

INTRODUCTION TO SNOWMAKING & Trail Analysis

By:
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❖ Nordic Video Introduction

❖ Snowmaking Basics

- Natural vs Man Made Snow
- Factors effecting snowmaking process

❖ Building a Trail

- Acreage
- Capacity Required
- Weather Data

❖ Example

- Rikerts





Snowmaking

A SIMPLE PROCESS... OR IS IT?

Water droplets

+

Cold air

=

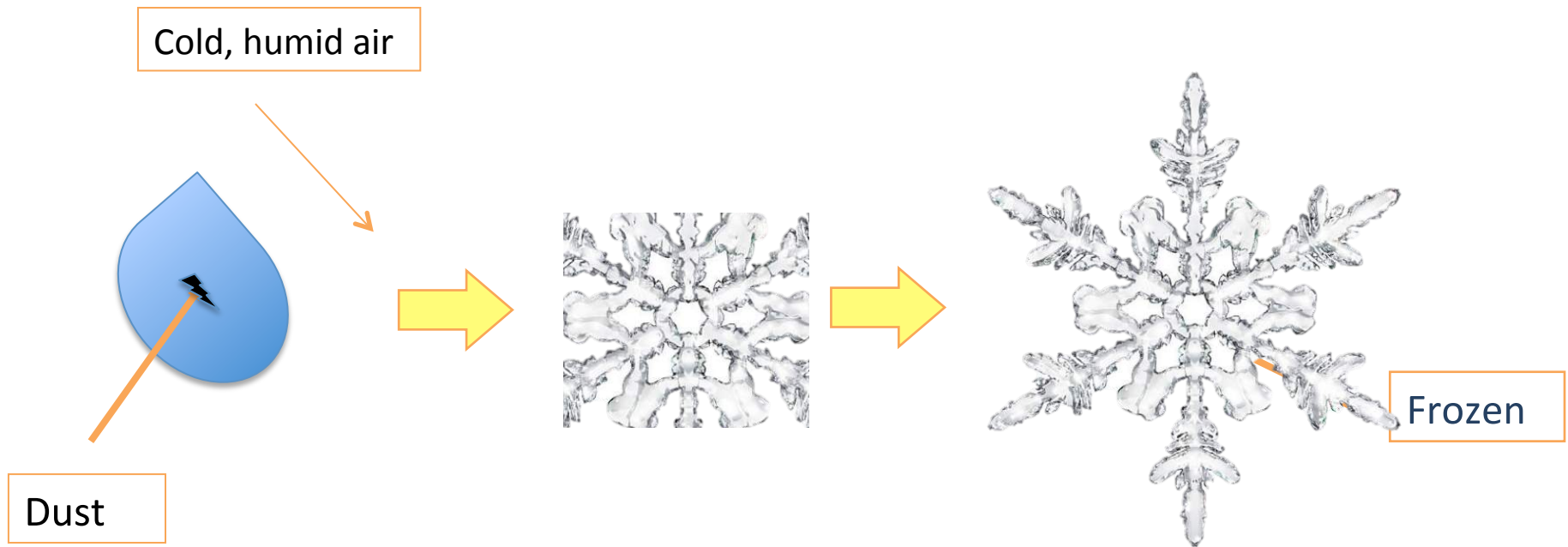
Snow

Natural Snow

- ❖ **Snow Density** - Natural snow is lighter.
- ❖ **Water content** - ranges from 6% to 12%.
- ❖ **Dendrite** - a crystal or crystalline mass with a branching, treelike structure.
- ❖ **Each snowflake is unique**



Natural Snow

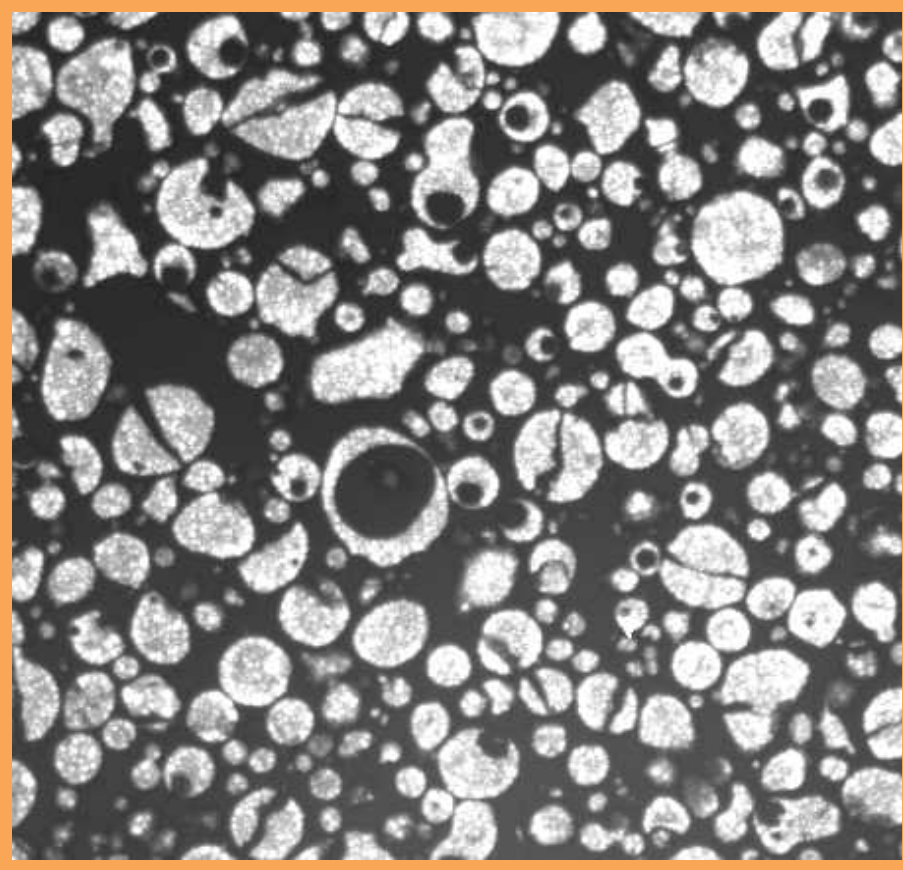


Forms From the Inside to the Outside

Snow

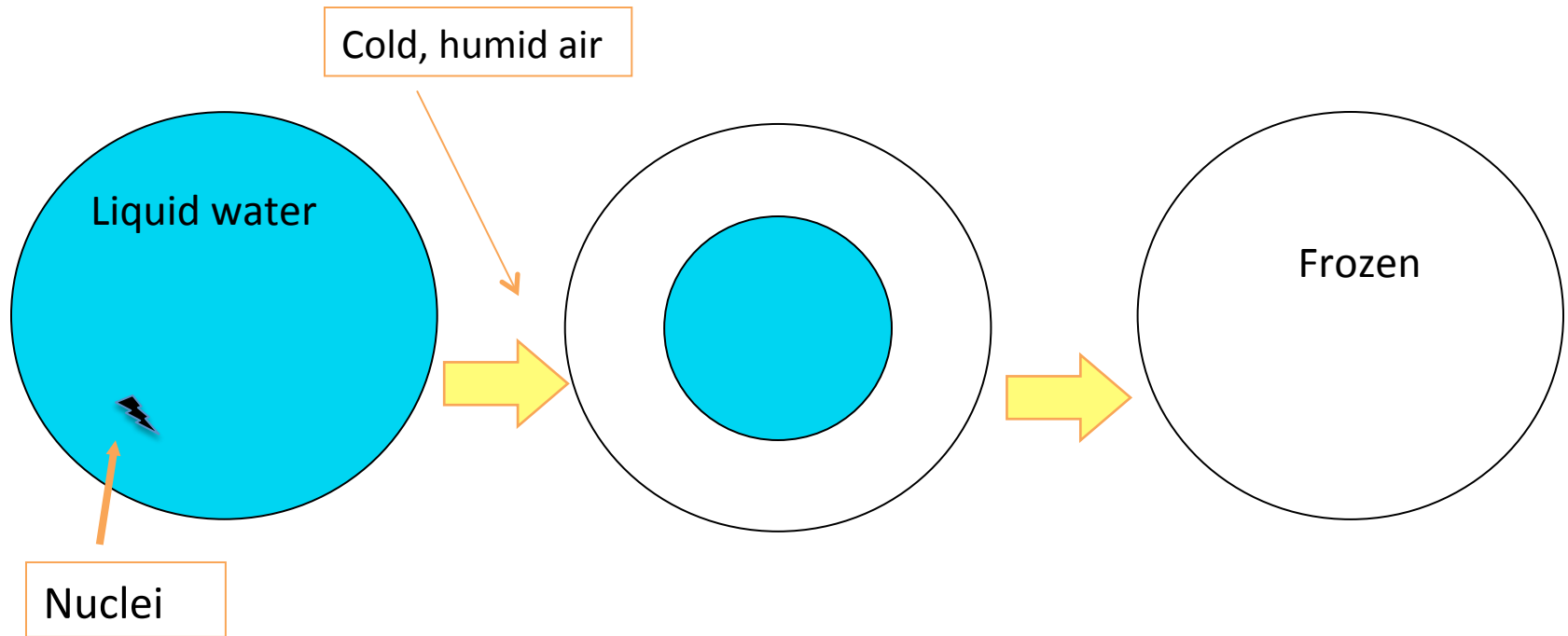


Man-Made Snow



- ❖ **Snow Density** – Man-Made is heavier per volume.
- ❖ **Water content** - ranges from 20% to 50%.
- ❖ **Shape** – man-made snow is a frozen/crystalized ball.
- ❖ **The Size** - of man-made snow crystals are 200 to 800 microns.

Man-Made Snow



Freezes from the outside in

Here are a few Variables Effecting the Freezing Process of a Water Droplet:

- ❖ **Temperature**
- ❖ **Humidity**
- ❖ **Droplet Size**
- ❖ **Water Temperature**
- ❖ **Nucleation**
- ❖ **Dwell Time**

