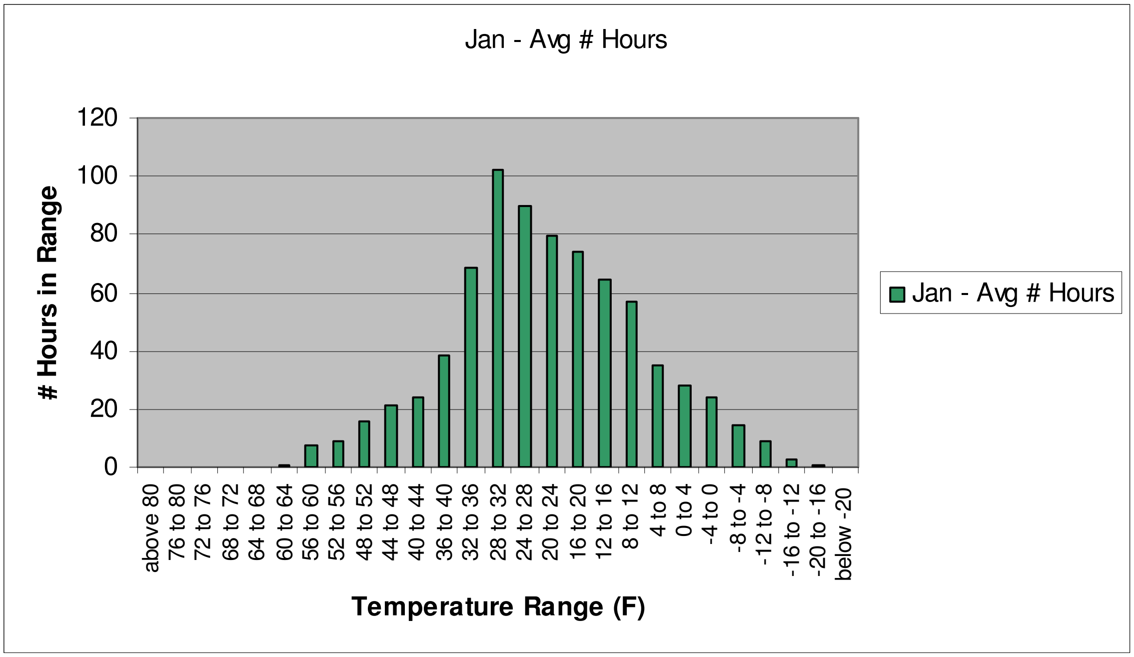
Hourly Temperature data from 1999-2007 was obtained from NYSDEC Div. Air Resources for the Air Monitoring Station located at the base of Belleayre Mountain, and was analyzed for this report. Some of the most useful data for the purposes of this report are shown in the following graphs. The graphs indicate the number of hours temperature occured within specified ranges for the 1999-2007 data. Graphs are shown on a monthly basis for the ski season (November – March), and are included for average and minimum values of the data considered.

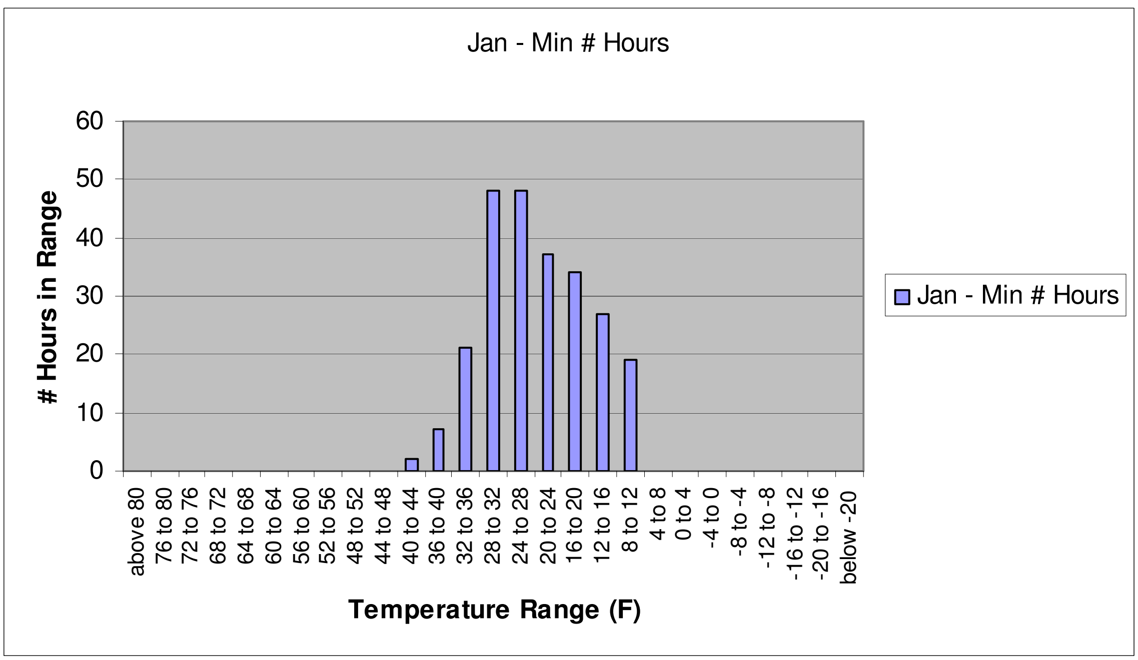


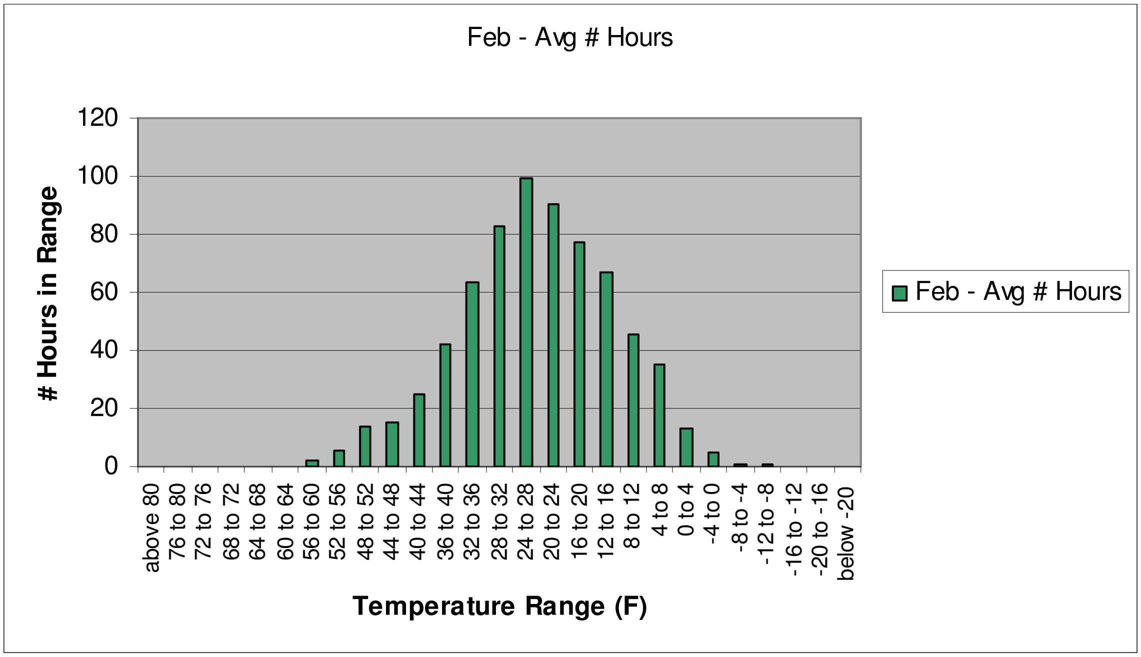


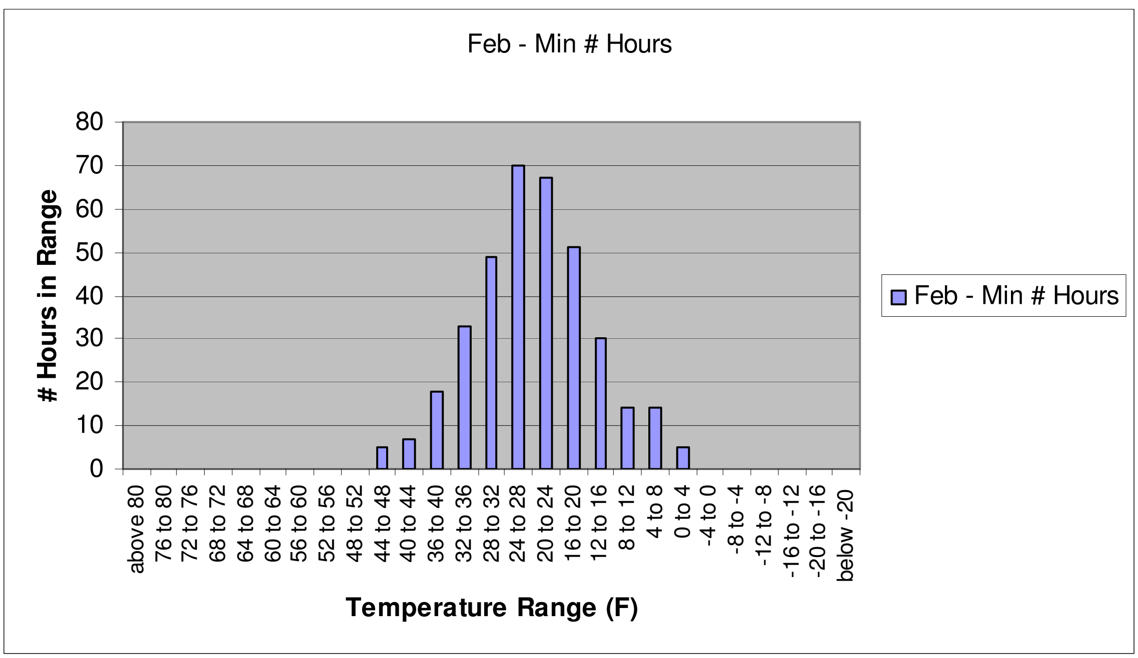

Dec - Avg # Hours
120
100
80
60
40
20
0
Hours in Range
above 80
76 to 80
72 to 76
68 to 72
64 to 68
60 to 64
56 to 60
52 to 56
48 to 52
44 to 48
40 to 44
36 to 40
32 to 36
28 to 32
24 to 28
20 to 24
16 to 20
12 to 16
8 to 12
4 to 8
0 to 4
-4 to 0
-8 to -4
-12 to -8
-16 to -12
-20 to -16
below -20
Temperature Range (F)
Dec - Avg # Hours

