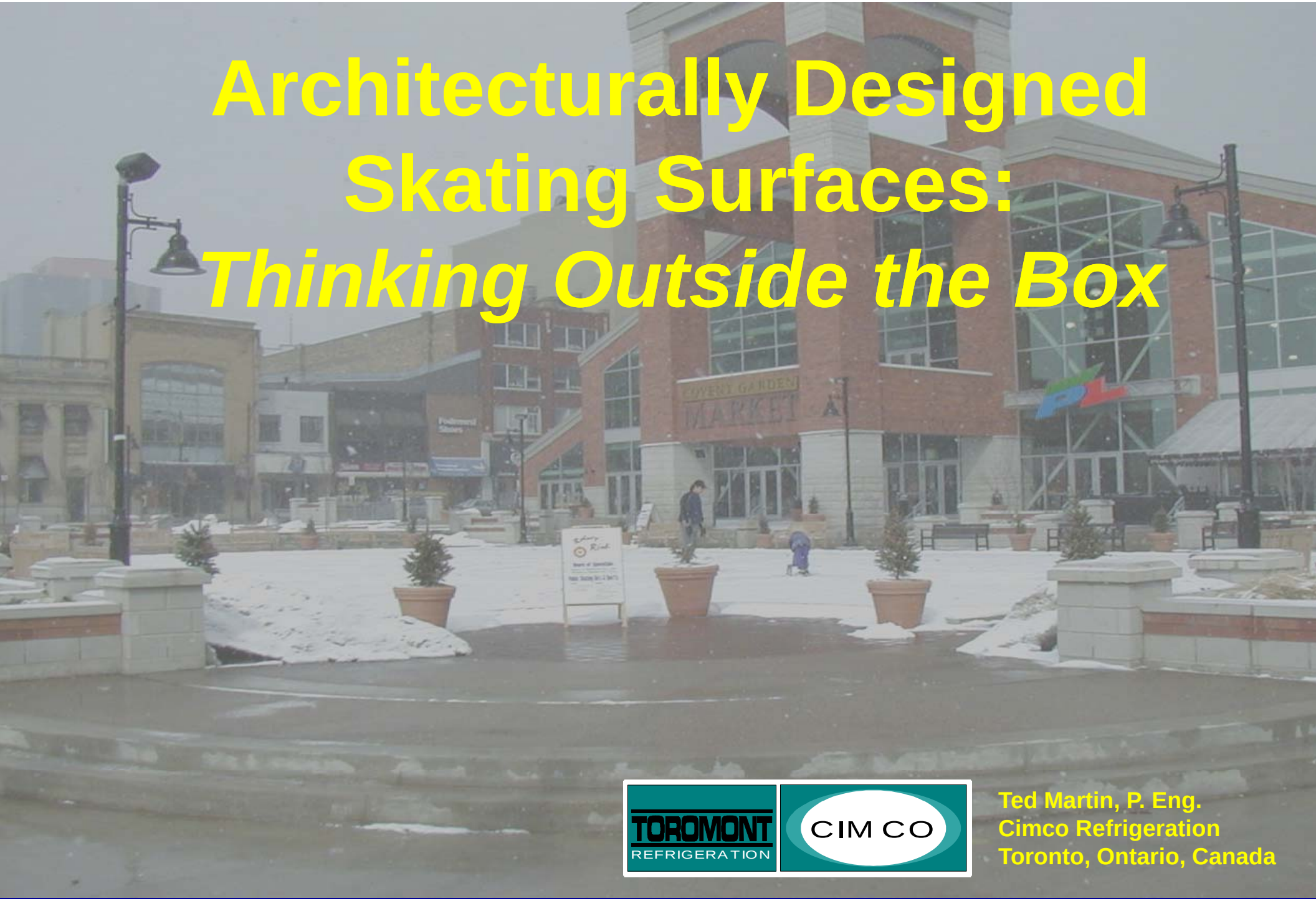
Architecturally Designed Skating Surfaces: *Thinking Outside the Box*