Temperature

❖ Dry Bulb Temperature



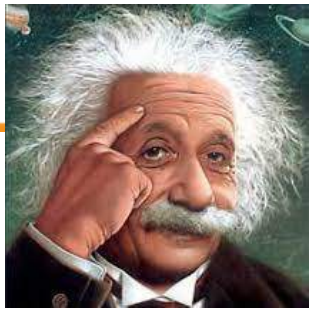
❖ Relative Humidity



Water mass in air

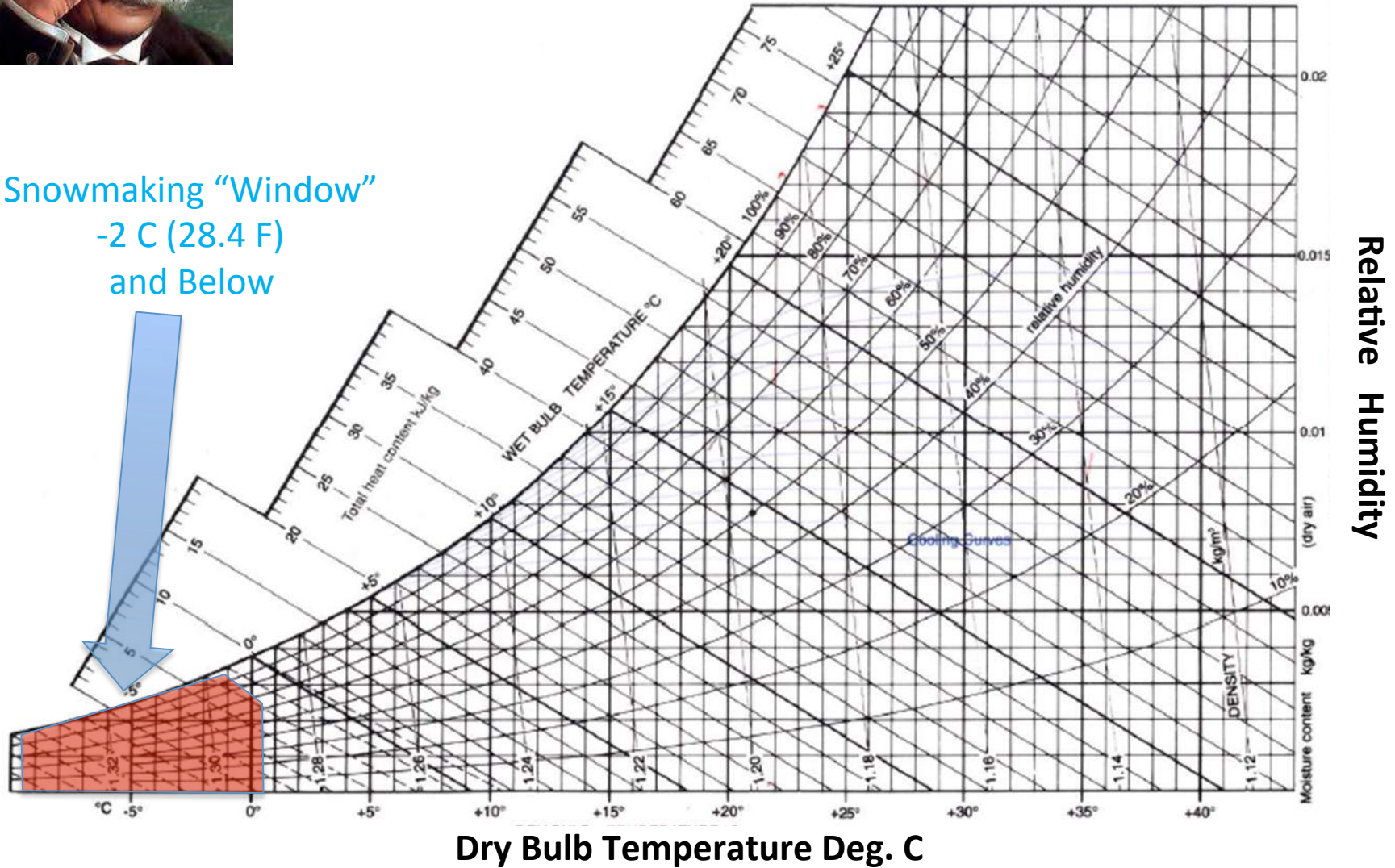
RH =

Maximum water mass that may contain air under
the same temperature and volume conditions

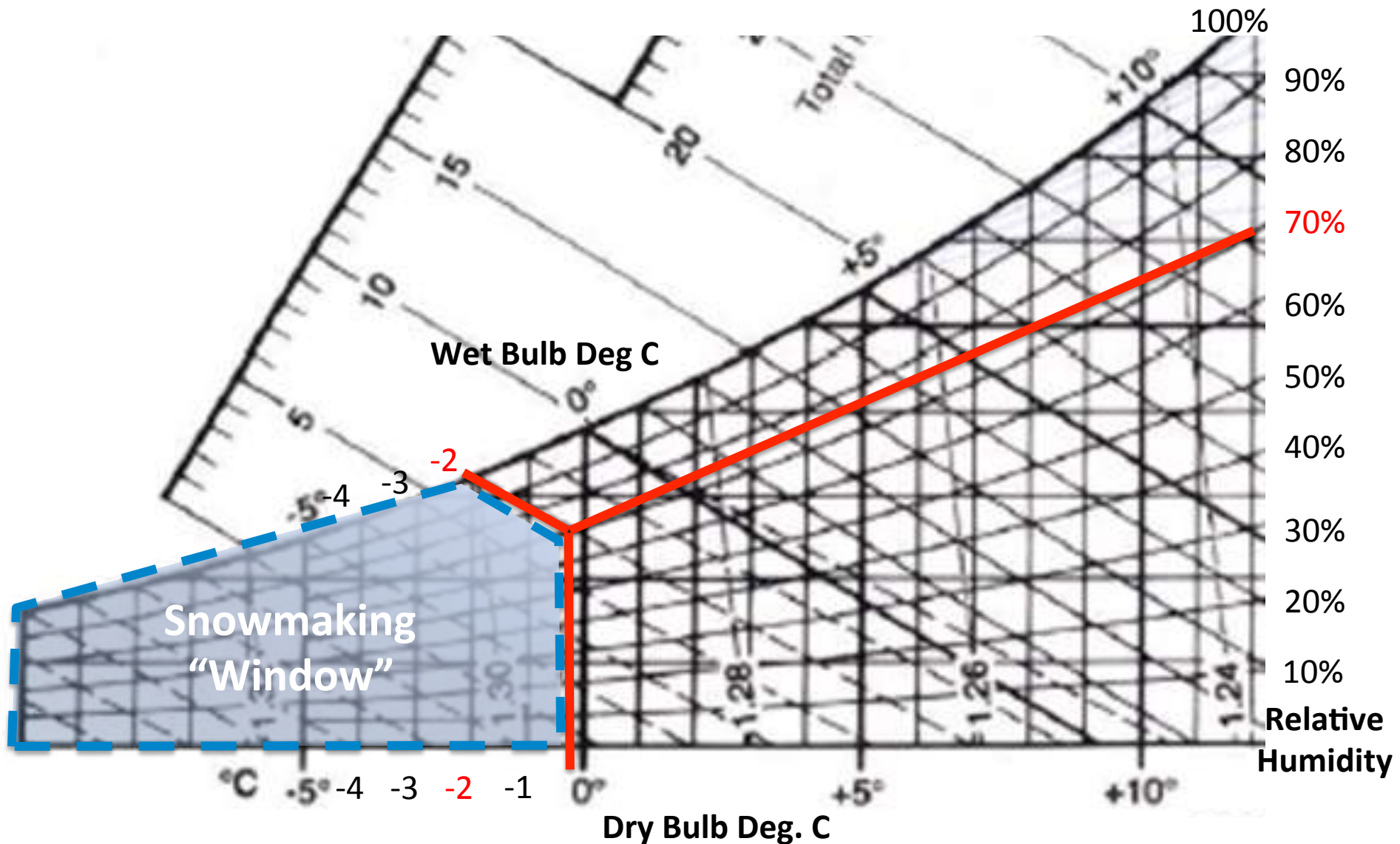


The Psychrometric Diagram

Snowmaking "Window"
-2 C (28.4 F)
and Below



Snowmaking Window -2 Deg C



Droplet Size

Surface Area to Mass Ratio

4 Times

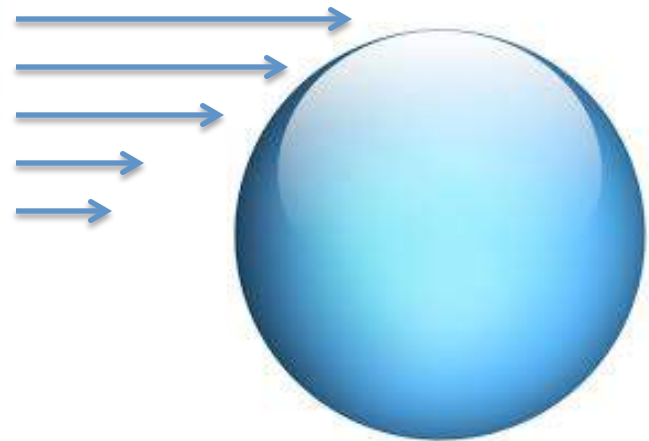
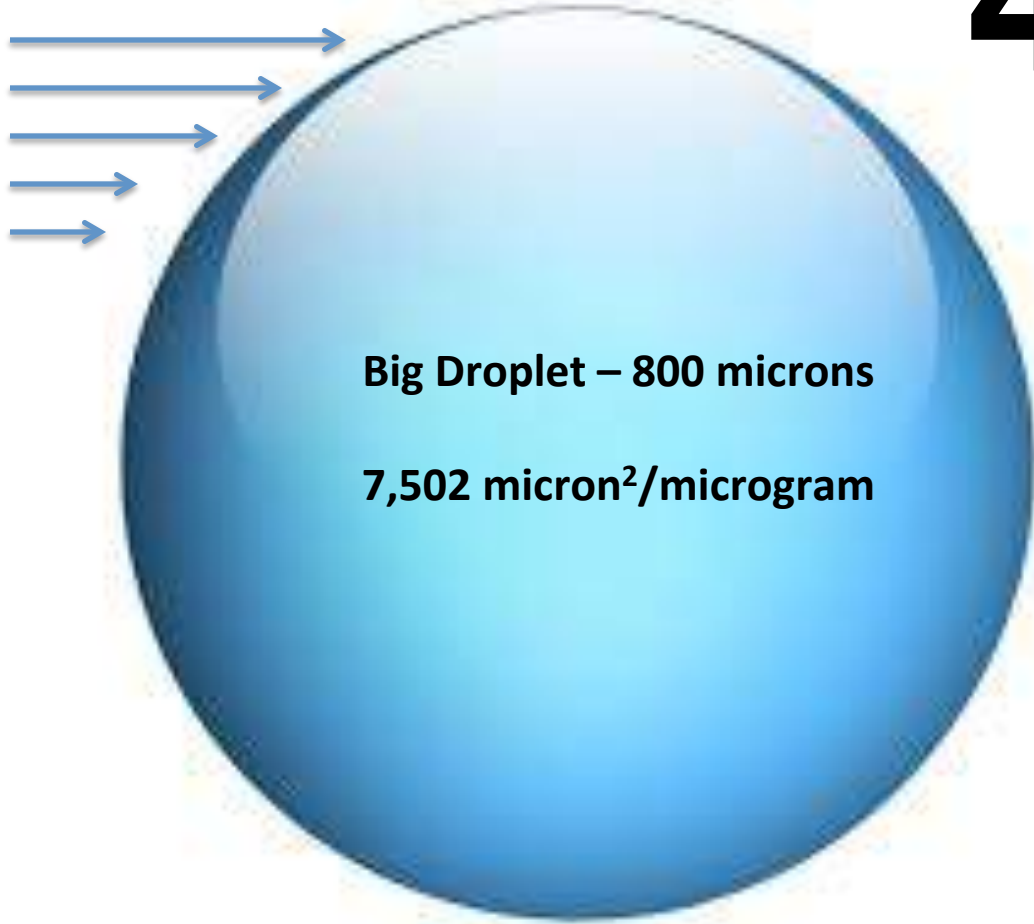
Big Droplet – 800 microns

7,502 $\mu\text{m}^2/\mu\text{g}$

Small Droplet – 200 microns

29,915 $\mu\text{m}^2/\mu\text{g}$

Cools Faster!