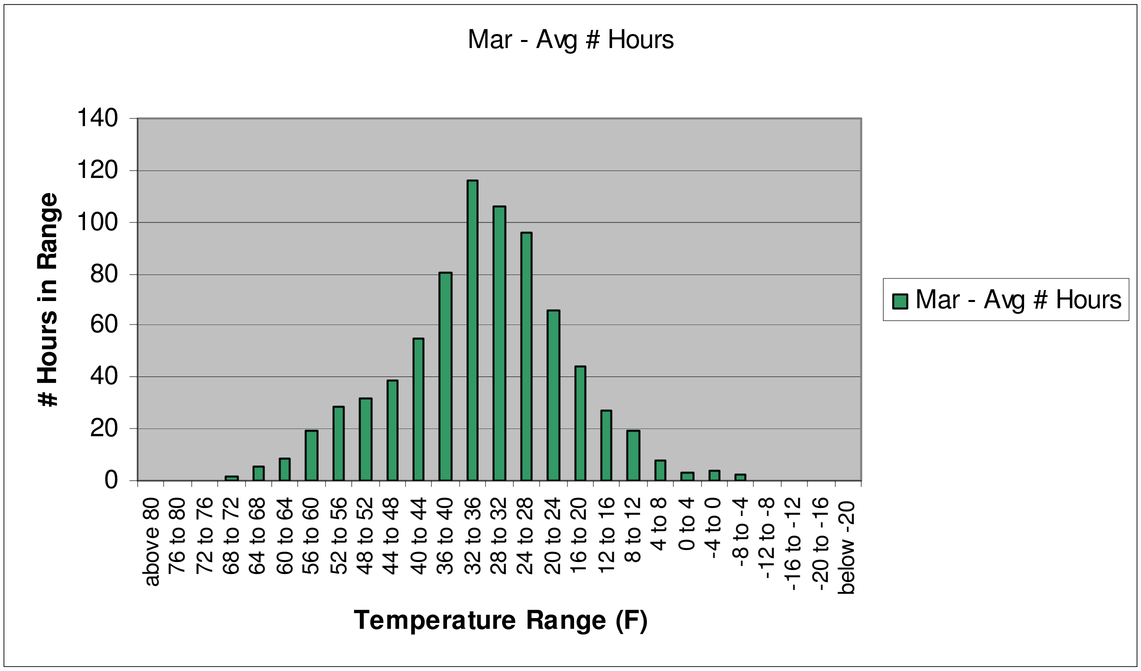

Dec - Min # Hours
80
70
60
50
40
30
20
10
0
Hours in Range
above 80
76 to 80
72 to 76
68 to 72
64 to 68
60 to 64
56 to 60
52 to 56
48 to 52
44 to 48
40 to 44
36 to 40
32 to 36
28 to 32
24 to 28
20 to 24
16 to 20
12 to 16
8 to 12
4 to 8
0 to 4
-4 to 0
-8 to -4
-12 to -8
-16 to -12
-20 to -16
below -20
Temperature Range (F)
Dec - Min # Hours

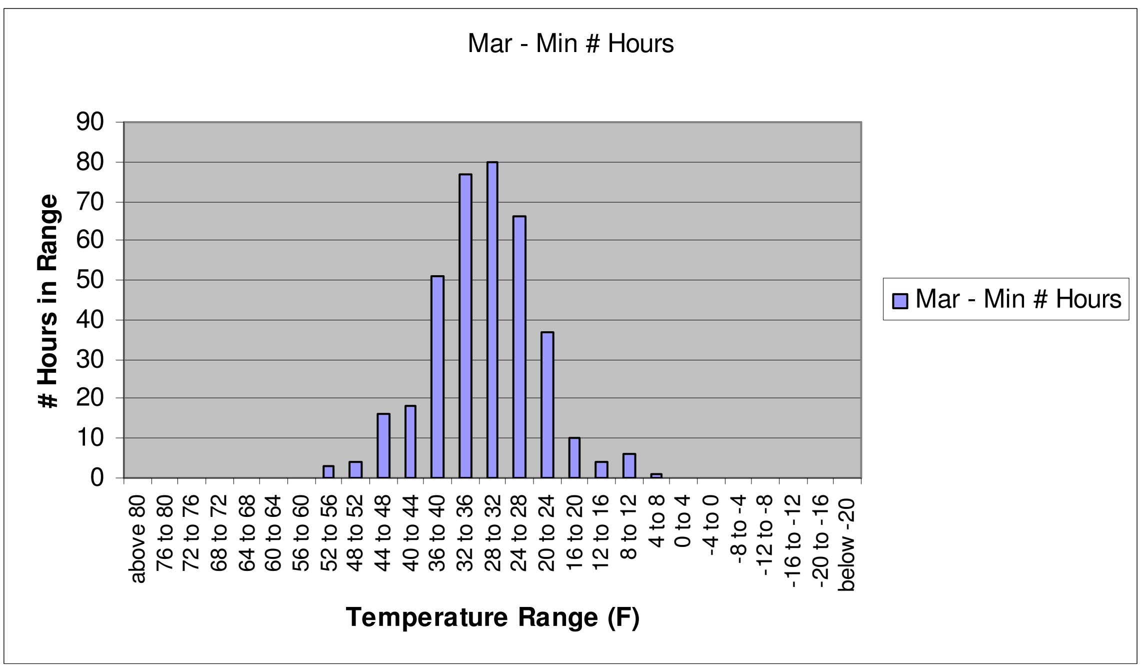

Jan - Avg # Hours
120
100
80
60
40
20
0
Hours in Range
above 80
76 to 80
72 to 76
68 to 72
64 to 68
60 to 64
56 to 60
52 to 56
48 to 52
44 to 48
40 to 44
36 to 40
32 to 36
28 to 32
24 to 28
20 to 24
16 to 20
12 to 16
8 to 12
4 to 8
0 to 4
-4 to 0
-8 to -4
-12 to -8
-16 to -12
-20 to -16
below -20
Temperature Range (F)
Jan - Avg # Hours


Jan - Min # Hours
60
50
40
30
20
10
0
Hours in Range
above 80
76 to 80
72 to 76
68 to 72
64 to 68
60 to 64
56 to 60
52 to 56
48 to 52
44 to 48
40 to 44
36 to 40
32 to 36
28 to 32
24 to 28
20 to 24
16 to 20
12 to 16
8 to 12
4 to 8
0 to 4
-4 to 0
-8 to -4
-12 to -8
-16 to -12
-20 to -16
below -20
Temperature Range (F)
Jan - Min # Hours


Feb - Avg # Hours
Hours in Range
120
100
80
60
40
20
0
above 80
76 to 80
72 to 76
68 to 72
64 to 68
60 to 64
56 to 60
52 to 56
48 to 52
44 to 48
40 to 44
36 to 40
32 to 36
28 to 32
24 to 28
20 to 24
16 to 20
12 to 16
8 to 12
4 to 8
0 to 4
-4 to 0
-8 to -4
-12 to -8
-16 to -12
-20 to -16
below -20
Temperature Range (F)
Feb - Avg # Hours


Feb - Min # Hours
Hours in Range
80
70
60
50
40
30
20
10
0
above 80
76 to 80
72 to 76
68 to 72
64 to 68
60 to 64
56 to 60
52 to 56
48 to 52
44 to 48
40 to 44
36 to 40
32 to 36
28 to 32
24 to 28
20 to 24
16 to 20
12 to 16
8 to 12
4 to 8
0 to 4
-4 to 0
-8 to -4
-12 to -8
-16 to -12
-20 to -16
below -20
Temperature Range (F)
Feb - Min # Hours


Mar - Avg # Hours
Hours in Range
Temperature Range (F)
Mar - Avg # Hours
140
120
100
80
60
40
20
0
above 80
76 to 80
72 to 76
68 to 72
64 to 68
60 to 64
56 to 60
52 to 56
48 to 52
44 to 48
40 to 44
36 to 40
32 to 36
28 to 32
24 to 28
20 to 24
16 to 20
12 to 16
8 to 12
4 to 8
0 to 4
-4 to 0
-8 to -4
-12 to -8
-16 to -12
-20 to -16
below -20


Mar - Min # Hours
Hours in Range
Temperature Range (F)
Mar - Min # Hours
90
80
70
60
50
40
30
20
10
0
above 80
76 to 80
72 to 76
68 to 72
64 to 68
60 to 64
56 to 60
52 to 56
48 to 52
44 to 48
40 to 44
36 to 40
32 to 36
28 to 32
24 to 28
20 to 24
16 to 20
12 to 16
8 to 12
4 to 8
0 to 4
-4 to 0
-8 to -4
-12 to -8
-16 to -12
-20 to -16
below -20

Taking the data from the Minimum # Hours within the temperature ranges acceptable for snowmaking yields the following table which will be used as the basis for the allowable windows of snowmaking opportunity in the modeling of proposed snowmaking equipment. Also shown is a table showing the Average # Hours with temperature ranges acceptable for snowmaking.

Minimum # Hours in Temp Range

Temp Range	November	December	January	February	March
24 to 28	37	67	48	70	66
20 to 24	7	29	37	67	37
16 to 20	0	36	34	51	10
12 to 16	0	12	27	30	4
8 to 12	0	6	19	14	6
4 to 8	0	0	0	14	1
0 to 4	0	0	0	5	0
Total Hours	44	150	165	251	124

Average # Hours in Temp Range

Temp Range	November	December	January	February	March
24 to 28	50	107	90	100	96
20 to 24	30	88	79	90	66
16 to 20	11	92	74	77	44
12 to 16	7	47	64	67	27
8 to 12	4	30	57	46	20
4 to 8	1	19	35	36	8
0 to 4	0	6	28	13	3
Total Hours	102	389	428	429	264

PROPOSED TRAIL OPENING PHASES

Based on an interview with Belleaye Mountain Management staff, a trail opening phasing plan was developed. Goals were set for Initial Opening (Snowmaking Phase 1), and for the Christmas Holiday Operation (Snowmaking Phases 2-5).