TOROMONT REFRIGERATION

CIMCO

Ted Martin, P. Eng.
Cimco Refrigeration
Toronto, Ontario, Canada

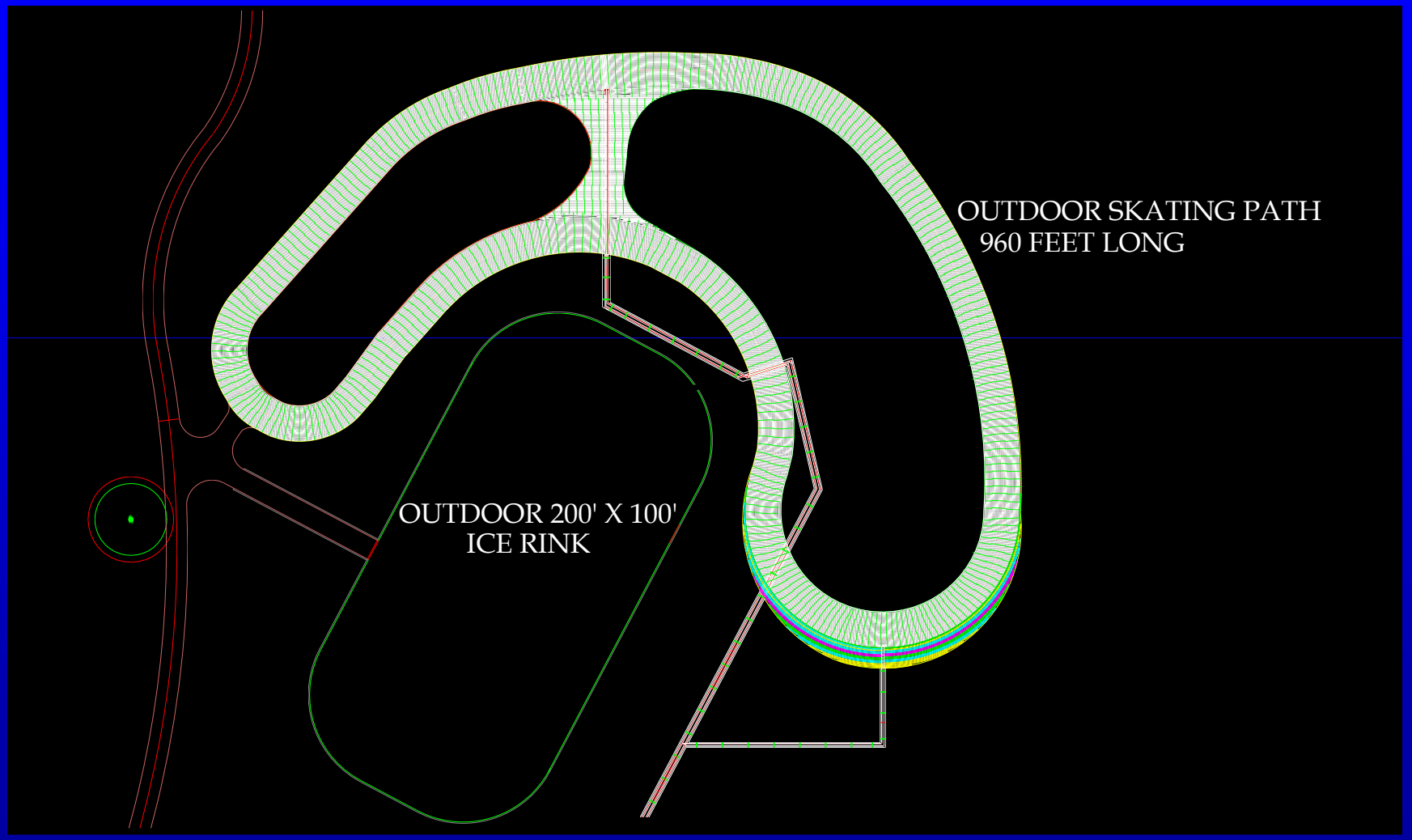
What is an “Architecturally Designed Skating Surface”?

- A skating surface designed by the architect to compliment a facility
- Generally offers no-cost pleasure skating only
- Attracts the public to the building or facility
- Dual–purpose winter/summer
- The size and shape is designed to test our engineering abilities
- Examples include:
    - Skating path
    - Skating rink/reflecting pool