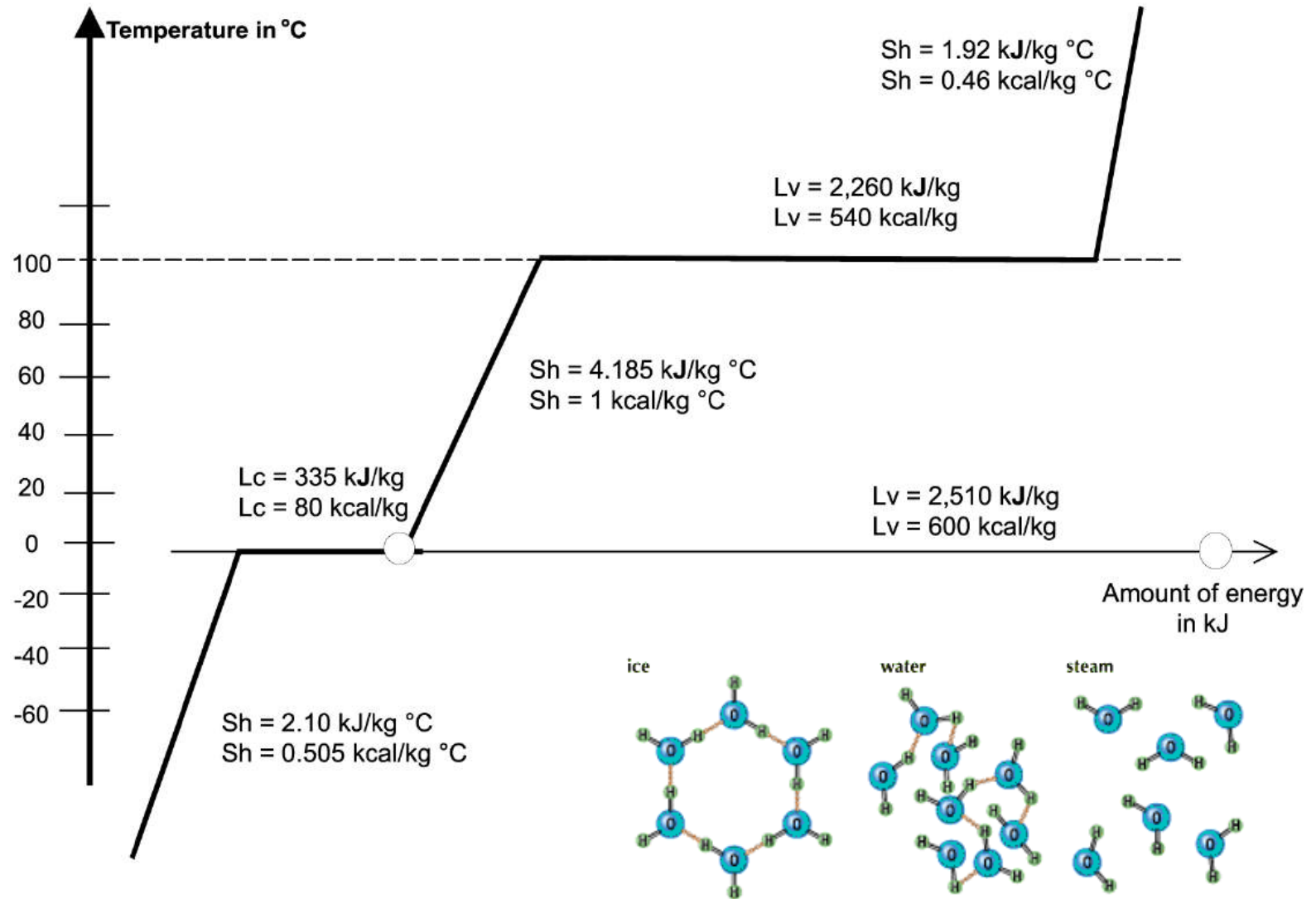
Water Temperature

- ❖ Water must cool to at least 32 degrees F. during the freezing process.
- ❖ Not all water will change from a liquid to a solid at 32 degrees F.
- ❖ Pure water will not freeze until -40F



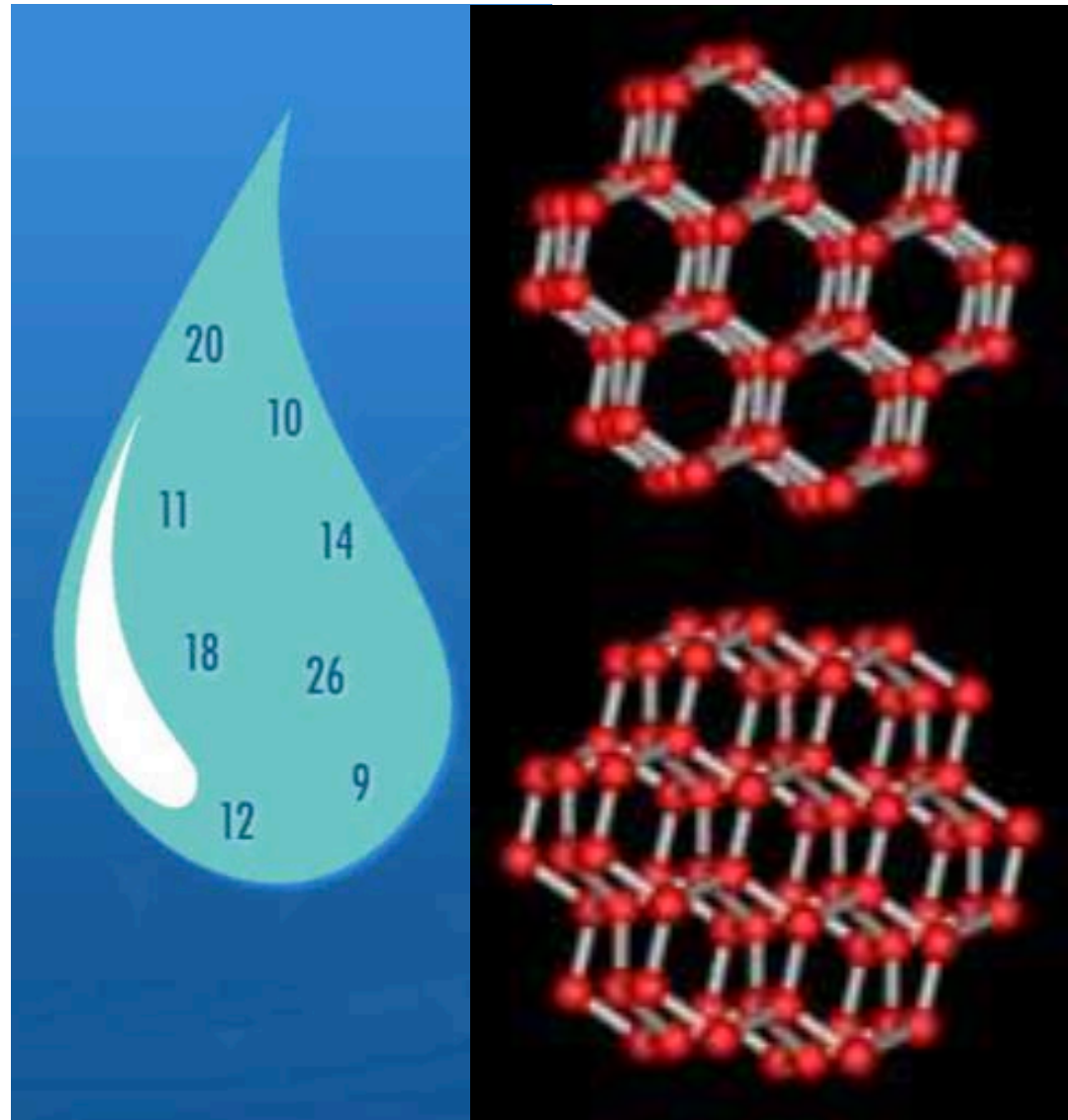
32°

Phase Change Diagram for Water



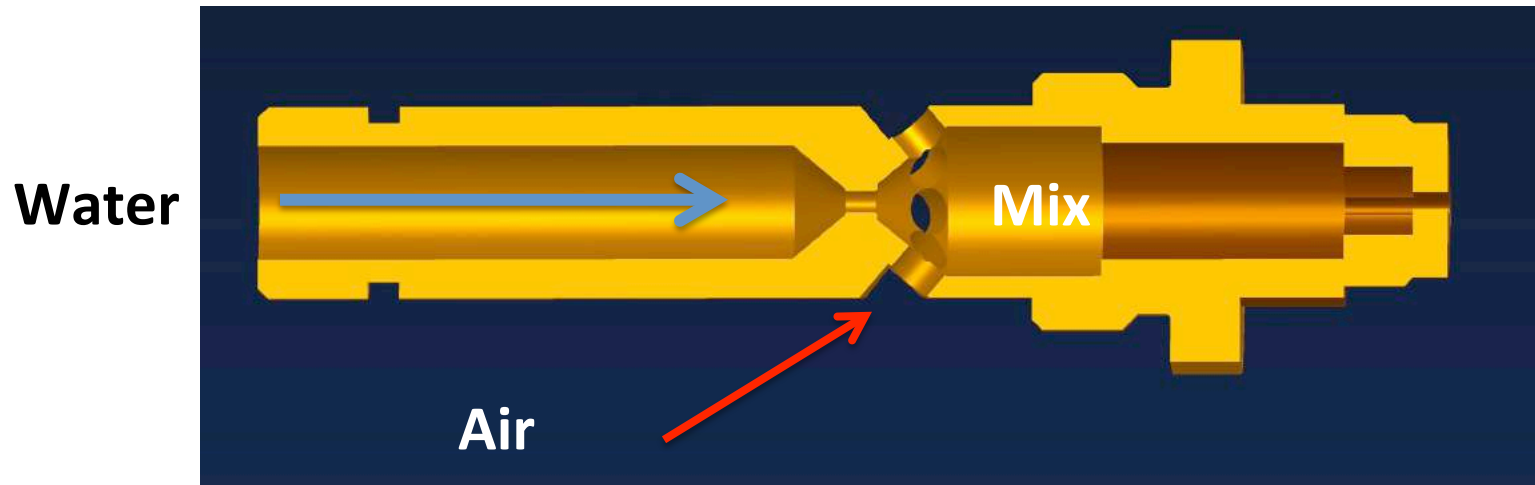
Nucleators

- ❖ There are various types of nucleators.
- ❖ Internal and External.
- ❖ Organic and Inorganic.
- ❖ Each type of nucleator has its “signature” freezing temperature