The goal for Initial Opening is to open the Discovery Lodge facility, the proposed Discovery Lift, existing Tomahawk Lift, Dot Nebel Upper & Lower Trails, Deer Run & Deer Run Extension Trails, and the Iroquois Trail. This will provide significant skiing for all levels of skiers Novice – Expert on opening day of the ski area.

The goal of the Christmas Holiday Operation is that all Lift and Trail Pods will be opened and connected. The majority of the trails are planned to be opened by this critical holiday.

See UMP Drawing SM1 for the Snowmaking Phasing Plan.

As previously discussed, an approximation of the snowmaking water required per ski season is 1 mg per acre of skiable area. As indicated in the energy modeling spreadsheets for this project, it is assumed that approximately 18" of snow is needed to open up a trail. With 30% loss, and 50% water/snow ratio, this equates to approximately 0.3 mg water/ acre of trail. After the initial trail opening, approximately 0.7 mg water/ acre of trail is required to maintain the skiable surface throughout the rest of the ski season.

EQUIPMENT SELECTION

The selection of snowmaking equipment involves the consideration of many factors including available weather windows of snowmaking opportunity, proposed trail opening schedule, available water supply flow and pressure, available stationary air compressor capacity, available electrical system capacity, trail slope and width, trail exposure, capital cost, maintenance cost, and energy cost among other variables. In general there are three types of snow making guns available on the market today; Internal Mix, External Mix, and Fan Gun. The internal and external mix require piped water and compressed air. The Fan Guns require piped water, and electrical power supply. The advantages of each type of gun are as follows;

Internal Mix – Also known as "High Energy" guns, have the advantage of making good quality snow in more marginal weather conditions, require less water pressure at the hydrant, typically cost less per unit, and broadcast the snow a greater distance requiring less moving of the snow by the groomers. The disadvantage of these guns is that they typically use significantly more compressed air volume, which results in more energy cost. These guns lend themselves to use on the upper sections where the water pressure is less, and it is desirable broadcast the snow all the way across the trail, as groomers cannot traverse this steep terrain to push the snow across the trail.

External Mix – Also known as "Low Energy" guns, have the advantage of requiring significantly less air volume to make snow resulting in energy savings. The disadvantage of these guns is that they do not broadcast as far, requiring more grooming effort, they do not typically work as well in marginal weather conditions, and are slightly more expensive than the Internal Mix guns. These guns lend themselves well to trails that are not part of the initial opening phase, below mid station on the upper mountain, and trails that are not extremely wide.

Fan Guns – These guns have the advantage of typically being able to make snow well in marginal conditions, can broadcast a longer distance, and are very energy efficient. The disadvantage of these units is that they have a significantly higher cost, need a piece of equipment to move them around, and require electrical power connections. These guns lend themselves well to early opening signature trails, wide trails, and base/terminal areas.

ENERGY MODELING OF PROPOSED SYSTEM EXPANSION

In order to model various combinations of snowmaking equipment by various manufacturers, a spreadsheet was developed. The spreadsheet breaks out the proposed phases of snowmaking, with each trail represented on its perspective phases. Based the trails length, area, criteria established in the previous section, appropriate equipment was modeled on the trails and adjusted in spacing to achieve the goal of completing the phase within an allowable window of opportunity to make snow as indicated in the Weather Section of this report. Based on input temperature, equipment manufacturers data, trail length and area, the spreadsheet computes time to complete, water usage, air usage, electrical usage, overall energy use and associated energy cost, as well as new equipment cost for comparison purposes. Iterations were done with the spreadsheet to determine the most economical combination of equipment while achieving the management goals established.
Some of the basic input parameters in the spreadsheet include the following:

ENTER PEAK ELECTRIC COST ($/KWH)	$0.16
ENTER OFF-PEAK ELECTRIC COST ($/KWH)	$0.12
ENTER DEMAND CHARGE ($/KW)	$7.50
ENTER UPPER WATER PUMPING (KW/GPM)	0.5100
ENTER LOWER WATER PUMPING (KW/GPM)	0.2400
ENTER STATIONARY AIR (KW/CFM)	0.1551
ENTER STATIONARY AIR CAPITOL ($/CFM)	$85
ENTER EXIST STATIONARY AIR (CFM)	24,000
ENTER SNOW LOSS ALLOWANCE (%)	30
ENTER WATER/SNOW RATIO	0.5
ENTER PINE HILL PUMPING (KW/GPM)	0.16
ENTER VOLUME BEFORE PH PUMP (MG)	25
ENTER PINE HILL PUMPING RATE (GPM)	5400

The modeling of the energy use by the snowmaking system has several assumptions. The snowmaking is assumed to occur in phases. The phases are shown on UMP Drawing SM1. Snowmaking Phase 1 will cover with sufficient depth of snow, the initial trails to open the facility for the season. It is assumed that this will occur in the last 2 weeks of November, before Thanksgiving Holiday. Phases 2 through 5 will cover, with sufficient depth of snow, all of the remaining proposed snowmaking trails at the facility, and it is assumed that this will occur before the Christmas Holiday. Phases 6-10, 11-15, and 16-18 will occur throughout the rest of the ski season primarily January, February, and March, and will be sufficient to maintain the ski surface on the trails. The net water pumped over the course of a season will total approximately 1 mg water per acre of snowmaking area.

Summaries of the spreadsheet output for the various phases is shown on the following pages.

SUMMARY OF PHASE 1-5

MONTH	Nov.	Dec.			
SNOWMAKING PHASE	PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5
UPPER SYSTEM WATER REQ (MG)	6.6	15.0	10.3	10.3	8.4
UPPER SYSTEM CUMMULATIVE (MG)	6.6	21.6	31.9	42.2	50.6
LOWER SYSTEM WATER REQ (MG)	4.3	3.2	3.3	2.5	0.0
LOWER SYSTEM CUMMULATIVE (MG)	4.3	7.5	10.8	13.3	13.3
TOTAL PHASE WATER (MG)	10.9	18.2	13.6	12.8	8.4
CUMMULATIVE WATER (MG)	10.9	29.1	42.7	55.5	64.0
PINE HILL PUMPING VOL. REQUIRED (MG)	0.0	18.2	13.6	12.8	8.4
PINE HILL PUMPING TIME (HRS)	0	56	42	40	26
PINE HILL PUMPING OFF PEAK KW	0	864	864	864	864
PINE HILL PUMPING OFF PEAK KWH	0	48608	36349	34147	22496
PINE HILL ENERGY USE COST	$0	$5,833	$4,362	$4,098	$2,700
PINE HILL TOTAL MONTHLY ENERGY COST	$0	$16,992			
MTN PHASE ON PEAK KW	11809	10900	10994	8485	5845
MTN PHASE OFF PEAK KW	0	0	0	0	0
MTN MONTHLY PEAK KW	11809	10994			
MTN MONTHLY DEMAND CHARGE	$88,570	$82,456			
MTN ENERGY USE COST	$39,378	$64,680	$46,043	$31,637	$20,353
MTN TOTAL MONTHLY ENERGY COST	$127,948	$245,168			
MTN (KWH)	246114	404247	287767	197734	127206

SUMMARY OF PHASE 6-10

MONTH	Jan.				
SNOWMAKING PHASE	PHASE 6	PHASE 7	PHASE 8	PHASE 9	PHASE 10
UPPER SYSTEM WATER REQ (MG)	6.6	15.0	10.3	10.3	8.4
UPPER SYSTEM CUMMULATIVE (MG)	57.2	72.2	82.5	92.8	101.2
LOWER SYSTEM WATER REQ (MG)	4.3	3.2	3.3	2.5	0.0
LOWER SYSTEM CUMMULATIVE (MG)	17.6	20.8	24.2	26.7	26.7
TOTAL PHASE WATER (MG)	10.9	18.2	13.6	12.8	8.4
CUMMULATIVE WATER (MG)	74.8	93.0	106.7	119.5	127.9
PINE HILL PUMPING VOL. REQUIRED (MG)	10.9	18.2	13.6	12.8	8.4
PINE HILL PUMPING TIME (HRS)	33	56	42	40	26
PINE HILL PUMPING OFF PEAK KW	864	864	864	864	864
PINE HILL PUMPING OFF PEAK KWH	28939	48608	36349	34147	22496
PINE HILL ENERGY USE COST	$3,473	$5,833	$4,362	$4,098	$2,700
PINE HILL TOTAL MONTHLY ENERGY COST	$20,465				
MTN PHASE ON PEAK KW	3199	2609	2848	1753	1100
MTN PHASE OFF PEAK KW	8007	8604	8772	6732	4744
MTN MONTHLY PEAK KW	3199				
MTN MONTHLY DEMAND CHARGE	$23,996				
MTN ENERGY USE COST	$27,923	$49,724	$35,848	$25,412	$16,311
MTN TOTAL MONTHLY ENERGY COST	$179,213				
MTN (KWH)	215837	372869	274633	197734	127206

SUMMARY OF PHASE 11-15

MONTH	Feb				
SNOWMAKING PHASE	PHASE 11	PHASE 12	PHASE 13	PHASE 14	PHASE 15
UPPER SYSTEM WATER REQ (MG)	6.6	15.0	10.3	10.3	8.4
UPPER SYSTEM CUMMULATIVE (MG)	107.8	122.8	133.1	143.4	151.8
LOWER SYSTEM WATER REQ (MG)	4.3	3.2	3.3	2.5	0.0
LOWER SYSTEM CUMMULATIVE (MG)	31.0	34.2	37.5	40.0	40.0
TOTAL PHASE WATER (MG)	10.9	18.2	13.6	12.8	8.4
CUMMULATIVE WATER (MG)	138.8	157.0	170.6	183.4	191.9
PINE HILL PUMPING VOL. REQUIRED (MG)	10.9	18.2	13.6	12.8	8.4
PINE HILL PUMPING TIME (HRS)	33	56	42	40	26
PINE HILL PUMPING OFF PEAK KW	864	864	864	864	864
PINE HILL PUMPING OFF PEAK KWH	28939	48608	36349	34147	22496
PINE HILL ENERGY USE COST	$3,473	$5,833	$4,362	$4,098	$2,700
PINE HILL TOTAL MONTHLY ENERGY COST	$20,465				
MTN PHASE ON PEAK KW	3199	2609	2848	1753	1100
MTN PHASE OFF PEAK KW	8007	8604	8772	6732	4744
MTN MONTHLY PEAK KW	3199				
MTN MONTHLY DEMAND CHARGE	$23,996				
MTN ENERGY USE COST	$27,923	$49,724	$35,848	$25,412	$16,311
MTN TOTAL MONTHLY ENERGY COST	$179,213				
MTN (KWH)	215837	372869	274633	197734	127206