Neighborhood Skating Path

Vaughan Sports Center, Vaughan, Ontario

Outdoor Skating Path



Vaughan Sports Center, Vaughan, Ontario

Waterfront Skating Rink

Harbourfront, Toronto, Ontario, Canada

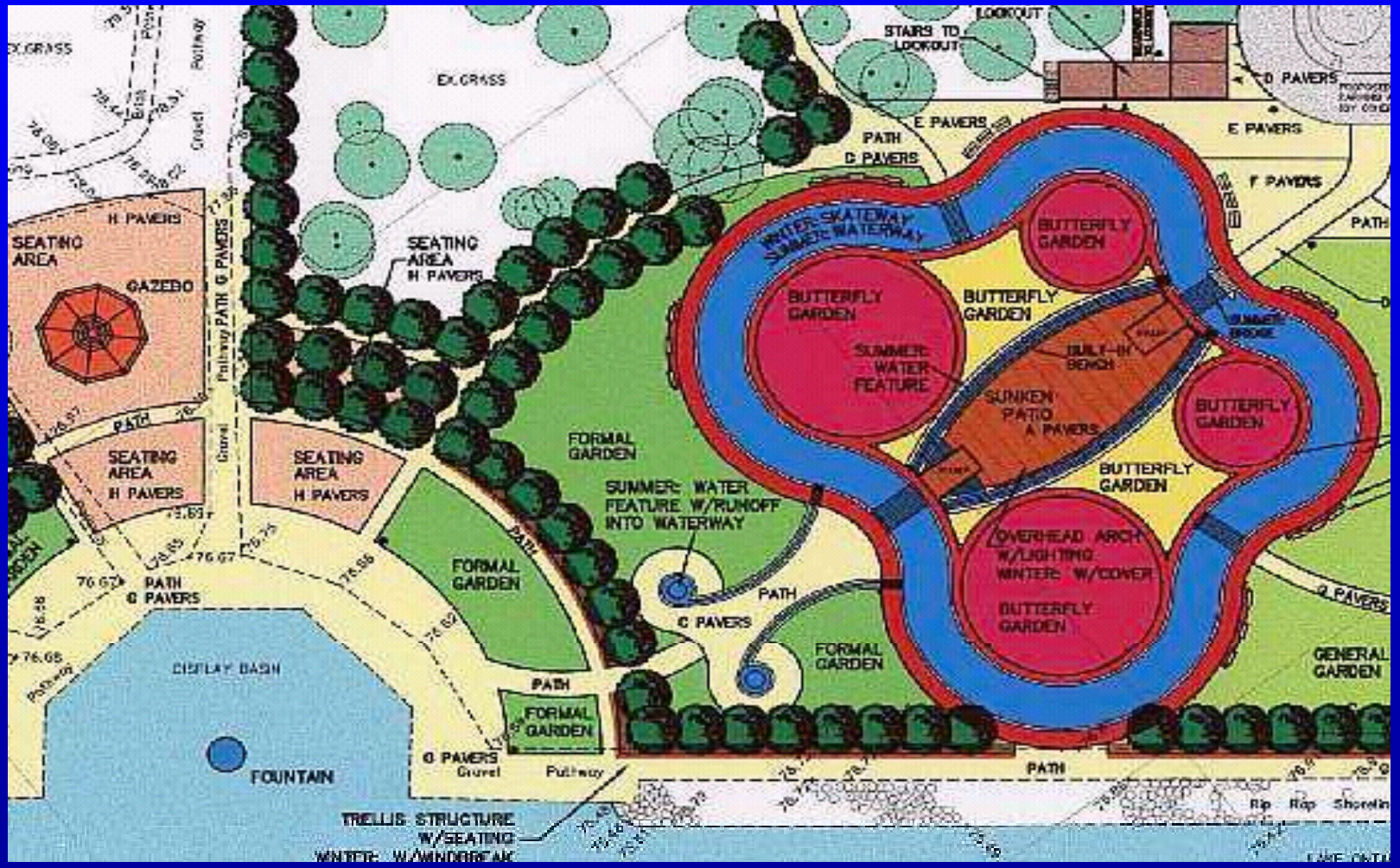
Rink / Reflecting Pool

Toronto City Hall, Ontario, Canada

Outdoor Free-form Rink

Toronto, Ontario, Canada

Butterfly Park - Skating Path



Bronte Butterfly Outdoor Rink, Oakville, Ontario

Outdoor Skating Path

Brampton Skating Path, Brampton, Ontario


Summertime Walking Path
Brampton, Ontario

Outdoor Skating Rink

Kitchener City Hall, Kitchener, Ontario

Summertime Reflecting Pool

Kitchener City Hall, Kitchener, Ontario

Refrigeration Loads

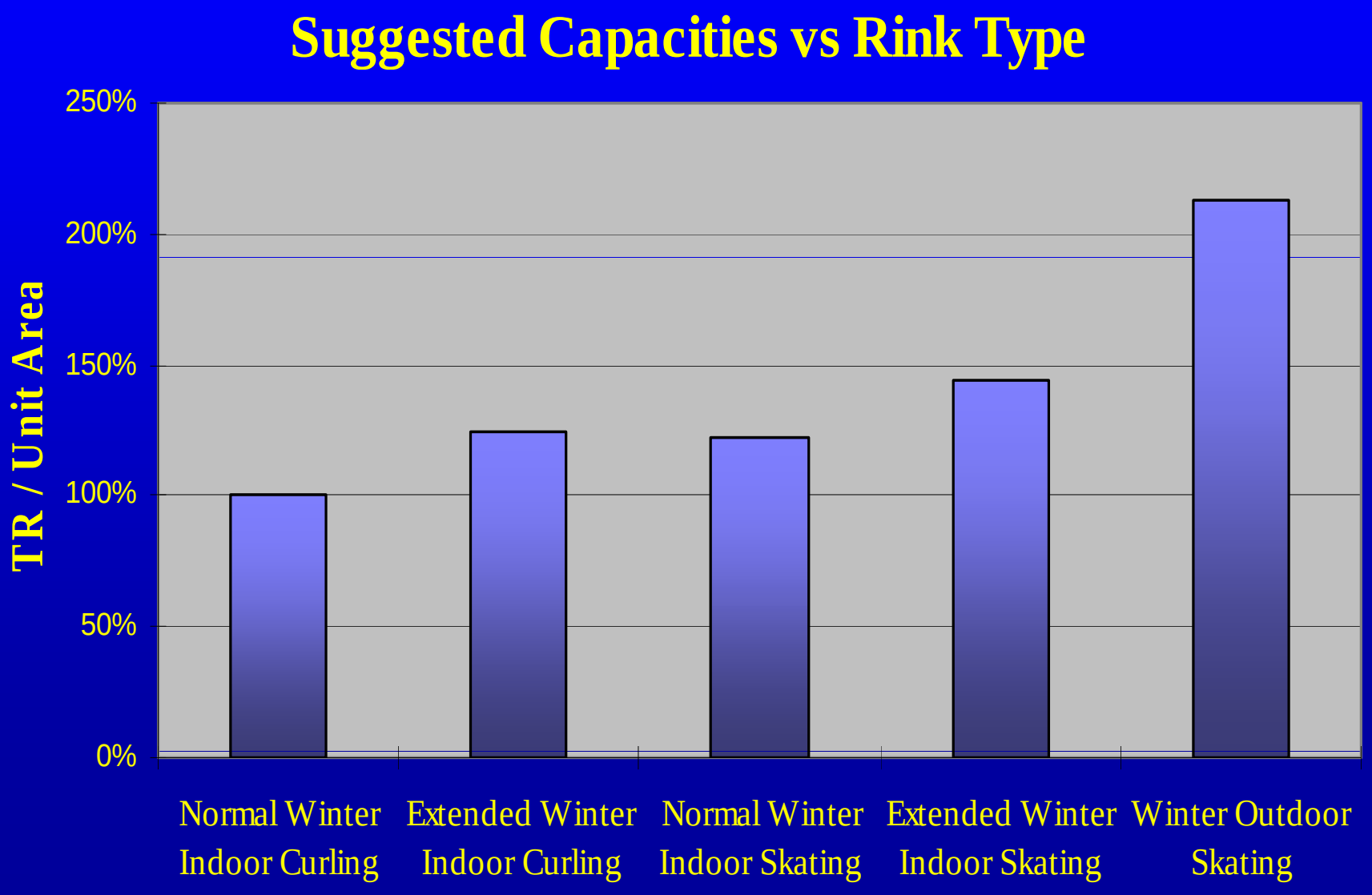
Typical Indoor Rink

- Lights, pumps
- Spectators / Skaters
- Rink air temperature
- Humidity
- Radiative load from ceiling
- Resurfacing