Internal Mix Nucleation

Micro droplets + Compressed air + Rapid expansion = Nuclei



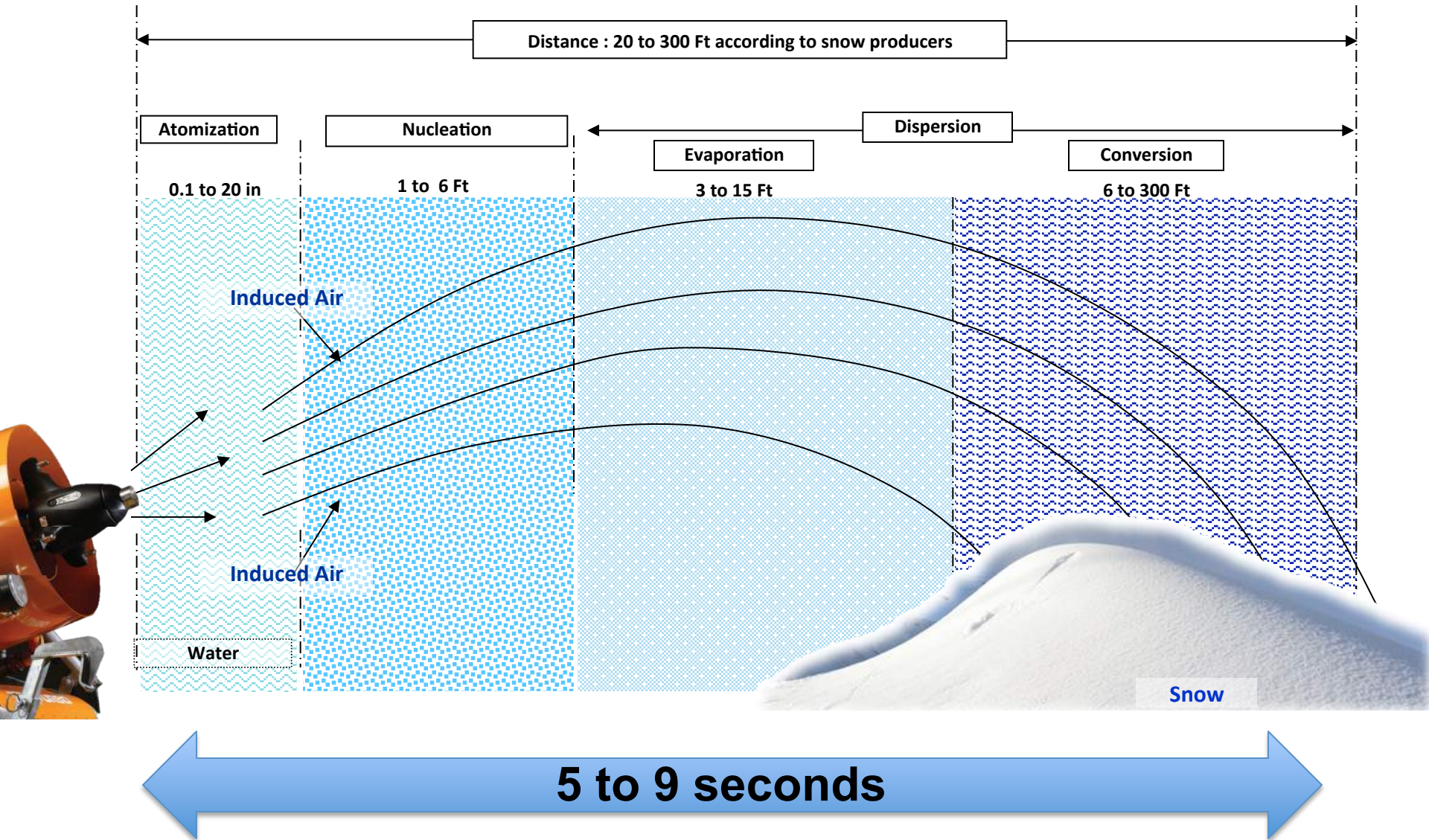
Ice Nucleators



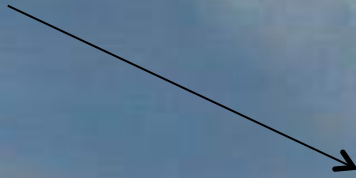
Snowguns Create Ice Nucleators



Snowmaking Principle



Evaporation



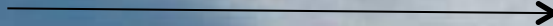
Atomization



Nucleation Zone



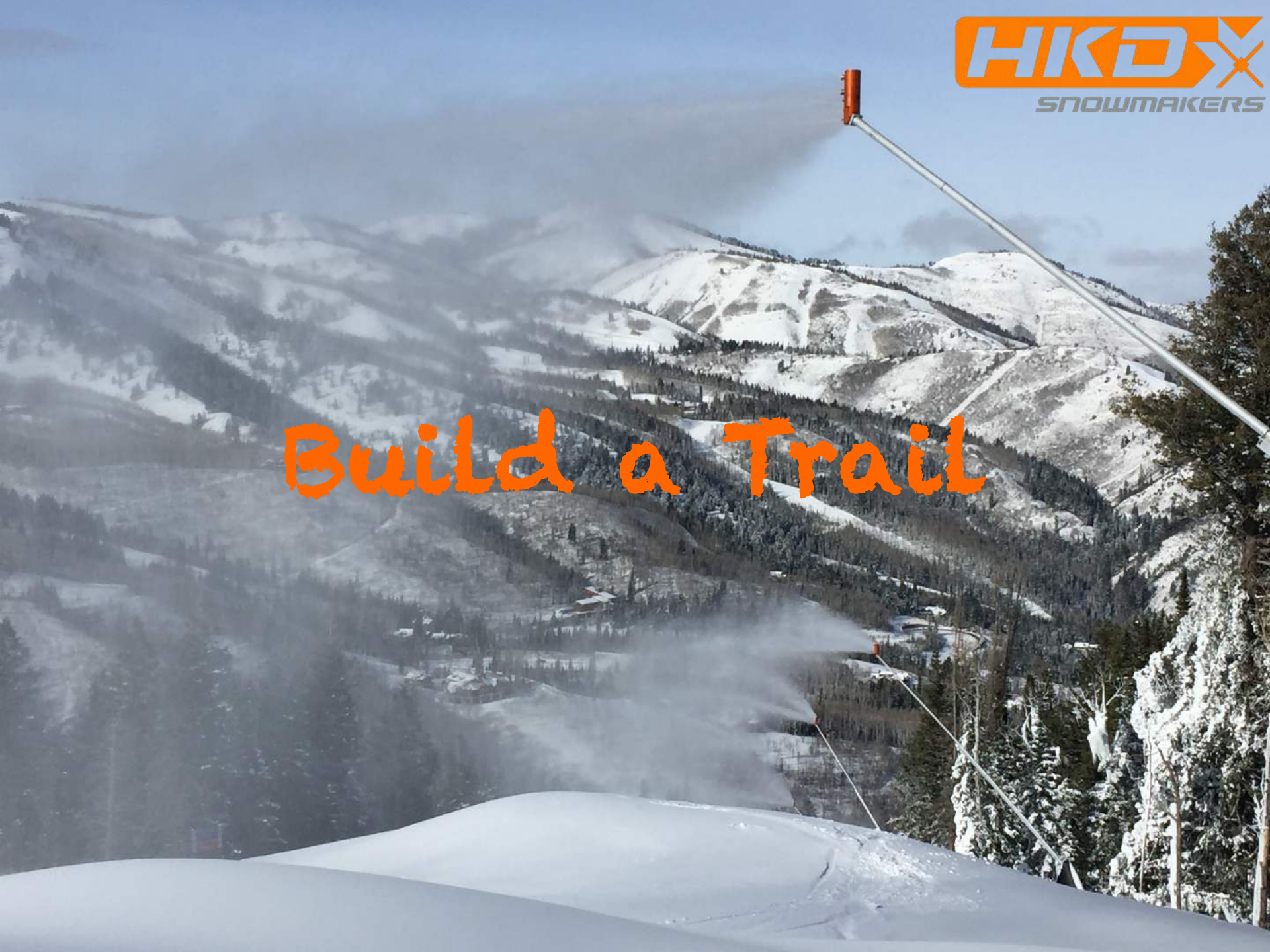
Conversion



5 to 12 seconds for Tower Guns



Build a Trail



Building a Trail for Success



Identify the Trail



Quantify your Resources



Evaluate Time



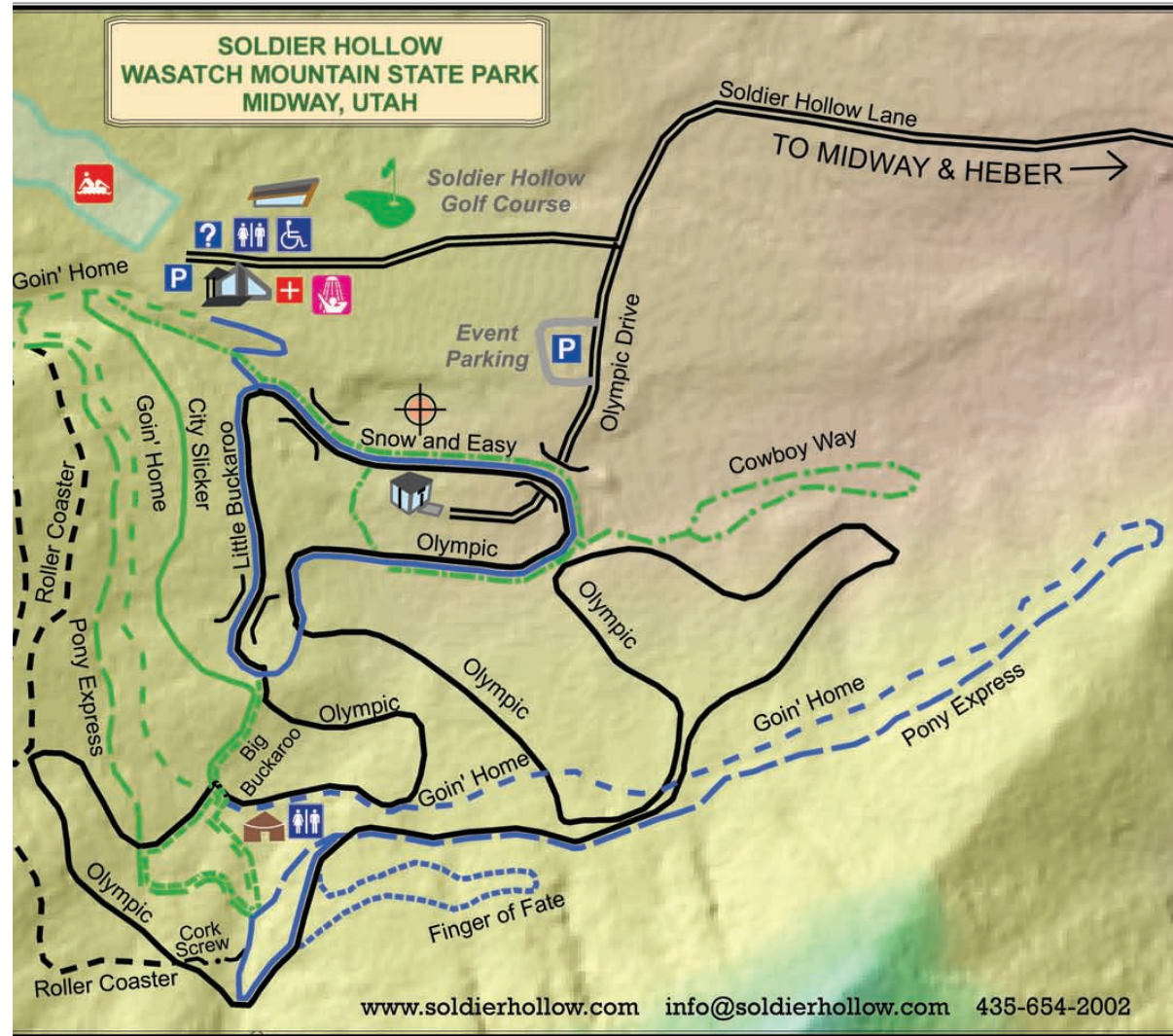
Evaluate Temperature



Generate a Budget

Select a Trail

Where would you
like to make snow?



Stadium / Splash Pad

Length of trail
250 Ft

Width of Trail
174 FT

Acreage of trail
1 Acres

Snow Depth Required
1.5 Feet

Gallons required
Gal per/acre FT 200,000

Water Required Gal
300,000



Formula : Length (FT) x Width (FT) / 43560 = Acres

Stadium / Splash Pad



The first option is the lowest cost and will provide a “starter” system for a Nordic center. This involves (1) 25HP pump and (1) carriage fan gun. With this option you can cover a large open area with the fan gun and stockpile snow for distribution onto narrow trails.

Budget Details

| USSA Nordic Option 4 | | Date: 6.19.17 | |
|--------------------------|------------------------------------------------|---------------|-------------|
| Quantity | Description | Line Price | Group Price |
| 1 | HKD Fan S/A Carriage w/ Halo | 38,390 | |
| 1 | Site Supervision and Startup | 1,000 | |
| 1 | HKD 25 Hp, 90 Gpm @ 350 Psi w/ fan front wheel | 18,000 | |
| 10 | HKD Hose, 2" Hose, 2" Cam M/F, Orange (100') | 3,488 | |
| HKD Snowmaking Equipment | | | 60,878 |
| USSA Discount | | | (7,678) |

Estimated Project Total

\$ 53,200

Estimated Project Total Price doesn't include, bringing primary power/ water to the site, freight charges, tax, permitting, or local civil engineering.

Items indicated with an asterisk * are not HKD produced products and these prices are for budgeting purposes only.