SUMMARY OF PHASE 16-18

MONTH	Mar		
SNOWMAKING PHASE	PHASE 16	PHASE 17	PHASE 18
UPPER SYSTEM WATER REQ (MG)	2.2	5.0	3.4
UPPER SYSTEM CUMMULATIVE (MG)	154.0	159.1	162.5
LOWER SYSTEM WATER REQ (MG)	1.4	1.1	1.1
LOWER SYSTEM CUMMULATIVE (MG)	41.4	42.5	43.6
TOTAL PHASE WATER (MG)	3.6	6.1	4.6
CUMMULATIVE WATER (MG)	195.5	201.6	206.1
PINE HILL PUMPING VOL. REQUIRED (MG)	3.6	6.1	4.6
PINE HILL PUMPING TIME (HRS)	11	19	14
PINE HILL PUMPING OFF PEAK KW	864	864	864
PINE HILL PUMPING OFF PEAK KWH	9661	16232	12141
PINE HILL ENERGY USE COST	$1,159	$1,948	$1,457
PINE HILL TOTAL MONTHLY ENERGY COST	$4,564		
MTN PHASE ON PEAK KW	3199	2609	2848
MTN PHASE OFF PEAK KW	8007	8604	8772
MTN MONTHLY PEAK KW	3199		
MTN MONTHLY DEMAND CHARGE	$23,996		
MTN ENERGY USE COST	$9,318	$16,602	$11,973
MTN TOTAL MONTHLY ENERGY COST	$61,889		
MTN (KWH)	72025	124506	91729

Tabulation of the snowmaking summaries result in the following totals for proposed seasonal energy cost, snowmaking quantities, snowmaking unit costs, and total seasonal snowmaking energy usage for the proposed expanded system.

TOTAL PINE HILL SEASON ENERGY COST	**$62,485**
TOTAL MTN SEASON ENERGY COST	**$793,432**
TOTAL SEASON ENERGY COST	**$855,918**
TOTAL SEASON WATER (mg)	**206**
SEASON SNOW MADE (ACRE-FT)	**886**
SEASON UNIT COST ($/ACRE-FT)	**$966**
SEASON UNIT COST ($/TRAIL ACRE)	**$4,153**
MTN SEASON TOTAL(KWH)	**3,927,890**

Existing snowmaking energy use cost for the 2007-2008 season was $1,146,901. The estimated volume of snow actually applied to the hill for this is 1 (mg/acre) x 1,000,000 (gal/mg) x 150 (acres) / 7.48 (gal/cf) / 43,560 (sf/acre) x 2 (snow/water) – 30% loss = 645 (acre-ft). The estimated existing unit cost for the production of snow is $1,146,901 / 645 (acre-ft) = $1778/ acre-ft. The unit cost in ($/ trail acre) = $1,146,901 / 150 (acre) = $7,646/ acre.

It should be noted that the proposed changes to the snowmaking system will result in significant savings in energy use. The unit cost for producing snow will go from an estimated $7,646 / acre down to appx. $4,153 / acre, a unit cost reduction of over 45%.

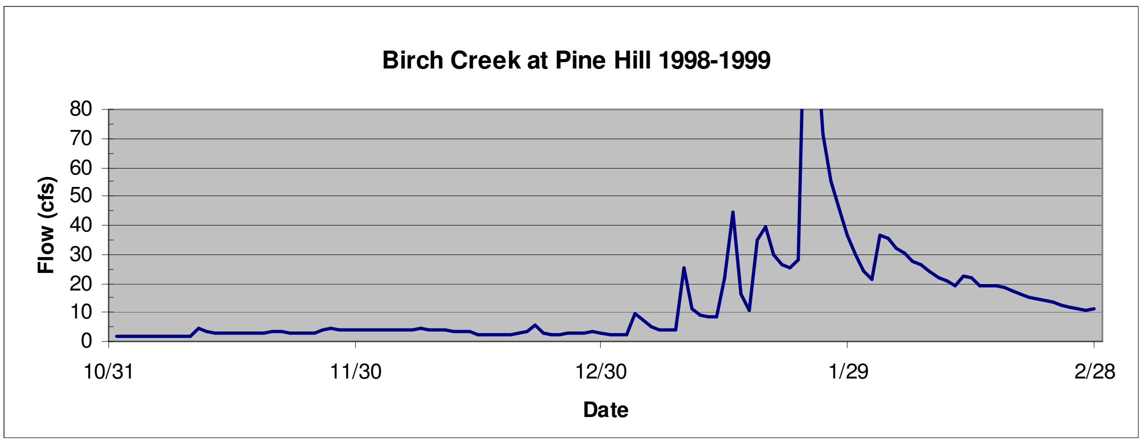
If the proposed expanded facility made snow at existing snowmaking unit costs, the projected season energy cost would be $1,575,077. The projected annual savings in snowmaking energy costs is $1,575,077 - $855,918 = $719,159/year.

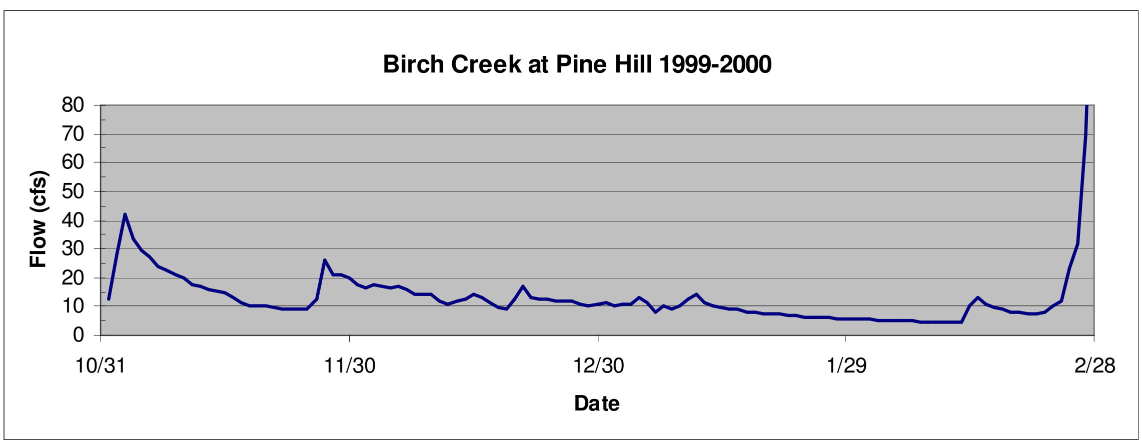
If the current annual cost of rental compressors $322,275 is considered, (rental compressors will not be required in the proposed system), **the overall annual savings in snowmaking costs is $1,041,434.**

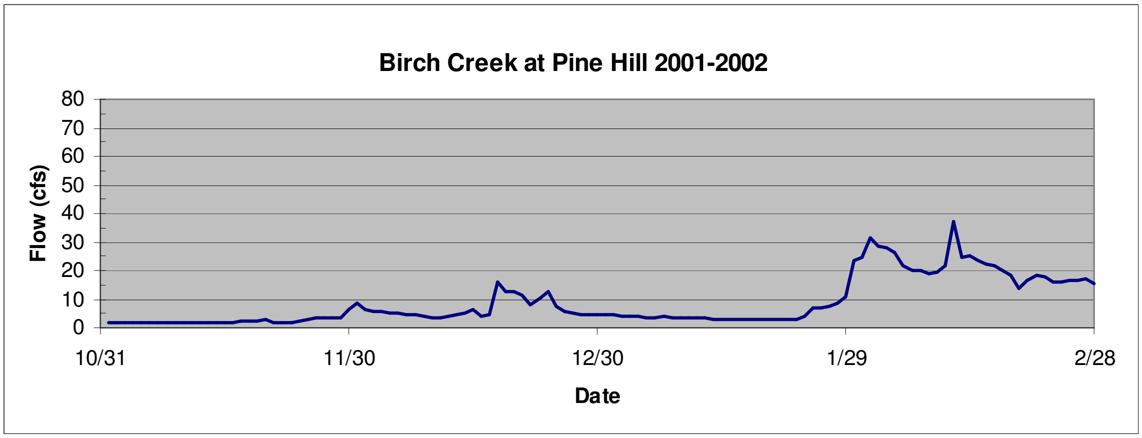
PROPOSED WATER SUPPLY SYSTEM

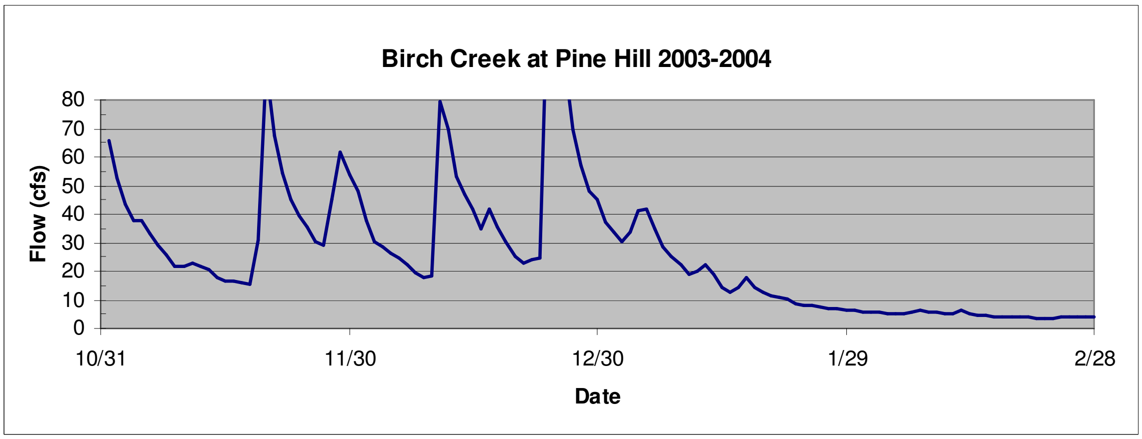
From historical records, the overall annual volume of water required for the ski area snowmaking system is appx. 1 mg per acre of man made snow terrain. This means a volume of 203 mg will be required per ski season for the proposed expanded ski area. Per the snowmaking equipment modeling, the Initial Opening requires 10.5 mg, and a total of 64 mg for the Christmas Holiday Operation. The existing usable storage volume at Pine Hill Lake is 25 mg, and Cathedral Glen is 2 mg.