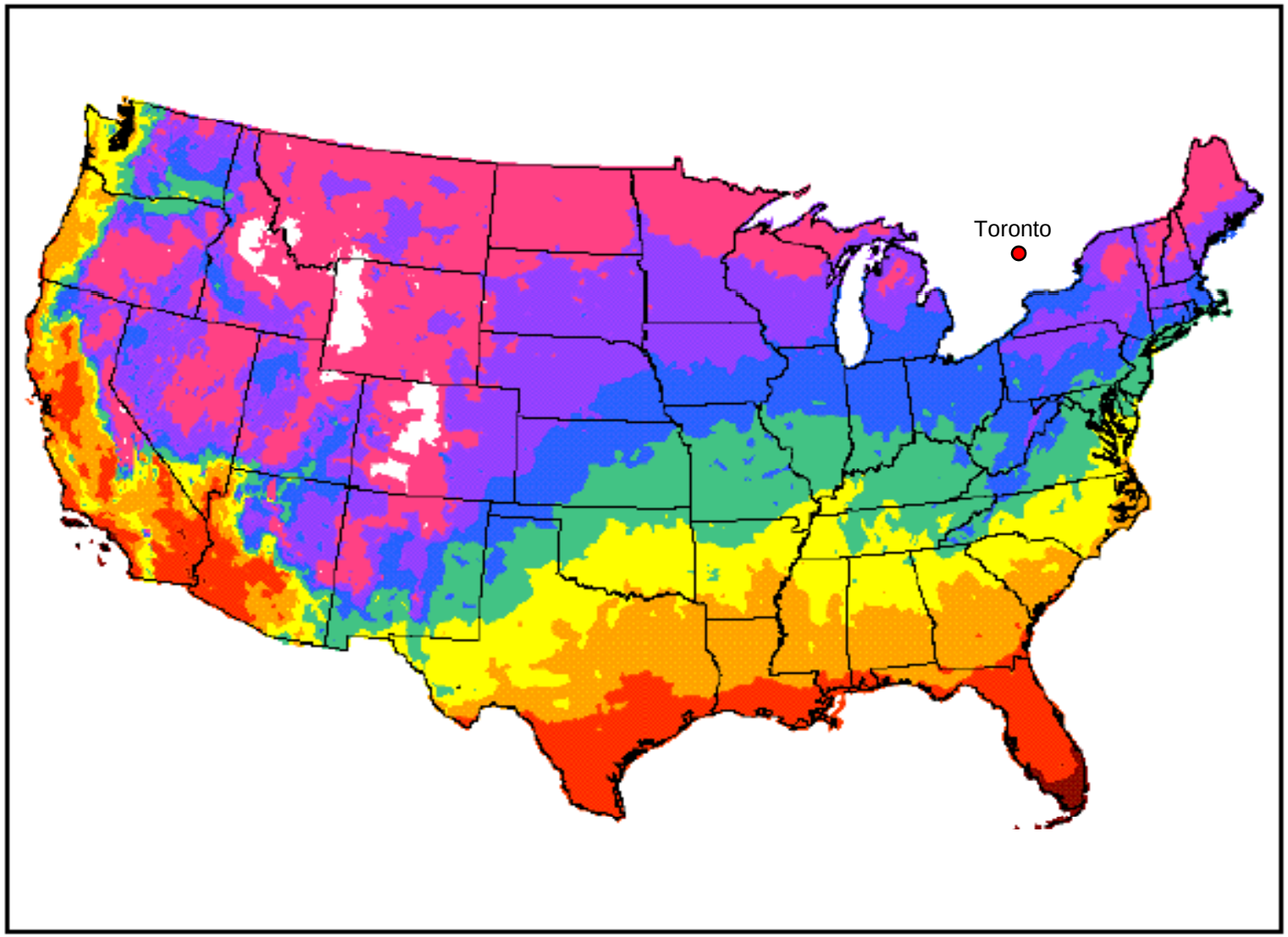
Typical Outdoor Rink

- Pumps
- Sun
- Ambient air temperature
- Wind
- Ground heat
- Rain
- Resurfacing

Typical Rink Freezing Design



Days with Mean Temp. Below 32 °F



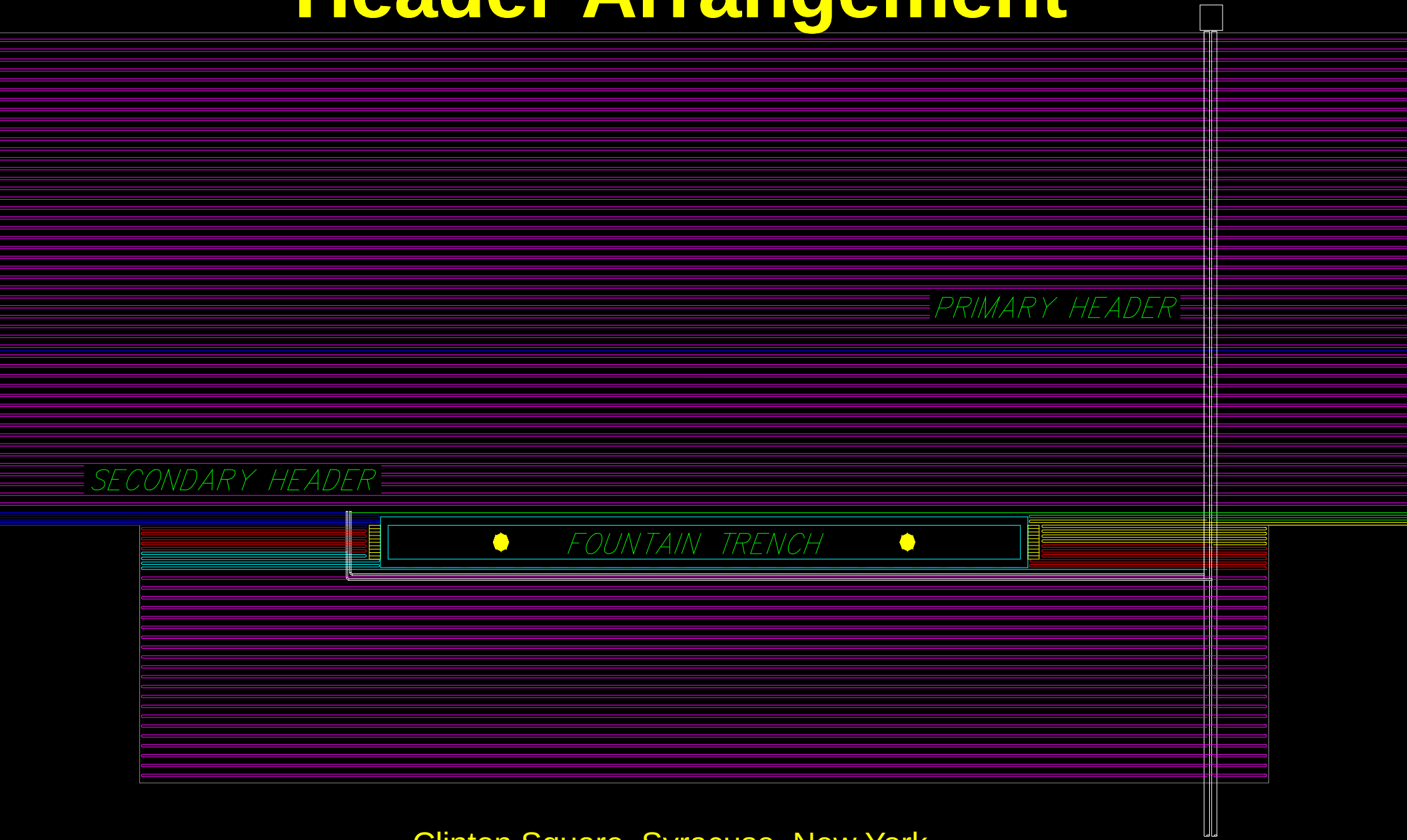
- ANNUAL -
A < 0.5
B 0.5 - 30.4
C 30.5 - 60.4
D 60.5 - 90.4
E 90.5 - 120.4
F 120.5 - 150.4
G 150.5 - 180.4
H 180.5 - 240.4
I > 240.4