All Freight charges FOB plant or Source

\$ 53,200

Operation Time + Cost

| Time to open *Roughly* 18 GPM | | | | |
|-------------------------------|---------|----------|-----------|-------|
| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
| CXC Splash | 300,000 | 18 | 1 | 277 |
| CXC Splash | 300,000 | 18 | 2 | 138 |
| CXC Splash | 300,000 | 18 | 3 | 92 |
| CXC Splash | 300,000 | 18 | 4 | 69 |

| Operations Cost Electric (1 Fan 166 HR) \$.12 KWH | | | |
|---------------------------------------------------|-----|----------|---------------|
| Description | KWH | Total KW | Price |
| 1 25HP pump | 19 | 3167 | \$380 |
| 1 Fan Gun | 18 | 3000 | \$360 |
| Water (fire hydrant \$1.93 per cubic feet) | | | \$874 |
| Total | | | \$1614 |

| Time to open *Roughly* 30 GPM | | | | |
|-------------------------------|----------------|-----------|-----------|------------|
| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
| CXC Splash | 300,000 | 30 | 1 | 166 |
| CXC Splash | 300,000 | 30 | 2 | 83 |
| CXC Splash | 300,000 | 30 | 3 | 55 |
| CXC Splash | 300,000 | 30 | 4 | 41 |

| Operations Cost Generator (1 Fan 166 HR) \$2.37 per gal | | | |
|---------------------------------------------------------|--------------|----------|---------------|
| Description | | Per Hour | Price |
| 100KW Gen Rental | Per Week | | 1,200 |
| Diesel | 3 Gal per hr | \$7.11 | \$1,180 |
| Water (fire hydrant \$1.93 per cubic feet) | | | \$874 |
| Total | | | \$3154 |

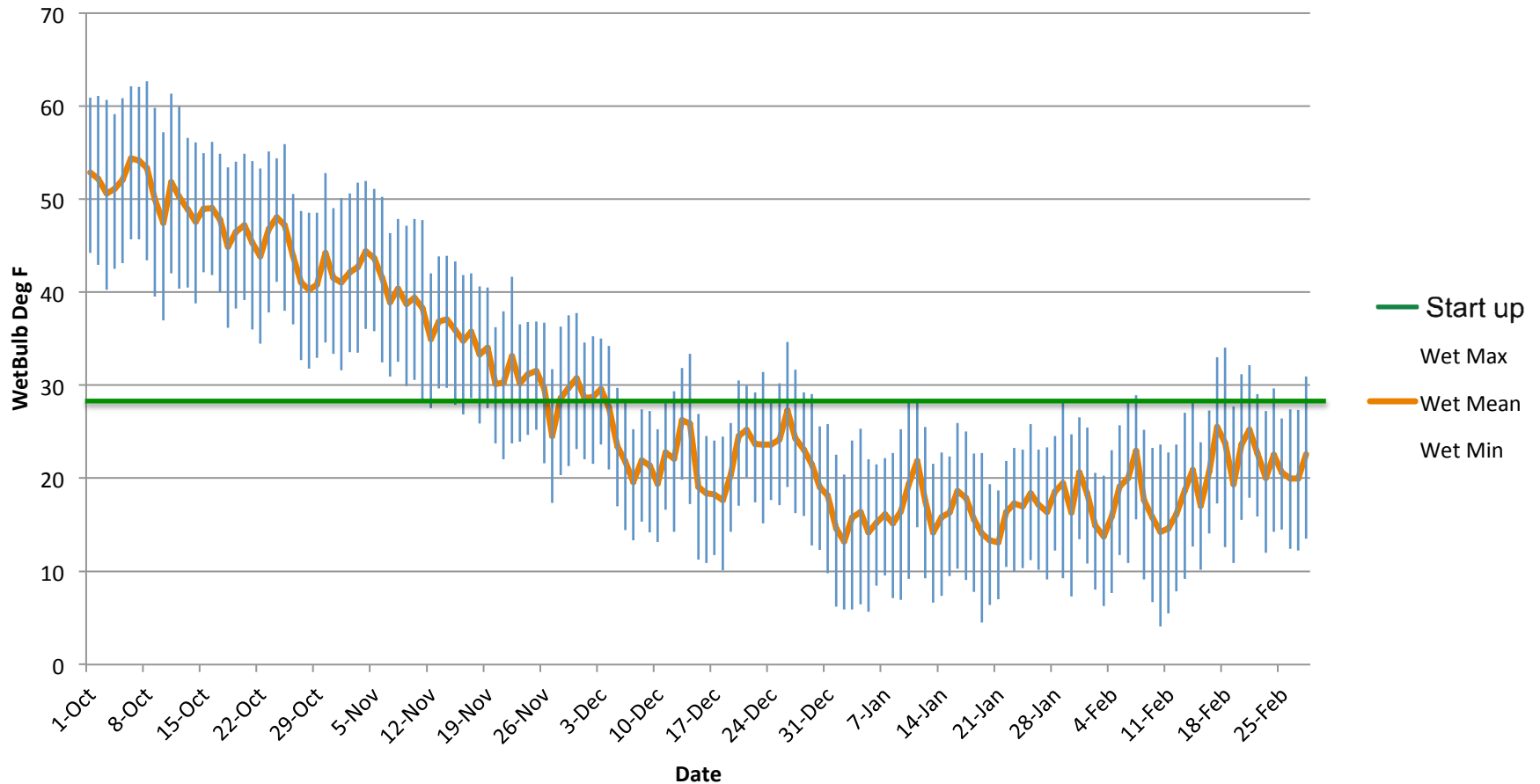
| Time to open *Roughly* 50 GPM | | | | |
|-------------------------------|---------|----------|-----------|-------|
| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
| CXC Splash | 300,000 | 50 | 1 | 100 |
| CXC Splash | 300,000 | 50 | 2 | 50 |
| CXC Splash | 300,000 | 50 | 3 | 33 |
| CXC Splash | 300,000 | 50 | 4 | 25 |

| Labor Cost | | | |
|-------------|----------|-------|---------|
| Description | Per Hour | Hours | Price |
| 2 Workers | \$11 | 166 | \$3,652 |



Daily Weather Data

10 Years Average Daily WetBulb Temp 2007 - 2017



Station: KMSN Elevation 886 ft

1 Kilometer

Length of trail
3280 Ft

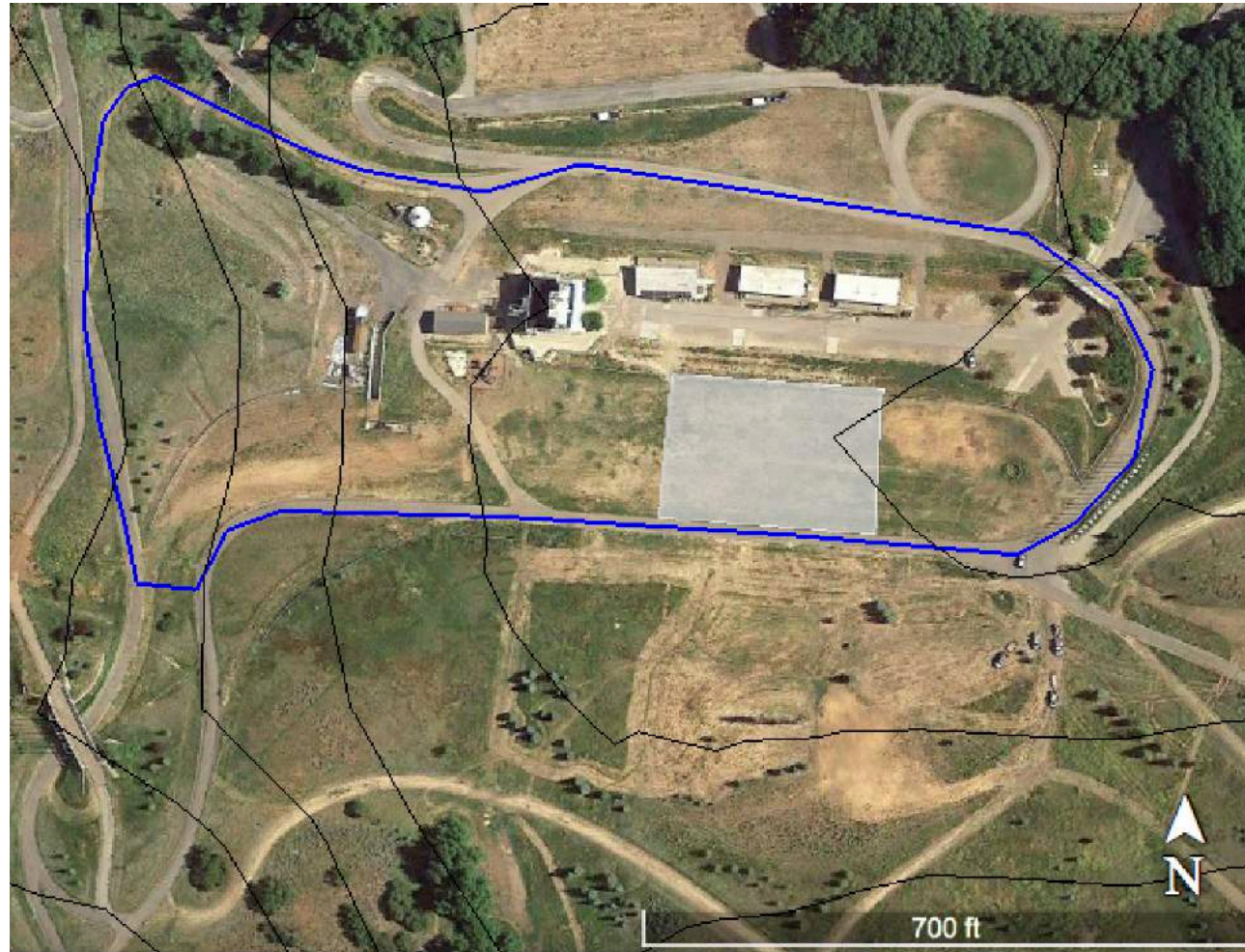
Width of Trail
18FT

Acreage of trail
1.35 Acres + Splash

Snow Depth Required
1.5 Feet

Gallons required
Gal per/acre FT 200,000

Water Required Gal
705,000



Formula : Length (FT) x Width (FT) / 43560 = Acres

1 Kilometer

The second option is a completely portable system, with no fixed infrastructure. Realistically this can cover +/- 1.5 K of terrain due to the labor-intensive nature of this design. It will utilize soft hose and portable manifolds on the ground. They will be connected to a portable water pump and rental air compressor. This option requires less capital and the greatest amount of labor.

\$137,967



Budget Details

USSA Nordic Option 3

Date: 6.19.17

| Quantity | Description | Line Price | Group Price |
|-----------------------------------------------------------------|-----------------------------------------------|------------|----------------|
| 2 | 10' Impulse R5 Tower, S-Sled | 10,110 | |
| 7 | 10' Phazer Tower, R5-Valve, S-Sled | 35,385 | |
| 1 | HKD System Engineering | 2,500 | |
| 5 | Site Supervision and Startup | 5,000 | |
| 1 | HKD 75 Hp, 275 Gpm @ 350 Psi | 24,500 | |
| 40 | HKD Hose, 1½" Hose, 1½" Cam M/F, Orange (50') | 6,491 | |
| 50 | HKD Hose, 3" Hose, 3" Cam M/F, Orange (100') | 24,939 | |
| 10 | HKD 150-1' 1.5" Air Hydrant | 1,250 | |
| 10 | Rogers R150-13", 1.5" Hydrant, 800 PSI HP | 2,790 | |
| HKD Snowmaking Equipment | | | 112,965 |
| *** Rental Air Compressor @ 500 CFM \$2,000- \$5,000 per month. | | | 1 |
| Electrical Switchgear* | | | 6,000 |
| Manifold and Valve(s)* | | | 25,000 |
| USSA Discount | | | (9,099) |
| Contingency (10% of non-HKD Products)* | | | 3,100 |

Estimated Project Total

\$ 137,967

Estimated Project Total Price doesn't include, bringing primary power/ water to the site, freight charges, tax, permitting, or local civil engineering.

Items indicated with an asterisk * are not HKD produced products and these prices are for budgeting purposes only.