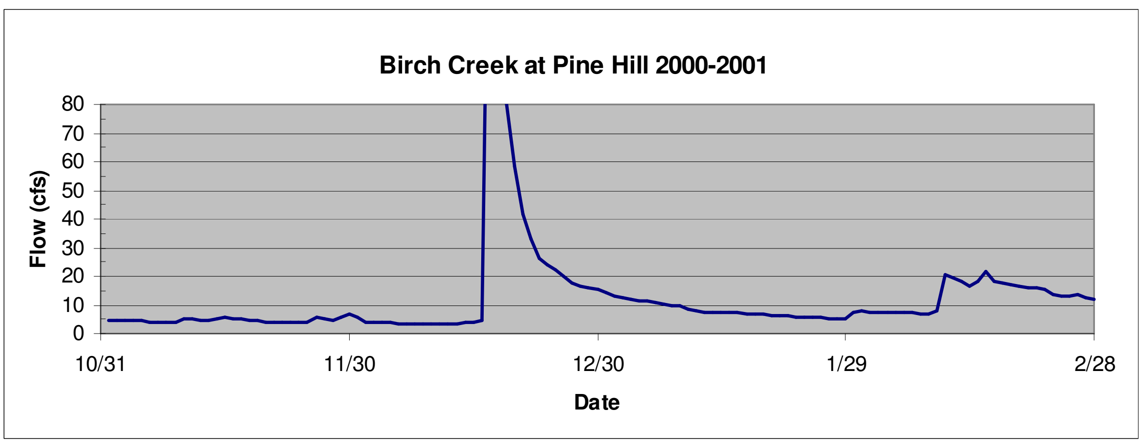
To evaluate the water recharge to the Pine Hill Lake reservoir available from Birch Creek, stream flow data was retrieved from the USGS Stream Monitoring Station # 013621955 located on Birch Creek at Big Indian NY, downstream of Pine Hill Lake. Data was retrieved from the period of 1999-2007. The data was then prorated by a factor of 0.632 which is the ratio of the size of the respective drainage areas to estimate the flow at the Pine Hill Lake diversion structure. The following graphs represent that data for the 1999-2007 ski seasons.

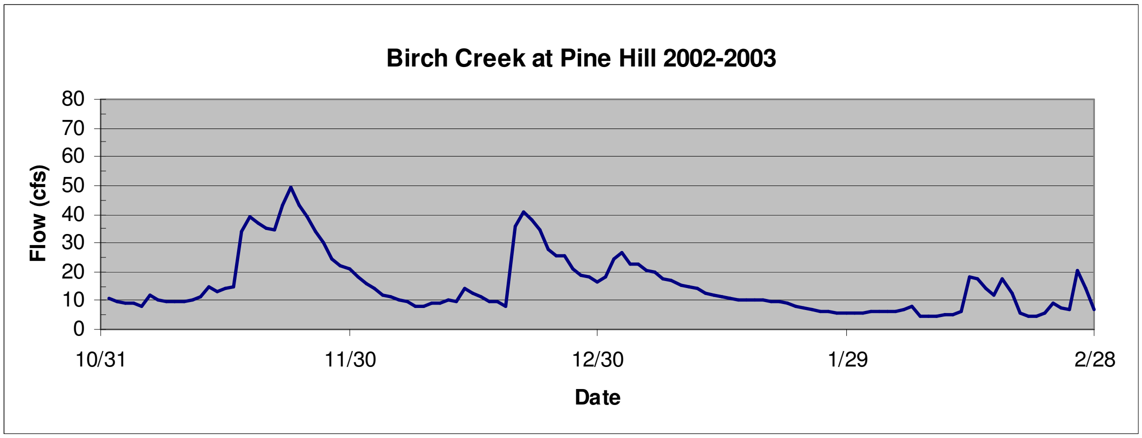




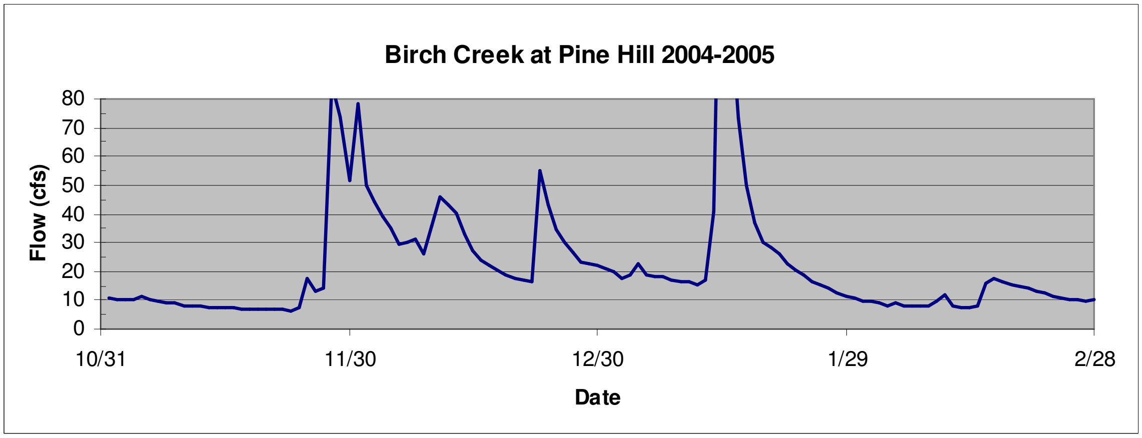

Birch Creek at Pine Hill 2001-2002
Flow (cfs)
80
70
60
50
40
30
20
10
0
10/31
11/30
12/30
1/29
2/28
Date


Birch Creek at Pine Hill 2003-2004
Flow (cfs)
80
70
60
50
40
30
20
10
0
10/31
11/30
12/30
1/29
2/28
Date

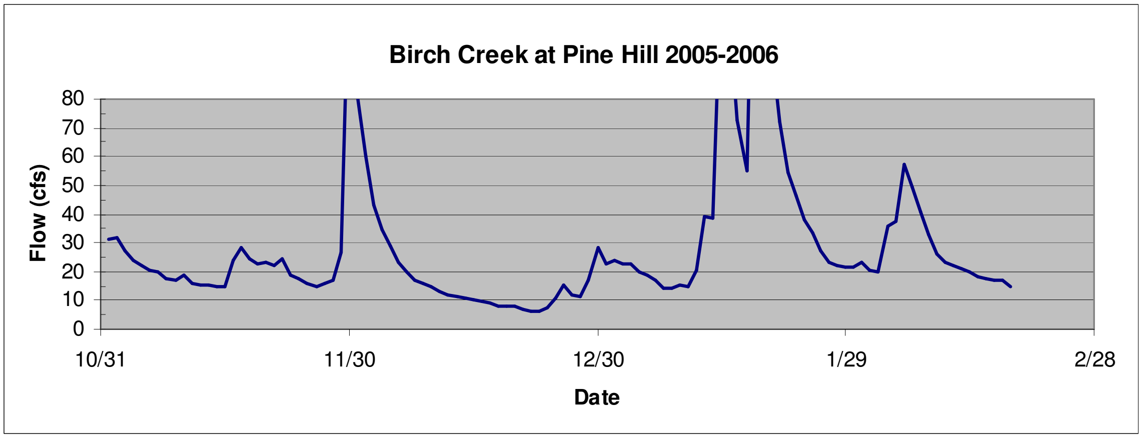

Birch Creek at Pine Hill 2000-2001
Flow (cfs)
80
70
60
50
40
30
20
10
0
10/31
11/30
12/30
1/29
2/28
Date



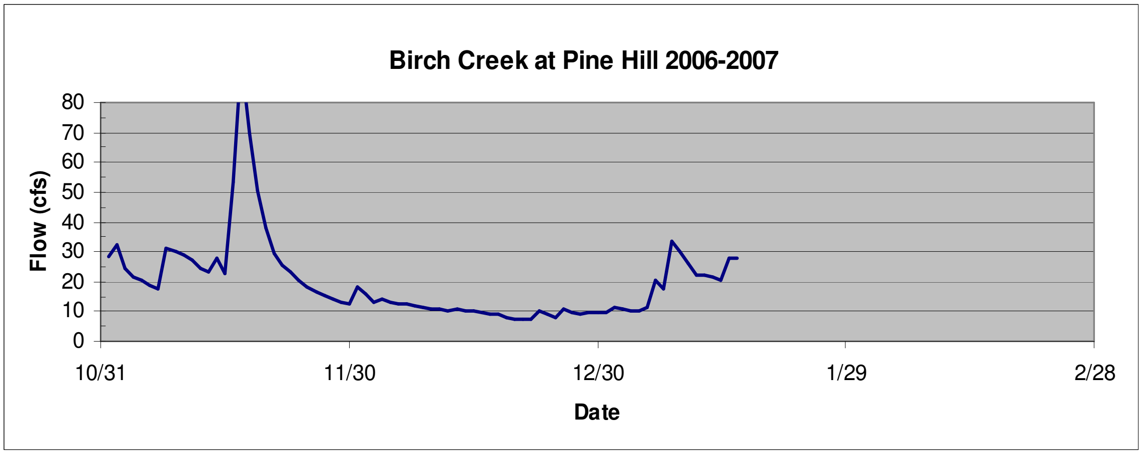
Birch Creek at Pine Hill 2002-2003
80
70
60
50
40
30
20
10
0
Flow (cfs)
10/31
11/30
12/30
1/29
2/28
Date



Birch Creek at Pine Hill 2004-2005
80
70
60
50
40
30
20
10
0
Flow (cfs)
10/31
11/30
12/30
1/29
2/28
Date



Birch Creek at Pine Hill 2005-2006
80
70
60
50
40
30
20
10
0
Flow (cfs)
10/31
11/30
12/30
1/29
2/28
Date



The existing diversion structure located at Pine Hill Lake reservoir is currently designed to be able to divert water from the stream to the Lake when the stream flows exceed 5 cfs. In order to provide better flow for stream habitat protection as recommended by DEC Fisheries, minimum stream conservation flow is proposed to be increased to 8 cfs during the ski season. This could be done by simply cutting an additional conservation flow notch in the diversion structure weir. A cover plate can be installed during the off season to maintain 5 cfs mimimum conservation flow when allowable by DEC Fisheries.