Caution:

12 hours @	60 °F
+ 12 hours @	0 °F
= mean	30 °F

Source: National Oceanic and Atmospheric Administration / US Department of Commerce

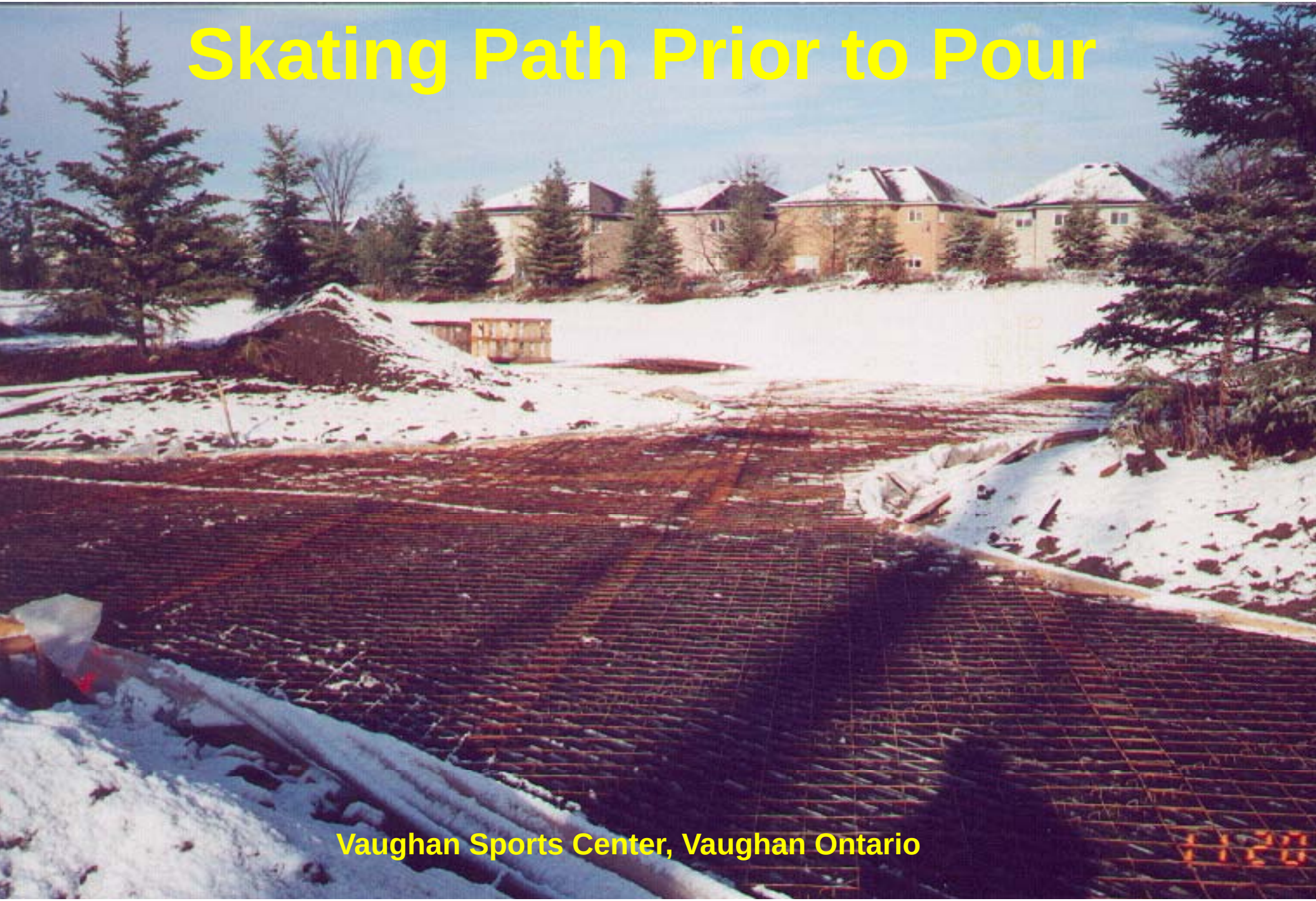
Header Arrangement