All Freight charges FOB plant or Source

Operation Time + Cost

Time to open *Roughly* 18 GPM

| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
|------------|---------|----------|-----------|-------|
| CXC 1 K | 705,000 | 18 | 1 | 653 |
| CXC 1 K | 705,000 | 18 | 5 | 101 |
| CXC 1 K | 705,000 | 18 | 9 | 72 |
| CXC 1 K | 705,000 | 18 | 15 | 43 |

Time to open *Roughly* 30 GPM

| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
|----------------|----------------|-----------|-----------|-----------|
| CXC 1 K | 705,000 | 30 | 1 | 391 |
| CXC 1 K | 705,000 | 30 | 5 | 78 |
| CXC 1 K | 705,000 | 30 | 9 | 43 |
| CXC 1 K | 705,000 | 30 | 15 | 26 |

Time to open *Roughly* 50 GPM

| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
|------------|---------|----------|-----------|-------|
| CXC 1 K | 705,000 | 50 | 1 | 235 |
| CXC 1 K | 705,000 | 50 | 5 | 47 |
| CXC 1 K | 705,000 | 50 | 9 | 26 |
| CXC 1 K | 705,000 | 50 | 15 | 16 |

Operations Cost Electric (9 gun 43 HR) \$.12 KWH

| Description | KWH | Total KW | Price |
|--------------------------------------------|----------|----------|----------------|
| 1 75HP pump | 56 | 2437 | \$293 |
| Air Rental ele | Per Week | | \$1,100 |
| 1 100HP Compressor | 75 | 3264 | \$392 |
| Water (fire hydrant \$1.93 per cubic feet) | | | \$1,919 |
| Total | | | \$3,704 |

Operations Cost Generator (9 gun 43 Hr) \$2.37 per gal

| Description | | Per Hour | Price |
|--------------------------------------------|-----------------|----------|----------------|
| 100KW Gen Rental | Per Week | | \$1,200 |
| Diesel | 4.25 Gal per hr | \$10.07 | \$430 |
| Air Rental | Per Week | | \$720 |
| Diesel for Air | 8.45 Gal per hr | \$20.02 | \$861 |
| Water (fire hydrant \$1.93 per cubic feet) | | | \$1,919 |
| Total | | | \$5,130 |



Accurate Weather Data



| | | HR | Min | time | interval | wb F | run int? | | | run window? | flowrate | int flow total | fi |
|----|---------|------|-----|------|----------|------|----------|-------|------|-------------|----------|----------------|----|
| 22 | 10/5/10 | 1656 | 16 | 56 | 4:56 PM | 1:00 | 52 | FALSE | C130 | 122 | FALSE | 0 | 0 |
| 23 | 10/5/10 | 1756 | 17 | 56 | 5:56 PM | 1:00 | 51 | FALSE | C131 | 123 | FALSE | 0 | 0 |
| 24 | 10/5/10 | 1856 | 18 | 56 | 6:56 PM | 1:00 | 48 | FALSE | C132 | 124 | FALSE | 0 | 0 |
| 25 | 10/5/10 | 1956 | 19 | 56 | 7:56 PM | 1:00 | 48 | FALSE | C133 | 125 | FALSE | 0 | 0 |
| 26 | 10/5/10 | 2028 | 20 | 28 | 8:28 PM | 0:32 | 47 | FALSE | C141 | 126 | FALSE | 0 | 0 |
| 27 | 10/5/10 | 2056 | 20 | 56 | 8:56 PM | 0:28 | 48 | FALSE | C145 | 127 | FALSE | 0 | 0 |
| 28 | 10/5/10 | 2111 | 21 | 11 | 9:11 PM | 0:15 | 47 | FALSE | C160 | 128 | FALSE | 0 | 0 |
| 29 | 10/5/10 | 2156 | 21 | 56 | 9:56 PM | 0:45 | 47 | FALSE | C140 | 129 | FALSE | 0 | 0 |
| 30 | 10/5/10 | 2256 | 22 | 56 | 10:56 PM | 1:00 | 44 | FALSE | C138 | 130 | FALSE | 0 | 0 |
| 31 | 10/5/10 | 2356 | 23 | 56 | 11:56 PM | 1:00 | 43 | FALSE | C139 | 131 | FALSE | 0 | 0 |
| 32 | 10/6/10 | 2 | 0 | 2 | 12:02 AM | 0:06 | 44 | FALSE | C212 | 132 | FALSE | 0 | 0 |
| 33 | 10/6/10 | 7 | 0 | 7 | 12:07 AM | 0:05 | 43 | FALSE | C229 | 133 | FALSE | 0 | 0 |
| 34 | 10/6/10 | 12 | 0 | 12 | 12:12 AM | 0:05 | 43 | FALSE | C230 | 134 | FALSE | 0 | 0 |
| 35 | 10/6/10 | 31 | 0 | 31 | 12:31 AM | 0:19 | 44 | FALSE | C161 | 135 | FALSE | 0 | 0 |
| 36 | 10/6/10 | 56 | 0 | 56 | 12:56 AM | 0:25 | 44 | FALSE | C156 | 136 | FALSE | 0 | 0 |
| 37 | 10/6/10 | 156 | 1 | 56 | 1:56 AM | 1:00 | 46 | FALSE | C145 | 137 | FALSE | 0 | 0 |
| 38 | 10/6/10 | 239 | 2 | 39 | 2:39 AM | 0:43 | 45 | FALSE | C150 | 138 | FALSE | 0 | 0 |
| 39 | 10/6/10 | 256 | 2 | 56 | 2:56 AM | 0:17 | 46 | FALSE | C168 | 139 | FALSE | 0 | 0 |
| 40 | 10/6/10 | 303 | 3 | 3 | 3:03 AM | 0:07 | 45 | FALSE | C209 | 140 | FALSE | 0 | 0 |
| 41 | 10/6/10 | 356 | 3 | 56 | 3:56 AM | 0:53 | 46 | FALSE | C151 | 141 | FALSE | 0 | 0 |
| 42 | 10/6/10 | 456 | 4 | 56 | 4:56 AM | 1:00 | 46 | FALSE | C150 | 142 | FALSE | 0 | 0 |
| 43 | 10/6/10 | 556 | 5 | 56 | 5:56 AM | 1:00 | 43 | FALSE | C151 | 143 | FALSE | 0 | 0 |
| 44 | 10/6/10 | 654 | 6 | 54 | 6:54 AM | 0:58 | 40 | FALSE | C153 | 144 | FALSE | 0 | 0 |
| 45 | 10/6/10 | 656 | 6 | 56 | 6:56 AM | 0:02 | 40 | FALSE | C386 | 145 | FALSE | 0 | 0 |
| 46 | 10/6/10 | 709 | 7 | 9 | 7:09 AM | 0:13 | 40 | FALSE | C183 | 146 | FALSE | 0 | 0 |
| 47 | 10/6/10 | 756 | 7 | 56 | 7:56 AM | 0:47 | 46 | FALSE | C158 | 147 | FALSE | 0 | 0 |
| 48 | 10/6/10 | 854 | 8 | 54 | 8:54 AM | 0:58 | 49 | FALSE | C157 | 148 | FALSE | 0 | 0 |
| 49 | 10/6/10 | 856 | 8 | 56 | 8:56 AM | 0:02 | 49 | FALSE | C390 | 149 | FALSE | 0 | 0 |
| 50 | 10/6/10 | 956 | 9 | 56 | 9:56 AM | 1:00 | 51 | FALSE | C158 | 150 | FALSE | 0 | 0 |
| 51 | 10/6/10 | 1056 | 10 | 56 | 10:56 AM | 1:00 | 52 | FALSE | C159 | 151 | FALSE | 0 | 0 |
| 52 | 10/6/10 | 1156 | 11 | 56 | 11:56 AM | 1:00 | 53 | FALSE | C160 | 152 | FALSE | 0 | 0 |
| 53 | 10/6/10 | 1256 | 12 | 56 | 12:56 PM | 1:00 | 55 | FALSE | C161 | 153 | FALSE | 0 | 0 |
| 54 | 10/6/10 | 1356 | 13 | 56 | 1:56 PM | 1:00 | 56 | FALSE | C162 | 154 | FALSE | 0 | 0 |
| 55 | 10/6/10 | 1456 | 14 | 56 | 2:56 PM | 1:00 | 56 | FALSE | C163 | 155 | FALSE | 0 | 0 |

5-10 years, roughly 5000 line of data per year = **50,000 data points**



2.5 Kilometer

Length of trail
8202 Ft

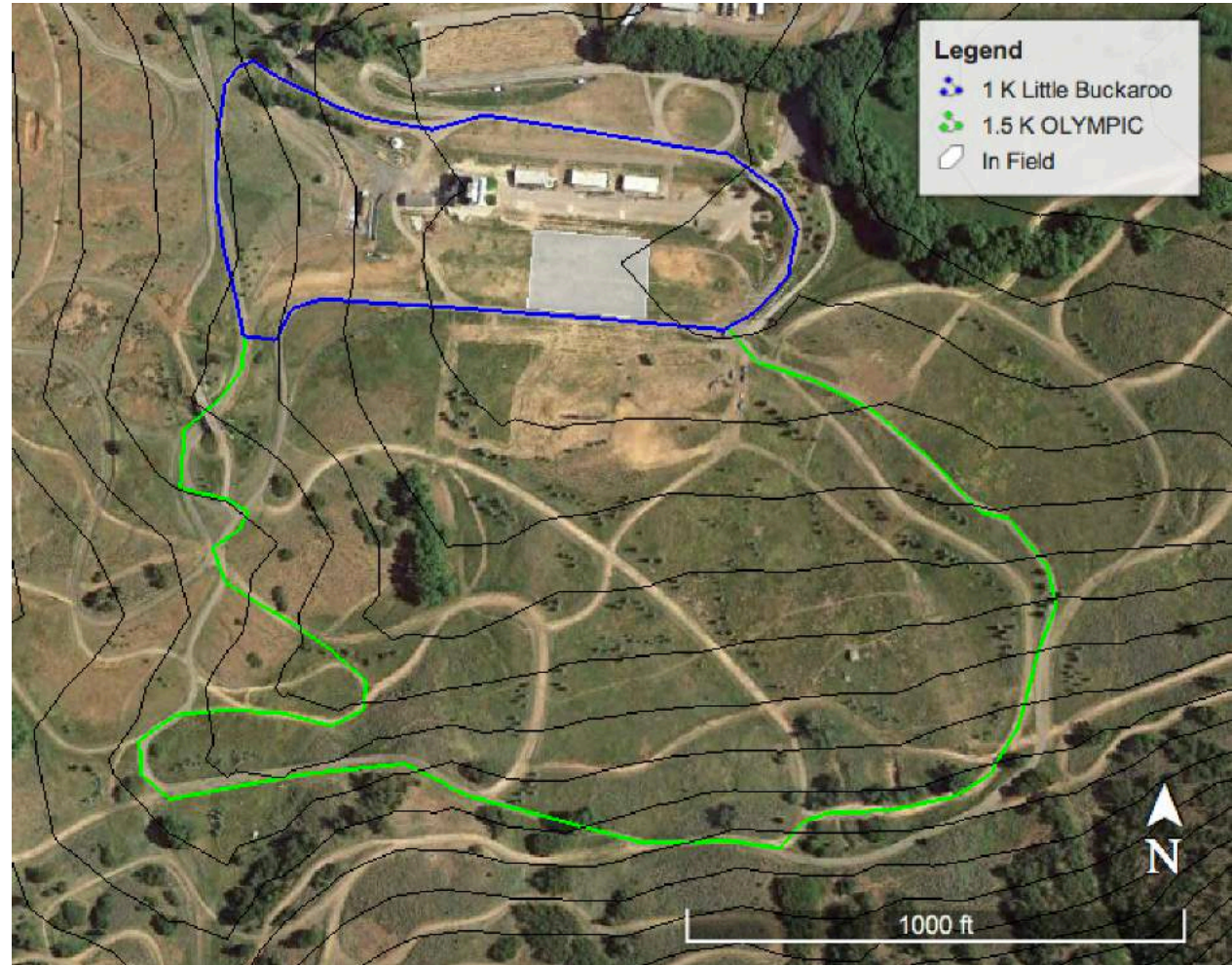
Width of Trail
18 FT

Acreage of trail
3.4 Acres + Splash

Snow Depth Required
1.5 Feet

Gallons required
Gal per/acre FT 200,000

Water Required Gal
1,317,000



Formula : Length (FT) x Width (FT) / 43560 = Acres

2.5 Kilometer



The first option outlined is a powerful, traditional mobile air water system with (26) 10' Impulse snow guns on S Sleds. This Preliminary budget includes a pump station with (2) 200 HP pumps and (2) 125HP central air compressors, 6" water and air pipe buried below frost line, and hydrant locations every 100 feet on 2.5k of Nordic trails. This provides you with an expandable, high output, efficient, manual air water system.