The available volumes to recharge the Pine Hill Lake reservoir from the Birch Creek diversion structure based on the computed Birch Creek at Pine Hill flows minus the 5 cfs and 8cfs conservation flows are presented in the following table. The numbers are provided for the potential snowmaking portion of the ski season, Nov. 1 – Feb. 28, and for December only which is a critical month in the water supply for snowmaking.

Ski Season	Ski Season Recharge Vol. (mg) over 5 cfs	Ski Season Recharge Vol. (mg) over 8 cfs	December Recharge Vol. (mg) over 5 cfs	December Recharge Vol. (mg) over 8 cfs
1998 - 1999	1101	938	0	**0**
1999 - 2000	1517	1260	166	106
2000 - 2001	802	617	421	391
2001 - 2002	758	610	38	**18**
2002 - 2003	1647	1390	243	183
2003 - 2004	2106	1871	815	755
2004 - 2005	1617	1335	549	489
2005 - 2006	1823	1570	277	220
2006 - 2007	1272	1092	112	53

As seen in the table above, for the entire ski season, the recharge volume over the base conservation flow of 8 cfs is typically greater than 600 mg which is more than adequate to supply a typical ski season snowmaking supply of appx. 203 mg.

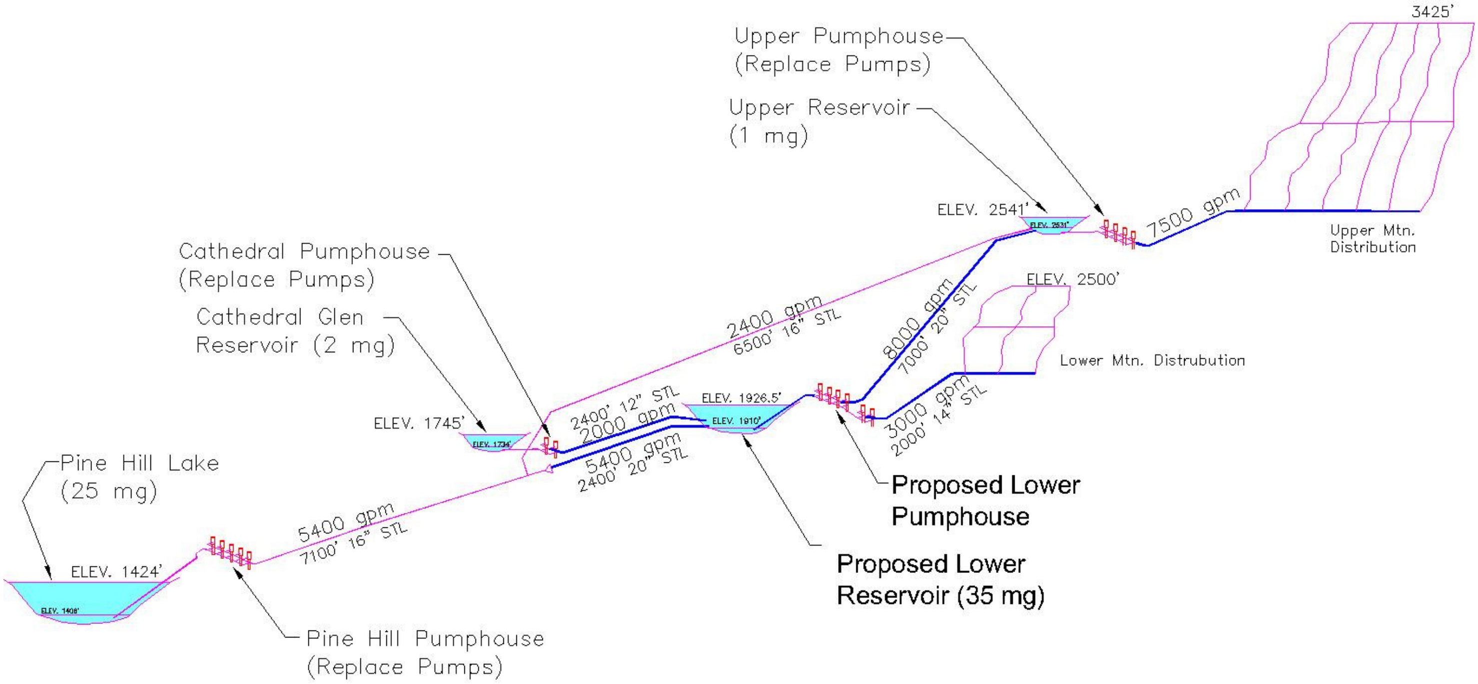
The overall required volume of water for the Christmas holiday phase is 64 mg per the snowmaking model, and the usable storage in Pine Hill Lake & Cathedral Glen reservoirs totals 25 + 2 = 27 mg. The minimum required recharge is 64-27 = 37 mg to meet the December demand. Based on the table above there are years where the available recharge in the month of December is not sufficient to meet the required volume for the Christmas holiday. Additional storage capacity will be necessary to meet the requirement. It is assumed that in drought years, there will be negligible water recharge available in the Cathedral Glen Reservoir. The desired additional storage capacity is 37 mg. In Alternative #1, the proposed new lower reservoir will provide an additional usable capacity of 35 mg, which will be sufficient to open most of the trails in a drought year. In Alternative #2, the existing Pine Hill Lake would be expanded to provide an additional capacity of 35 mg.

The Upper Distribution System requires a peak flow of 7500 gpm, and the Lower Distribution System requires a peak flow of 3000 gpm per the snowmaking model. The current pumping rate from Pine Hill Lake is only 3600 gpm. If the pumps at Pine Hill Lake were retrofitted, the pumping rate in the existing 16" transmission line could be as much a 5400 gpm. Since this maximum pumping rate is less than the required peak demand on the mountain, a new reservoir is also required to equalize this flow rate, unless the entire transmission line were either replaced with a larger size line, or an additional transmission line were installed.

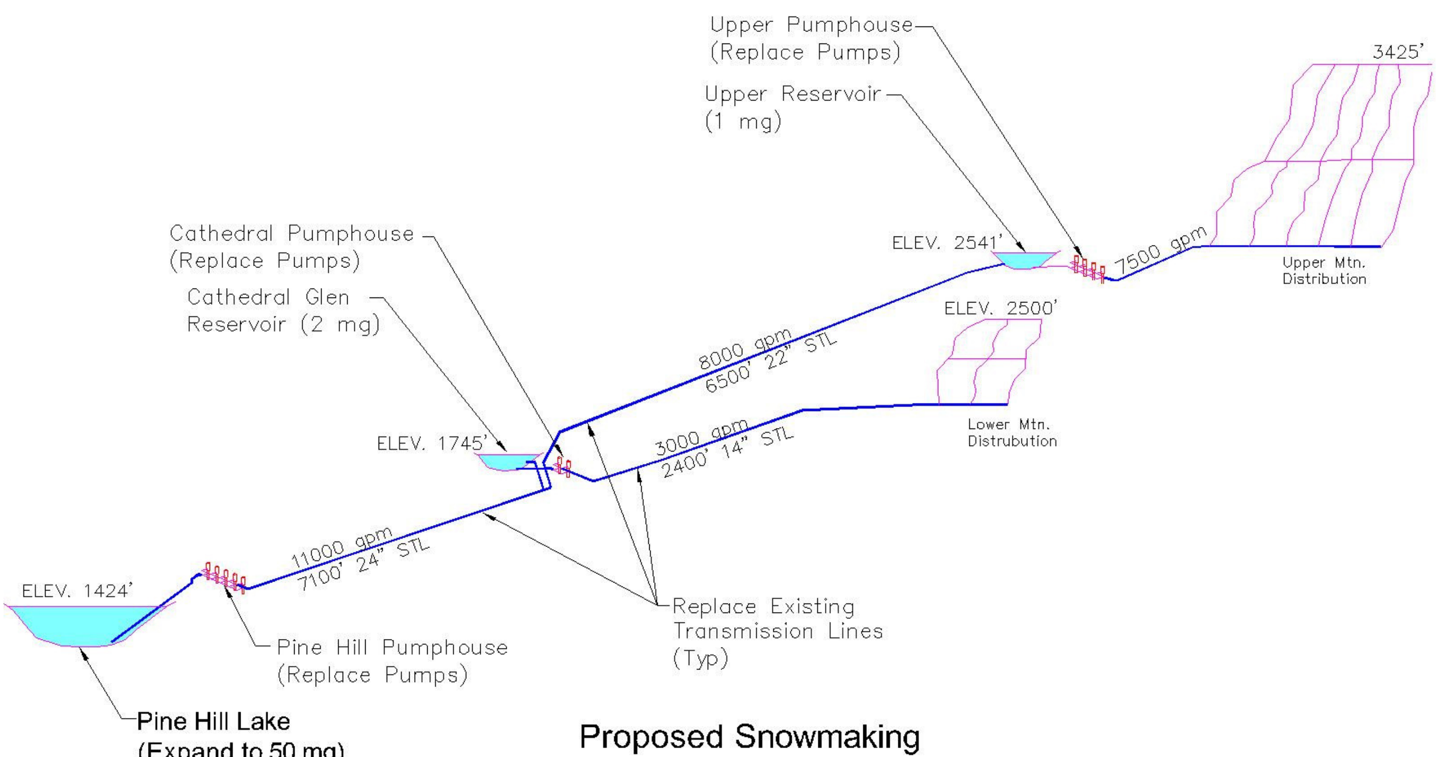
Reservoir site selection criteria should include the following; land area availability, suitable soils, adequate buffers to environmentally sensitive areas, as high in elevation and as close to the ski trails as possible, in proximity to existing stream to utilize excess runoff from stream, and to allow recycling of melted snow from the ski center. The site behind the new Maintenance Garage meets all of these criteria.