Clinton Square, Syracuse, New York

Headers Prior to Concrete Pour

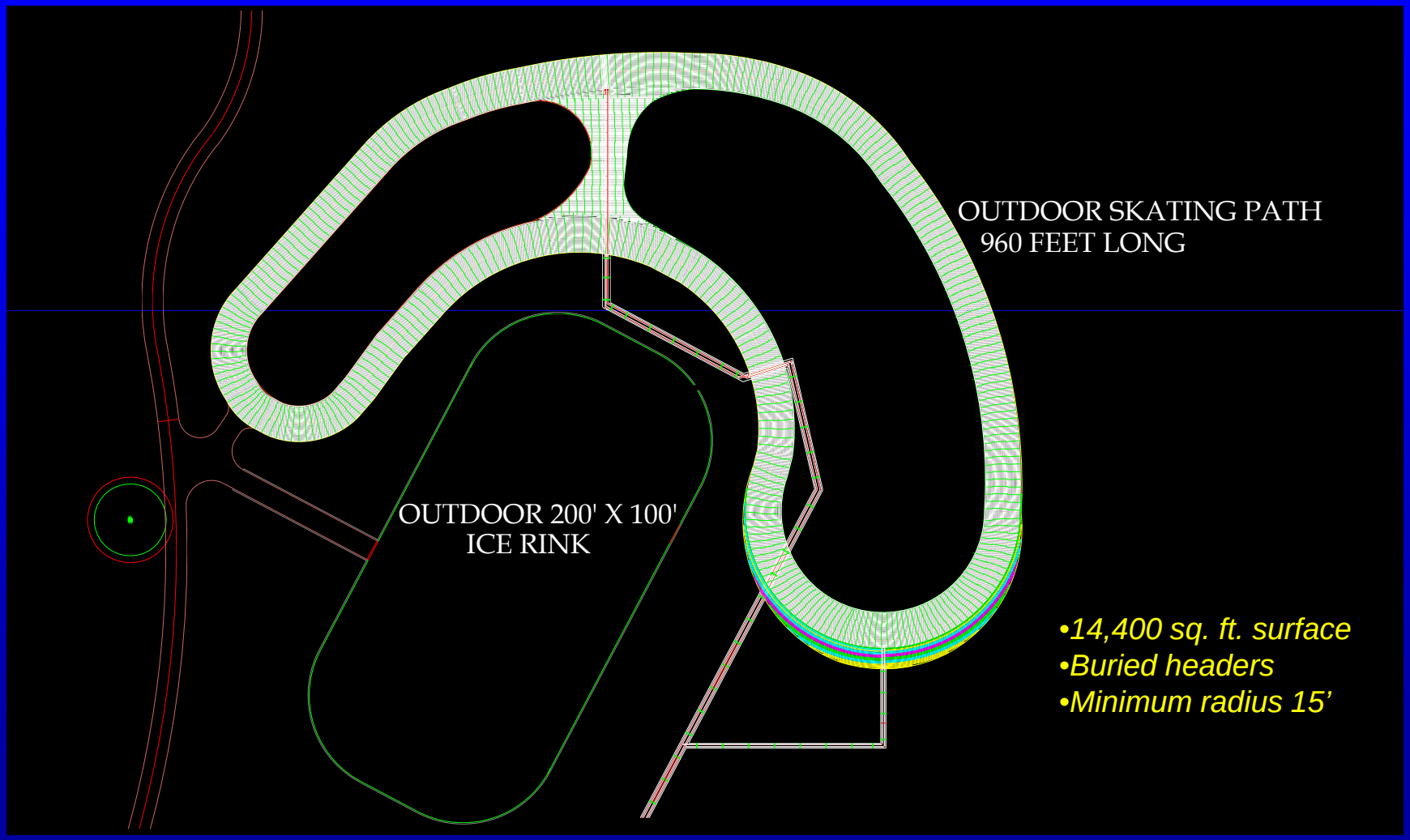
Skating Path Prior to Pour



Vaughan Sports Center, Vaughan Ontario

Concrete Pour