\$1,042,077

Budget Details

USSA Nordic Option 1

Date: 6.19.17

| Quantity | Description | Line Price | Group Price |
|-------------------------------------------------|-----------------------------------------------|------------|-----------------|
| 6 | 10' Impulse R5 Tower, S-Sled | 30,330 | |
| 20 | 10' Phazer Tower, R5-Valve, S-Sled | 101,100 | |
| 1 | KLiK Weather Station | 2,310 | |
| 2 | Automatic Air Relief Valve | 4,124 | |
| 1 | Pumphouse Automation Controls | 23,000 | |
| 1 | HKD System Engineering | 10,000 | |
| 5 | Site Supervision and Startup | 5,000 | |
| 68 | HKD Hose, 1½" Hose, 1½" Cam M/F, Orange (50') | 11,034 | |
| 80 | Air Hydrant 8", 1.5" | 10,000 | |
| 80 | Rogers R150-8", 1.5" Hydrant, 800 PSI HP | 27,584 | |
| HKD Snowmaking Equipment | | | 224,483 |
| 8202 | 6 5/8" x 0.219" | 278,868 | |
| 8202 | 6 5/8" x 0.188" | 229,656 | |
| 4 | Utility Crossings* | 800 | |
| Piping Materials (Installed)* | | | 509,324 |
| 2, 200 HP, 400GPM, 500Psi, w/VFD Pump's* | | | 99,840 |
| 2, 500 CFM Compressors* | | | 88,000 |
| Electrical Switchgear* | | | 15,000 |
| Valve(s)* | | | 10,000 |
| Building(s)* | | | 45,000 |
| USSA Discount | | | (26,286) |
| Contingency (10% of non-HKD Products)* | | | 76,716 |

Estimated Project Total

\$ 1,042,077

Estimated Project Total Price doesn't include, bringing primary power/ water to the site, freight charges, tax, permitting, or local civil engineering.

Items indicated with an asterisk * are not HKD produced products and these prices are for budgeting purposes only.
All Freight charges FOB plant or Source

Operation Time + Cost

| Time to open *Roughly* 18 GPM | | | | |
|-------------------------------|-----------|----------|-----------|-------|
| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
| CXC 1 K | 1,317,000 | 18 | 1 | 1219 |
| CXC 1 K | 1,317,000 | 18 | 12 | 102 |
| CXC 1 K | 1,317,000 | 18 | 26 | 47 |
| CXC 1 K | 1,317,000 | 18 | 30 | 41 |

| Operations Cost Electric (26 gun 28 Hr) \$.12 KWH | | | |
|---------------------------------------------------|-----|----------|----------------|
| Description | KWH | Total KW | Price |
| 2 200 HP pump | 298 | 8386 | \$1,006 |
| 2 125 HP Compressor | 186 | 5234 | \$628 |
| Well or Lake Feed | | | 0 |
| Total | | | \$1,634 |

| Time to open *Roughly* 30 GPM | | | | |
|-------------------------------|------------------|-----------|-----------|-----------|
| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
| CXC 1 K | 1,317,000 | 30 | 1 | 732 |
| CXC 1 K | 1,317,000 | 30 | 12 | 61 |
| CXC 1 K | 1,317,000 | 30 | 26 | 28 |
| CXC 1 K | 1,317,000 | 30 | 30 | 24 |

| Time to open *Roughly* 50 GPM | | | | |
|-------------------------------|-----------|----------|-----------|-------|
| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
| CXC 1 K | 1,317,000 | 50 | 1 | 439 |
| CXC 1 K | 1,317,000 | 50 | 12 | 37 |
| CXC 1 K | 1,317,000 | 50 | 26 | 17 |
| CXC 1 K | 1,317,000 | 50 | 30 | 15 |



Efficient 2.5 Kilometer

Length of trail

8202 Ft

*6,200 Ft of pipe

Width of Trail

18 FT

Acreage of trail

3.4 Acres + Splash

Snow Depth Required

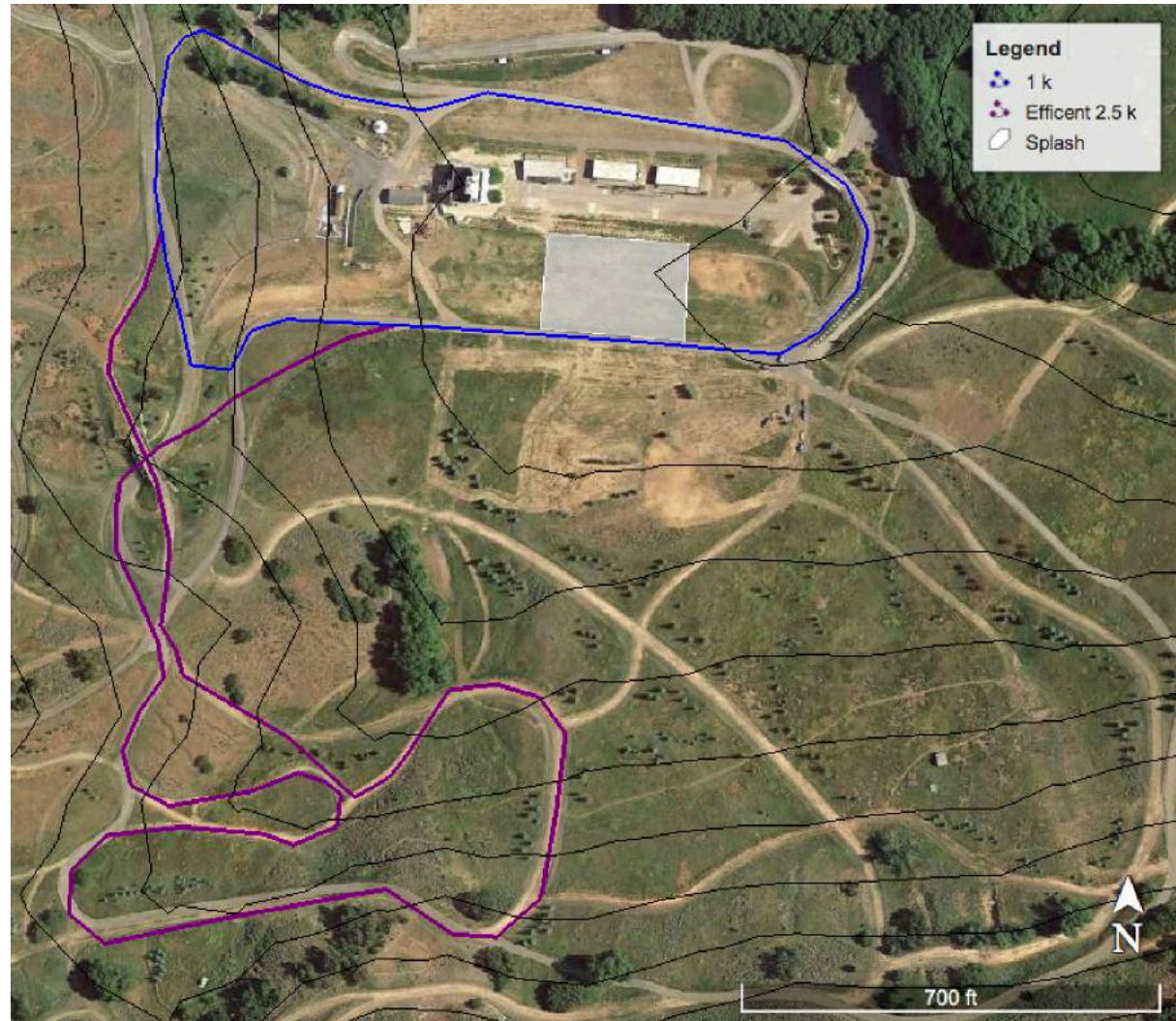
1.5 Feet

Gallons required

Gal per/acre FT 200,000

Water Required Gal

1,317,000



Formula : Length (FT) x Width (FT) / 43560 = Acres

Efficient 2.5 Kilometer



The second option outlined is a slightly smaller system that assumes the nordic trail system has some trails that overlap allowing for efficient pipe routing reducing the amount of pipe needed by 25%. This Preliminary budget includes a small pump station with (1) 200 HP pump and (1) 125HP central air compressor, 4" water and air pipe buried below frost line, and hydrant locations every 100 feet. This system utilizes (12) Impulse snow guns on S sleds, providing you with a low maintenance, high efficiency, manual air water system.

\$693,948

Budget Details

| USSA Nordic Option 2 | | Date: 6.19.17 | |
|----------------------|-----------------------------------------------------|---------------|-----------------|
| Quantity | Description | Line Price | Group Price |
| 3 | 10' Impulse R5 Tower, S-Sled | 15,165 | |
| 9 | 10' Phazer Tower, R5-Valve, S-Sled | 45,495 | |
| 1 | KLiK Weather Station | 2,310 | |
| 1 | Automatic Air Relief Valve | 2,062 | |
| 1 | Pumphouse Automation Controls | 23,000 | |
| 1 | HKD System Engineering | 10,000 | |
| 5 | Site Supervision and Startup | 5,000 | |
| 30 | HKD Hose, 1 1/2" Hose, 1 1/2" Cam M/F, Orange (50') | 4,868 | |
| 62 | HKD 150-8' 1.5" Air Hydrant | 7,750 | |
| 62 | Rogers R150-8', 1.5" Hydrant, 800 PSI HP | 21,378 | |
| | HKD Snowmaking Equipment | | 137,028 |
| 6200 | 4 1/2" x 0.219" | 198,400 | |
| 6200 | 4 1/2" x 0.188" | 161,200 | |
| 4 | Utility Crossings* | 800 | |
| | Piping Materials (Installed)* | | 360,400 |
| | 1, 200HP 400 GPM @ 500 PSI, w/VFD Pump's* | | 49,920 |
| | 1, 125HP Compressor @ 500 CFM* | | 45,000 |
| | Electrical Switchgear* | | 12,000 |
| | Valve(s)* | | 10,000 |
| | Building(s)* | | 40,000 |
| | USSA Discount | | (12,132) |
| | Contingency (10% of non-HKD Products)* | | 51,732 |

Estimated Project Total

\$ 693,948

Estimated Project Total Price doesn't include, bringing primary power/ water to the site, freight charges, tax, permitting, or local civil engineering.