In addition to providing the required storage volume for the holiday operation, there are several other distinct benefits of providing an new storage reservoir at this location; ability to store available water from the existing Cathedral Glen reservoir at a higher elevation, ability to pump from Pine Hill Lake at off-peak hours to avoid higher electrical use and demand charges, ability to divert higher stormwater flows from existing Crystal Brook stream to attenuate flows downstream.

The following two schematic diagrams show two alternatives to supply water to the snowmaking system at Belleayre. Alternative #1 provides a new lower storage reservoir and pumping facilities, while leaving the existing 16" transmission line from Pine Hill Lake intact. Alternative #2 does not provide for additional storage, but provides for increased pumping rates from Pine Hill lake by replacing pumps, and replaceing the existing 16" transmission line.



Proposed Snowmaking
Water Supply Schematic
Alternative #1



Proposed Snowmaking
Water Supply Schematic
Alternative #2

As a result of the required higher peak flows in the Mountain Upper and Lower Distribution Systems, the existing water distribution system on the upper and lower mountain will need to be modified to provide the increased flow rates indicated in the modeling. As a guide to the proper selection of piping, the following chart was created to determine the maximum flow allowable in various sizes of steel pipe. A maximum flow velocity of 6 ft/sec yields a reasonable maximum head loss due to friction inside the pipe. The proposed distribution system conceptual plans indicate pipe sizing based on this guide chart, and the modeled flow requirements of the previous section. Transmission lines were sized on a case by case basis and allow a somewhat higher friction loss.

SNOWMAKING WATER LINES

LENGTH (ft)	DIA. (in)	HAZEN "C"	FLOW (gpm)	VEL. (ft/sec)	LOSS (ft)	LOSS (psi)	LOSS (%)
1000	6	120	530	6.0	26.67	11.6	2.67
1000	8	120	940	6.0	18.99	8.2	1.90
1000	10	120	1460	6.0	14.48	6.3	1.45
1000	12	120	2100	6.0	11.68	5.1	1.17
1000	14	120	2900	6.0	10.03	4.3	1.00
1000	16	120	3750	6.0	8.42	3.7	0.84
1000	18	120	4750	6.0	7.35	3.2	0.74
1000	20	120	5900	6.0	6.6	2.9	0.66
1000	22	120	7100	6.0	5.8	2.5	0.58

The following pages compute the required pump sizes for the two water supply alternatives.

SNOWMAKING WATER SUPPLY - ALTERNATIVE #1 - PUMP SIZING CALCS

PINE HILL PUMPS

FLOW (gpm)	5400		
SECTION 1 PIPE LENGTH (ft)	7100	SECTION 2 PIPE LENGTH (ft)	2400
PIPE DIAMETER (in)	16	PIPE DIAMETER (in)	20
HAZEN "C"	120	HAZEN "C"	120
Velocity Section 1 (ft/sec)	8.6	Velocity Section 2 (ft/sec)	5.5
Head Loss Section 1 (ft)	117	Head Loss Section 2 (ft)	13
Total Head Loss (ft)	131		
SUPPLY ELEV (ft)	1406		
DISCHARGE ELEV (ft)	1925		
DISCHARGE PRESS (psi)	0		
Computed TDH (ft)	650	OVERALL PUMP EFF. (%)	75
Computed Disch. Pressure (psi)	282		
Computed Electrical Power (hp)	1183	Computed kw/gpm	0.16

CATHEDRAL GLEN PUMPS

FLOW (gpm)	2000		
SECTION 1 PIPE LENGTH (ft)	2400		
PIPE DIAMETER (in)	12		
HAZEN "C"	120		
Velocity Section 1 (ft/sec)	5.7		
Head Loss Section 1 (ft)	26		
Total Head Loss (ft)	26		
SUPPLY ELEV (ft)	1734		
DISCHARGE ELEV (ft)	1926		
DISCHARGE PRESS (psi)	0		
Computed TDH (ft)	218	OVERALL PUMP EFF. (%)	75
Computed Disch. Pressure (psi)	94		
Computed Electrical Power (hp)	147	Computed kw/gpm	0.05

LOWER RESERVOIR PUMPS TO LOWER DISTRIBUTION

FLOW (gpm)	3000		
SECTION 1 PIPE LENGTH (ft)	2000		
PIPE DIAMETER (in)	14		
HAZEN "C"	120		
Velocity Section 1 (ft/sec)	6.3		
Head Loss Section 1 (ft)	21		
Total Head Loss (ft)	21		
SUPPLY ELEV (ft)	1910		
DISCHARGE ELEV (ft)	2500		
DISCHARGE PRESS (psi)	150		
Computed TDH (ft)	957	OVERALL PUMP EFF. (%)	75
Computed Disch. Pressure (psi)	415		
Computed Electrical Power (hp)	968	Computed kw/gpm	0.24

SNOWMAKING WATER SUPPLY - ALTERNATIVE #1 - PUMP SIZING CALCS (cont)

FLOW (gpm)	8000		
SECTION 1 PIPE LENGTH (ft)	7000		
PIPE DIAMETER (in)	20		
HAZEN "C"	120		
Velocity Section 1 (ft/sec)	8.2		
Head Loss Section 1 (ft)	81		
Total Head Loss (ft)	81		
SUPPLY ELEV (ft)	1910		
DISCHARGE ELEV (ft)	2541		
DISCHARGE PRESS (psi)	0		
Computed TDH (ft)	712	OVERALL PUMP EFF. (%)	75
Computed Disch. Pressure (psi)	309		
Computed Electrical Power (hp)	1919	Computed kw/gpm	0.18

<u>UPPER RESERVOIR PUMPS TO UPPER DISTRIBUTION</u>

FLOW (gpm)	7500		
SECTION 1 PIPE LENGTH (ft)	7000		
PIPE DIAMETER (in)	20		
HAZEN "C"	120		
Velocity Section 1 (ft/sec)	7.7		
Head Loss Section 1 (ft)	72		
Total Head Loss (ft)	72		
SUPPLY ELEV (ft)	2531		
DISCHARGE ELEV (ft)	3425		
DISCHARGE PRESS (psi)	150		
Computed TDH (ft)	1311	OVERALL PUMP EFF. (%)	75
Computed Disch. Pressure (psi)	569		
Computed Electrical Power (hp)	3315	Computed kw/gpm	0.33

SNOWMAKING WATER SUPPLY - ALTERNATIVE #2

PINE HILL PUMPS

FLOW SECTION #1 (gpm)	11000	FLOW SECTION #2 (gpm)	8000
SECTION 1 PIPE LENGTH (ft)	7100	SECTION 2 PIPE LENGTH (ft)	6500
PIPE DIAMETER (in)	24	PIPE DIAMETER (in)	22
HAZEN "C"	120	HAZEN "C"	120
Velocity Section 1 (ft/sec)	7.8	Velocity Section 2 (ft/sec)	6.8
Head Loss Section 1 (ft)	61	Head Loss Section 2 (ft)	85
Total Head Loss (ft)	146		
SUPPLY ELEV (ft)	1406		
DISCHARGE ELEV (ft)	2541		
DISCHARGE PRESS (psi)	0		
Computed TDH (ft)	1281	OVERALL PUMP EFF. (%)	75
Computed Disch. Pressure (psi)	556		
Computed Electrical Power (hp)	4749		

CATHEDRAL GLEN PUMPS TO LOWER DISTRIBUTION

FLOW (gpm)	3000		
SECTION 1 PIPE LENGTH (ft)	2400		
PIPE DIAMETER (in)	14		
HAZEN "C"	120		
Velocity Section 1 (ft/sec)	6.3		
Head Loss Section 1 (ft)	26		
Total Head Loss (ft)	26		
SUPPLY ELEV (ft)	1734		
DISCHARGE ELEV (ft)	1926		
DISCHARGE PRESS (psi)	150		
Computed TDH (ft)	563	OVERALL PUMP EFF. (%)	75
Computed Disch. Pressure (psi)	244		
Computed Electrical Power (hp)	570		

UPPER RESERVOIR PUMPS TO UPPER DISTRIBUTION

FLOW (gpm)	7500		
SECTION 1 PIPE LENGTH (ft)	7000		
PIPE DIAMETER (in)	20		
HAZEN "C"	120		
Velocity Section 1 (ft/sec)	7.7		
Head Loss Section 1 (ft)	72		
Total Head Loss (ft)	72		
SUPPLY ELEV (ft)	2531		
DISCHARGE ELEV (ft)	3425		
DISCHARGE PRESS (psi)	150		
Computed TDH (ft)	1311	OVERALL PUMP EFF. (%)	75
Computed Disch. Pressure (psi)	569		
Computed Electrical Power (hp)	3315		

It is desired to make an analysis of the annual energy costs of the two alternative water supply systems to aid in the selection of the best system.

Some data can be assumed to be common to the two systems and is displayed in the following table:

SNOWMAKING ALTERNATIVE WATER SUPPLY PUMPING COST COMPARISON COMMON DATA

	Nov - Dec	Jan - Mar	Total
Enter Upper Mountain Volume (mg)	51	112	163
Enter Lower Mountain Volume (mg)	13	30	44
Total (mg)	64	142	206
Enter Off Peak Energy Cost	$0.12		
Enter On Peak Energy Cost	$0.16		
Enter On Peak Demand Charge	$7.50		

In order to make a reasonable evaluation of the energy costs of the two alternatives, some assumptions must be made in regard to the operation of the systems. The assumptions are as follows:

Alternative #1 Assumptions

The proposed lower reservoir will begin the season full, with 35 mg of usable water. Water will be pumped from Cathedral Glen reservoir to replenish the lower reservoir during off peak times, and a total of 25 mg will be available during Nov. – Dec. Pine Hill Lake reservoir will then be pumped during off peak times to replenish the lower reservoir. During Jan.-March, another 25 mg will be available from Cathedral Glen Reservoir, and the rest of the demand will be replenished from Pine Hill Lake. All pumping from Pine Hill Lake and Cathedral Glen will be made during off peak hours due to the storage capacity provided at the new lower reservoir.