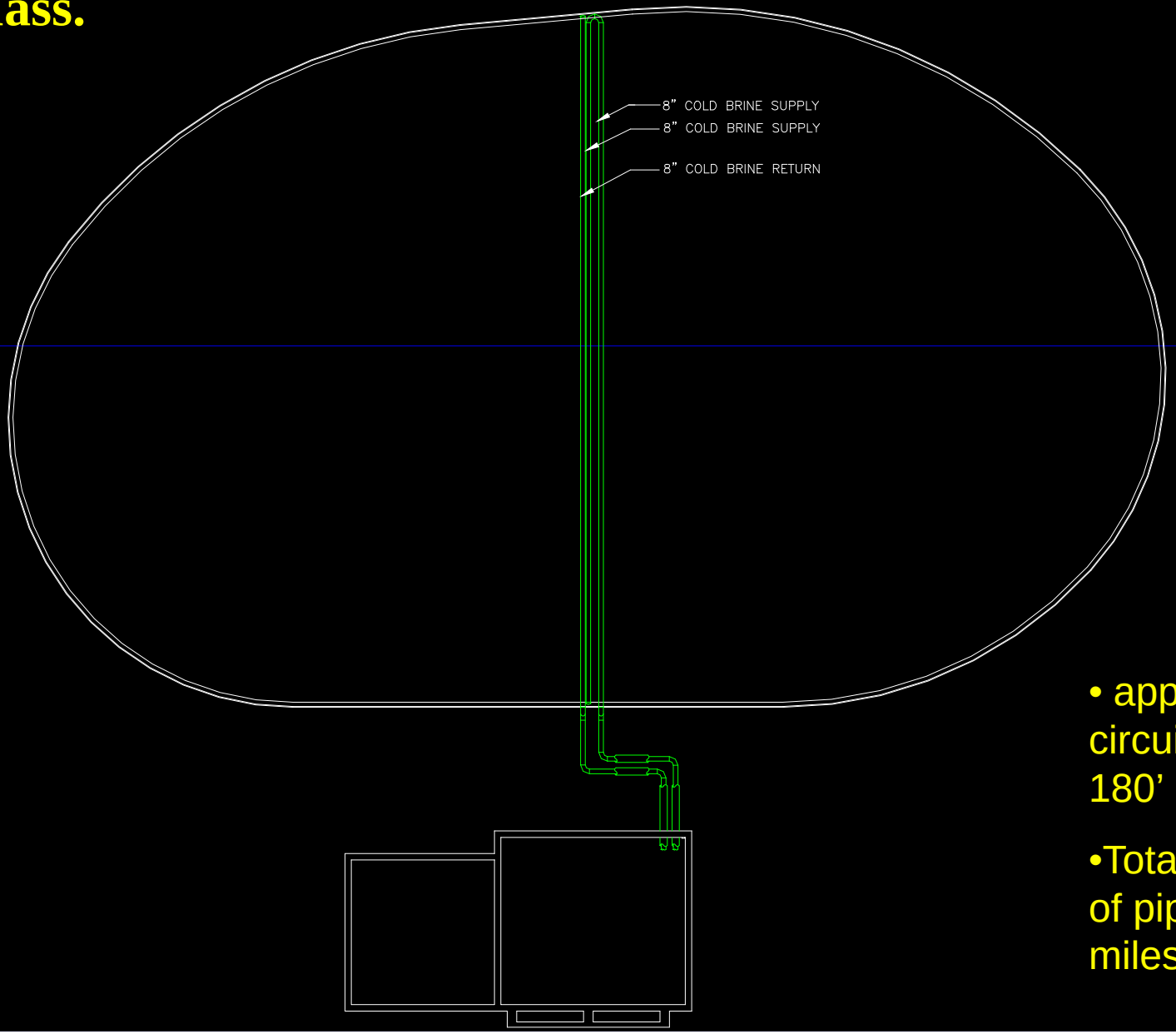
Outdoor Skating Path



Two Headers: 104 Circuits, each 480' Long - 800 USGPM @ 45'

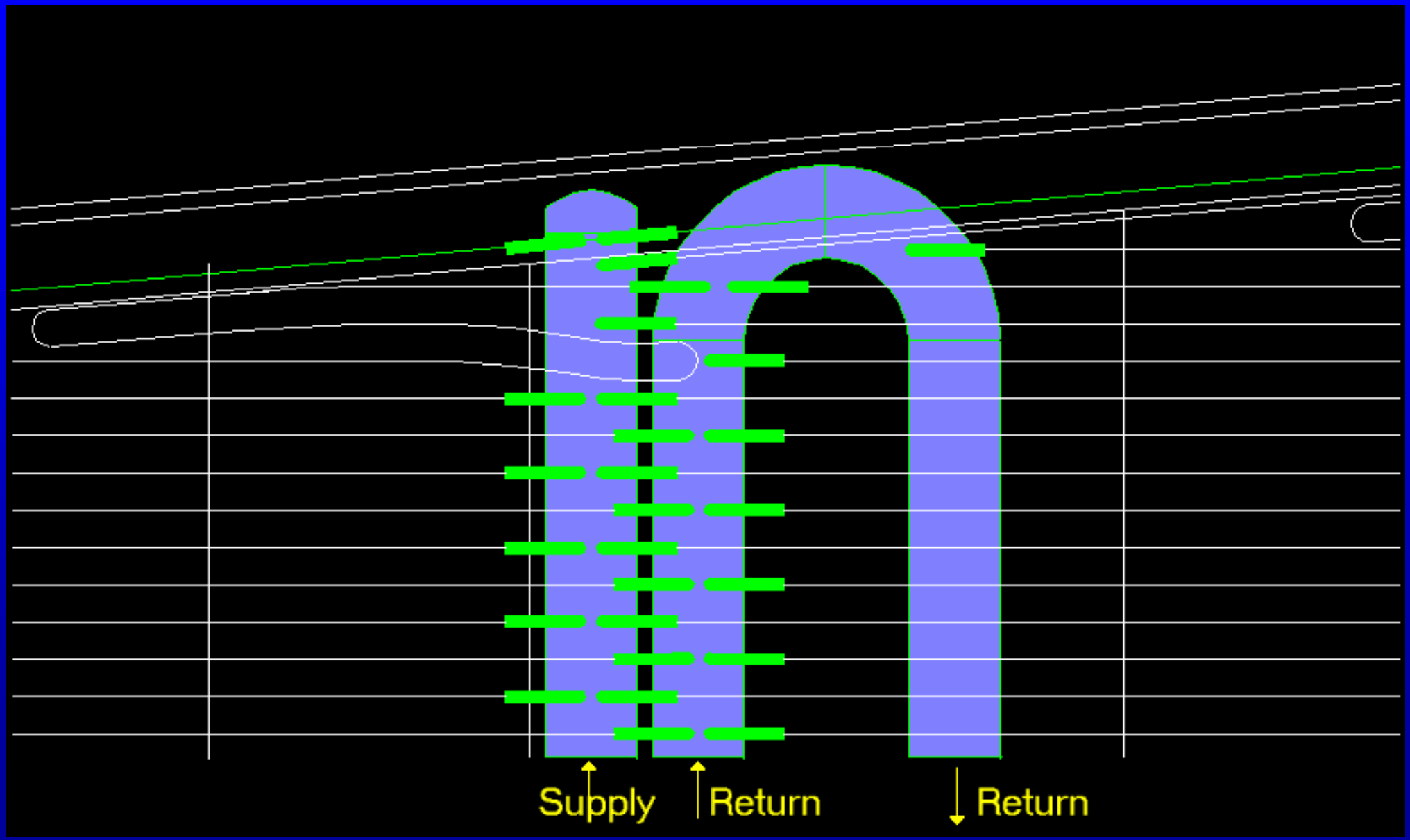
The Frog Pond - Header Arrangement

Boston, Mass.