Items indicated with an asterisk * are not HKD produced products and these prices are for budgeting purposes only.
All Freight charges FOB plant or Source

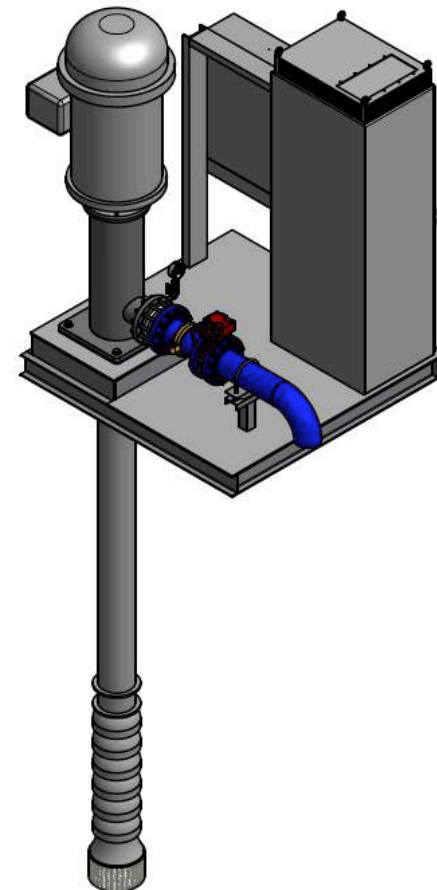
Operation Time + Cost

| Time to open *Roughly* 18 GPM | | | | |
|-------------------------------|-----------|----------|-----------|-------|
| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
| CXC 1 K | 1,317,000 | 18 | 1 | 1219 |
| CXC 1 K | 1,317,000 | 18 | 12 | 102 |
| CXC 1 K | 1,317,000 | 18 | 26 | 47 |
| CXC 1 K | 1,317,000 | 18 | 30 | 41 |

| Time to open *Roughly* 30 GPM | | | | |
|-------------------------------|------------------|-----------|-----------|-----------|
| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
| CXC 1 K | 1,317,000 | 30 | 1 | 732 |
| CXC 1 K | 1,317,000 | 30 | 12 | 61 |
| CXC 1 K | 1,317,000 | 30 | 26 | 28 |
| CXC 1 K | 1,317,000 | 30 | 30 | 24 |

| Time to open *Roughly* 50 GPM | | | | |
|-------------------------------|-----------|----------|-----------|-------|
| Trail Name | Gallons | Flow GPM | # of Guns | Hours |
| CXC 1 K | 1,317,000 | 50 | 1 | 439 |
| CXC 1 K | 1,317,000 | 50 | 12 | 37 |
| CXC 1 K | 1,317,000 | 50 | 26 | 17 |
| CXC 1 K | 1,317,000 | 50 | 30 | 15 |

| Operations Cost Electric (12 gun 61 Hr) \$.12 KWH | | | |
|---------------------------------------------------|-----|----------|----------------|
| Description | KWH | Total KW | Price |
| 1 200 HP pump | 298 | 9085 | \$1,090 |
| 1 125 HP Compressor | 93 | 5670 | \$680 |
| Well or Lake Feed | | | 0 |
| Total | | | \$1,770 |



Other Factors to Consider Before Investing

- Weather
- Wind
- Cat Time
- Capital
- Future Plans
- Trail Priority
- System limitations
 - Water
 - Air
 - Power



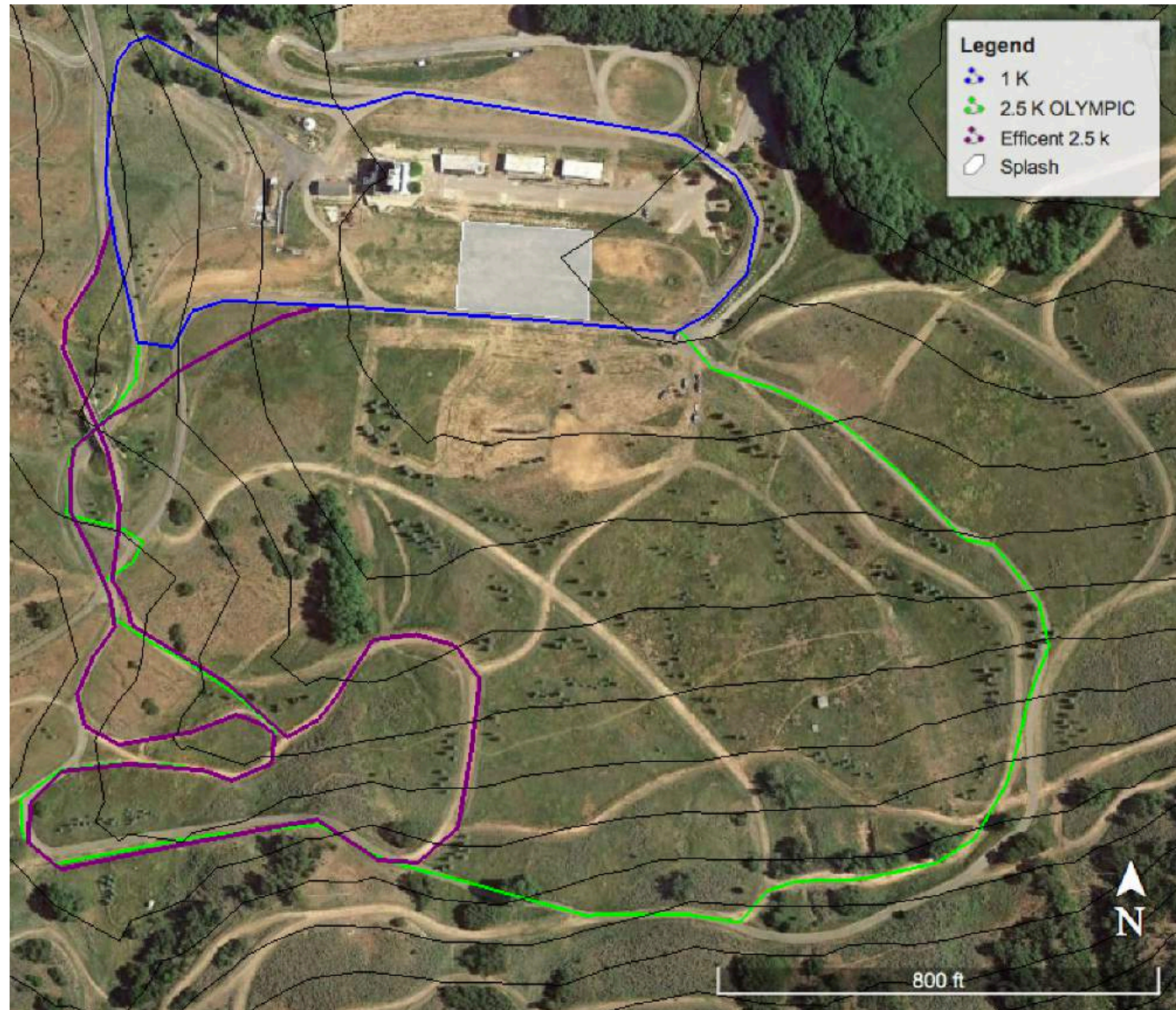
Solutions:

Stadium / Splash
\$53,200

1 Kilometer
\$137,967

2.5 Kilometer
\$1,042,077

Eff 2.5 Kilometer
\$693,948

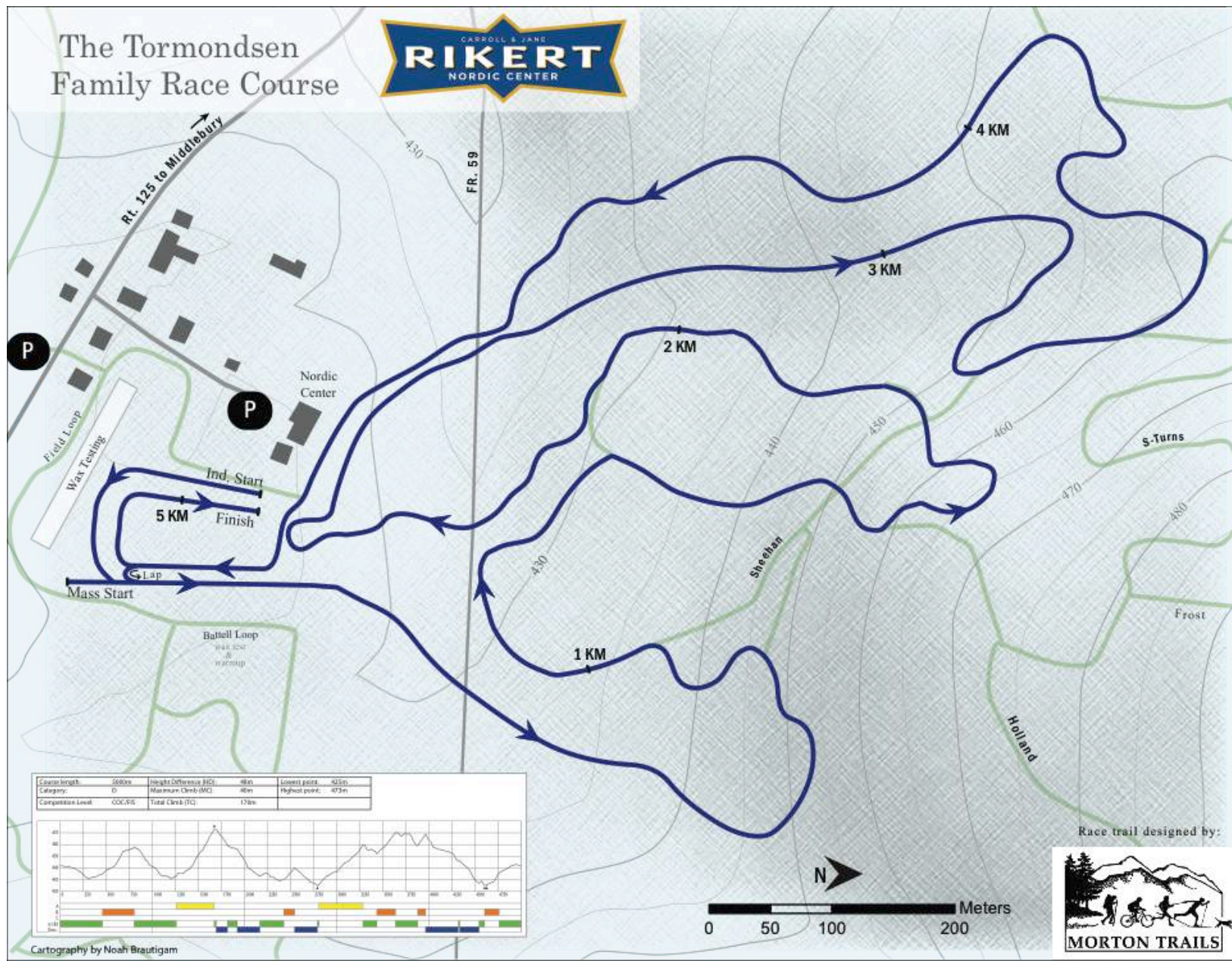


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Assumptions For 5 Year Cash Flow



- **Installation Cost** **\$850,000**
- **Operating Cost** **\$40,000**
- **Average Skier visits before installation (Base Year)** **7,425**
- **Average Days of operation before installation** **75**
- **Average Skier Visit per Day** **99**
- **Days of operation after installation** **140**
- **Percent increase in operating days/Visits** **87%**
- **Avg. Skier visit growth rate per year (5 year average)** **23%**



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Capital Cost Allocation

| | |
|--------------------------------------|------------|
| Pipe and Pipe Install | 59% |
| Pumps and Pumphouse Structure | 9% |
| Snow Guns | 18% |
| Permits | 11% |
| Engineering | 3% |

Investment Returns

Project Internal Rate of Return **14%**

Project Net Present Value @ 10% **\$66,299**

Payback in Seasons **7.1**



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**Rikert
Pumphouse**



**HKD SV5 -Narrow
Trail Performance**

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- ✘ Originally technology developed at Seven Springs by Herman K. Dupre. HKD Founded in 1990, over 625 Customers worldwide.
- ✘ HKD Merged with Quebec based Turbo Cristal in 2011, a Manufacturer of Fan Technology. The merger made HKD the largest Fully Integrated North American Snowmaking Supplier.
- ✘ We have 45 Employees and 6 Offices in North America, distribution in Europe, Japan, Korea and China.
- ✘ Our Mission, to remain the industry leader in high performance, energy efficient, user friendly snowmaking technology.





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Thank You