During November and December, it is assumed that pumping of water from the lower reservoir and out into the lower and upper distribution systems will occur during peak demand times, and will thus incur a demand charge.

During the rest of the season it is assumed that pumping of water from the lower reservoir and out into the lower and upper distribution systems will occur only during off peak times.

Alternative #2 Assumptions

During November and December, it is assumed that pumping of water from Pine Hill Lake to the upper pumphouse, and out into upper distribution systems will occur during peak demand times, and will thus incur a demand charge. Also it is assumed water pumped from the Cathedral Glen into the lower distribution system will occur during peak demand times, and will incur a demand charge.

During the rest of the season, it is assumed that all water pumping will occur during off peak times.

WATER SUPPLY SEASON ENERGY COST - ALTERNATIVE #1

November - December		January - March	
Lower Reservoir Initial Storage	35		
		Cathedral Glen to Lower Reservoir	
Cathedral Glen to Lower Reservoir			
Volume (mg)	25	Volume (mg)	25
Flow (gpm)	2000	Flow (gpm)	2000
Electrical Horsepower =	147	Electrical Horsepower =	147
Pump KW =	109	Pump KW =	109
Pumping Time (hrs) =	208	Pumping Time (hrs) =	208
Pumping KWH	22789	Pumping KWH	22789
Off Peak Energy Cost =	$2,735	Off Peak Energy Cost =	$2,735
Pine Hill to Lower Reservoir		Pine Hill to Lower Reservoir	
Volume (mg)	4	Volume (mg)	117.2
Flow (gpm)	5400	Flow (gpm)	5400
Electrical Horsepower =	1183	Electrical Horsepower =	1183
Pump KW =	882	Pump KW =	882
Pumping Time (hrs) =	12	Pumping Time (hrs) =	362
Pumping KWH	10616	Pumping KWH	319022
Off Peak Energy Cost =	$1,274	Off Peak Energy Cost =	$38,283
Lower Reservoir to Upper Res.		Lower Reservoir to Upper Res.	
Enter Volume (mg)	51	Enter Volume (mg)	112
Flow (gpm)	8000	Flow (gpm)	8000
Electrical Horsepower =	1919	Electrical Horsepower =	1919
Pump KW =	1431	Pump KW =	1431
Pumping Time (hrs) =	105	Pumping Time (hrs) =	233
Pumping KWH	150888	Pumping KWH	333684
On Peak Energy Cost =	$24,142	Off Peak Energy Cost =	$40,042
2 x Monthly Demand	$21,470		
Lower Reservoir to Lower Dist.		Lower Reservoir to Lower Dist	
Enter Volume (mg)	13	Enter Volume (mg)	30
Flow (gpm)	3000	Flow (gpm)	3000
Electrical Horsepower =	968	Electrical Horsepower =	968
Pump KW =	722	Pump KW =	722
Pumping Time (hrs) =	74	Pumping Time (hrs) =	168
Pumping KWH	53315	Pumping KWH	121461
On Peak Energy Cost =	$8,530	Off Peak Energy Cost =	$14,575
2 x Monthly Demand	$10,823		
Upper Reservoir to Upper Dist.		Upper Reservoir to Upper Dist	
Enter Volume (mg)	51	Enter Volume (mg)	112
Flow (gpm)	7500	Flow (gpm)	7500
Electrical Horsepower =	3315	Electrical Horsepower =	3315
Pump KW =	2472	Pump KW =	2472
Pumping Time (hrs) =	112	Pumping Time (hrs) =	249
Pumping KWH	277960	Pumping KWH	614698
On Peak Energy Cost =	$44,474	Off Peak Energy Cost =	$73,764
2 x Monthly Demand	$37,080		
Energy Cost Sub-Total	$150,528	Energy Cost Sub-Total	$169,399
Total Energy Cost Alt. #1	**$319,927**		

WATER SUPPLY SEASON ENERGY COST - ALTERNATIVE #2

November - December		January - March	
Pine Hill to Upper Reservoir		**Pine Hill to Upper Reservoir**	
Volume (mg)	51	Volume (mg)	112
Flow (gpm)	8000	Flow (gpm)	8000
Electrical Horsepower =	4749	Electrical Horsepower =	4749
Pump KW =	3542	Pump KW =	3542
Pumping Time (hrs) =	105	Pumping Time (hrs) =	233
Pumping KWH	373347	Pumping KWH	825643
On Peak Energy Cost =	$ 59,736	Off Peak Energy Cost =	$99,077
2 x Monthly Demand	$ 53,125		
Cathedral Glen to Lower Dist.		**Cathedral Glen to Lower Dist.**	
Enter Volume (mg)	13	Enter Volume (mg)	30
Flow (gpm)	3000	Flow (gpm)	3000
Electrical Horsepower =	570	Electrical Horsepower =	570
Pump KW =	425	Pump KW =	425
Pumping Time (hrs) =	74	Pumping Time (hrs) =	168
Pumping KWH	31379	Pumping KWH	71488
On Peak Energy Cost =	$ 5,021	Off Peak Energy Cost =	$ 8,579
2 x Monthly Demand	$ 6,370		
Upper Reservoir to Upper Dist.		**Upper Reservoir to Upper Dist.**	
Enter Volume (mg)	51	Enter Volume (mg)	112
Flow (gpm)	7500	Flow (gpm)	7500
Electrical Horsepower =	3315	Electrical Horsepower =	3315
Pump KW =	2472	Pump KW =	2472
Pumping Time (hrs) =	112	Pumping Time (hrs) =	249
Pumping KWH	277960	Pumping KWH	614698
On Peak Energy Cost =	$ 44,474	Off Peak Energy Cost =	$73,764
2 x Monthly Demand	$ 37,080		
Energy Cost Sub-Total	$ 205,804	Energy Cost Sub-Total	$181,420
Total Energy Cost Alt. #2	**$ 387,224**		

Comparison of Construction Costs

Item	Unit Price	Qty	Cost
12" Transmission Line	$75	2400	$180,000
14" Transmission Line	$85	2400	$204,000
20" Transmission Line	$100	2400	$240,000
20" Transmission Line	$100	7000	$700,000
Reservoir Construction	$3,000,000	1	$3,000,000
New Lower Pumphouse	$1,000,000	1	$1,000,000
		Total	$5,324,000

Alternative #2 Differential Construction Cost

Item	Unit Price	Qty	Cost
14" Transmission Line	$85	2400	$204,000
22" Transmission Line	$130	6500	$845,000
24" Transmission Line	$150	7100	$1,065,000
Pumphouse Construction	$1,000,000	1	$1,000,000
New Pine Hill Pumphouse	$1,000,000	1	$1,000,000
Pine Hill Lake Expansion	$2,000,000	1	$2,000,000
		Total	$6,114,000
		Difference	$790,000

Based on the annual energy cost estimates, and the differential construction cost estimate, Alternative #1 is recommended as the preferred alternative for the proposed snowmaking water supply.

PROPOSED COMPRESSED AIR SYSTEM

The cost of producing compressed air with the diesel powered portable rental compressors (currently used) and modern electrically driven centrifugal compressors (proposed) is calculated and compared below. For comparison purposes, 24 hours of operation at 24,000 cfm is used to compare energy costs. Also, monthly equipment rental cost is compared to monthly electrical demand charges.

Enter Compressed Air Flow (cfm)	24000
Enter Time (hrs)	24
Computed Volume (cf)	34560000
Rental Diesel Compressors	
Enter Fuel Cost ($/gal)	$2.75
Enter Unit Fuel Use (gpm)	0.3
Enter Unit Air Flow @ 102 psi (cfm)	1600
Enter Unit Rental Cost ($/wk)	$1,716
Computed Fuel Gallons	6,480
Computed Fuel Cost	$17,820
Computed Monthly Rental Cost	$102,960
New Electric Stationary Air Compressors	
Enter On Peak Cost ($/kwh)	$0.16
Enter Off Peak Cost ($/kwh)	$0.12
Enter Demand Charge Rate ($/kw)	$7.00
Enter Unit Air Flow @ 100 psi (cfm)	6000
Enter Equipment kw/cfm	0.143
Computed kw	3432
Computed kwh	82,368
On Peak Use Cost	$13,179
Off Peak Use Cost	$9,884
On Peak Monthly Demand Charge	$24,024

The results show that even when used during on-peak periods, the energy use costs for the newer electric compressors is significantly less than the diesel powered compressors for the assumed diesel fuel cost of $2.75 per gallon. The monthly demand charge for the new electrics is easily offset by the elimination of the monthly rental cost for the diesels. Based on this comparison, high efficiency modern stationary electric compressors are recommended for the compressed air system. Other benefits of this system include reduced diesel engine maintenance costs, reduced costs for maintenance of petroleum bulk storage equipment, and reduced on-site air emissions.

The existing compressed air distribution system on the upper and lower mountain will need to be modified to provide the increased air flow rates indicated in the modeling. As a guide to the proper selection of piping, the following chart was created to determine the maximum flow allowable in various sizes of steel pipe. The proposed distribution system plans indicate pipe sizing based on this guide chart, flow requirements from the snowmaking model.

SNOWMAKING AIR LINES

LENGTH (ft)	DIAMETER (in)	FREE AIR FLOW (cfm)	FREE AIR VELOCITY (ft/sec)	PRESSURE LOSS per 100' (psi)	PRESSURE LOSS TOTAL (psi)
10000	6	1200	101.9	0.035	3.5
10000	8	2500	119.4	0.035	3.5
10000	10	4500	137.5	0.035	3.5
10000	12	*6500*	137.9	*0.035*	3.5
10000	14	*9000*	140.3	*0.035*	3.5
10000	16	*12000*	143.2	*0.035*	3.5
10000	18	*16000*	150.9	*0.035*	3.5
10000	20	*20000*	152.8	*0.035*	3.5
10000	22	*24000*	151.5	*0.035*	3.5
10000	24	*30000*	159.2	*0.035*	3.5

Note: Pressure Loss for Compressed Air @ 100 psig. Data Highlighted in italics are extrapolated values from data chart