- approx. 360 circuits, avg. 180' long each
- Total 72,000' of pipe (13.6 miles)

The Frog Pond - Circuit Detail



Glycol/Brine Circuiting Issues (cont'd)

Issue: Material and Operating Costs

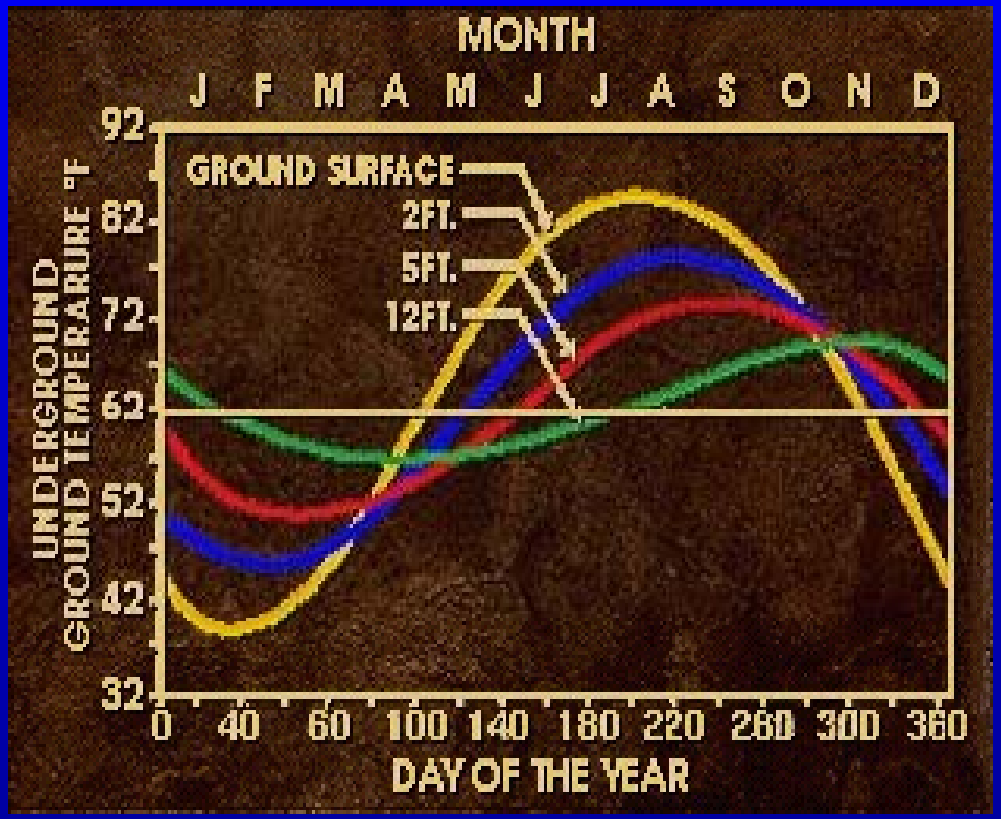
- Use multiple headers
  - Provides greater flexibility in ensuring a uniform temperature distribution
  - Reduces glycol / brine pump HP
  - Reduces header size
  - Increases installation costs

Outdoor Skating Path

Bronte Butterfly Outdoor Rink, Oakville Ontario

Other Technical Issues

- Glycol / Brine freeze point



Source: Alliant Energy GeoThermal Information Office - www.alliantgeo.com

Glycol / Brine Properties

Solution	Strength	Freezing Temp.	Thermal Conductivity	Price per 1000 USGAL
Ethelyne Glycol	38%	-10 dF	0.24	$4,210
Ethelyne Glycol	48%	-30 dF	0.22	$5,210
Propylene Glycol	42%	-10 dF	0.22	$5,254
Propylene Glycol	50%	-30 dF	0.20	$6,255
Calcium Chloride	21%	-10 dF	0.27	$1,925
Calcium Chloride	26%	-30 dF	0.25	$2,002

Methods of Control

Indoor Rink

- Measure ice temperature with infra red
- Measure brine return temperature
- Measure slab temperature
- Cycle pumps

Outdoor Rink

- Run brine pumps continuously
  - Pony pump for overnight operation
  - Two speed pump
- Measure brine return temperature

Typical Refrigeration Equipment - Skating Path

Path Size	15’ x 500’	15’ x 750’	15’ x 1000’	15’ x 1250’
Refrigeration Capacity	40 TR	60 TR	80 TR	100 TR
Compressor HP	(2) x 30 HP	(2) x 50 HP	(2) x 60 HP	(2) x 75 HP
# Sets of Headers	1	1	2	2
Total Glycol Flow	400 USGPM	400 USGPM	800 USGPM	800 USGPM
Pump HP	7.5 HP	15 HP	15 HP	20 HP
kWh / Day	400	677	760	960
Annual Energy Cost	$3,800	$6,500	$7,300	$9,245

Notes

- **45% ethylene glycol**
- **4 month season**
- **190 sq. ft. per TR**
- **$0.08 per kw-hr**
- **Compressor operation 6 hours per day**
- **Primary pump eighteen hours per day**
- **5 HP pony pump six hours per day**

“Outside the Box” Ideas

- Winter skating path / Summer man-made river
- Winter skating path / Summer nature path
- Winter skating rink / Summer reflecting pool
- “Skate-up” outdoor mall
- Winter skating oval / Summer 400m running track
- Half - pipe / Terrain park
- 5 mile long skating path

If you build it, they will come…

Questions?