# Setting Up a Maple Tubing System

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Uihlein Maple Research Forest

Cornell University

# Are you looking to get away from this?

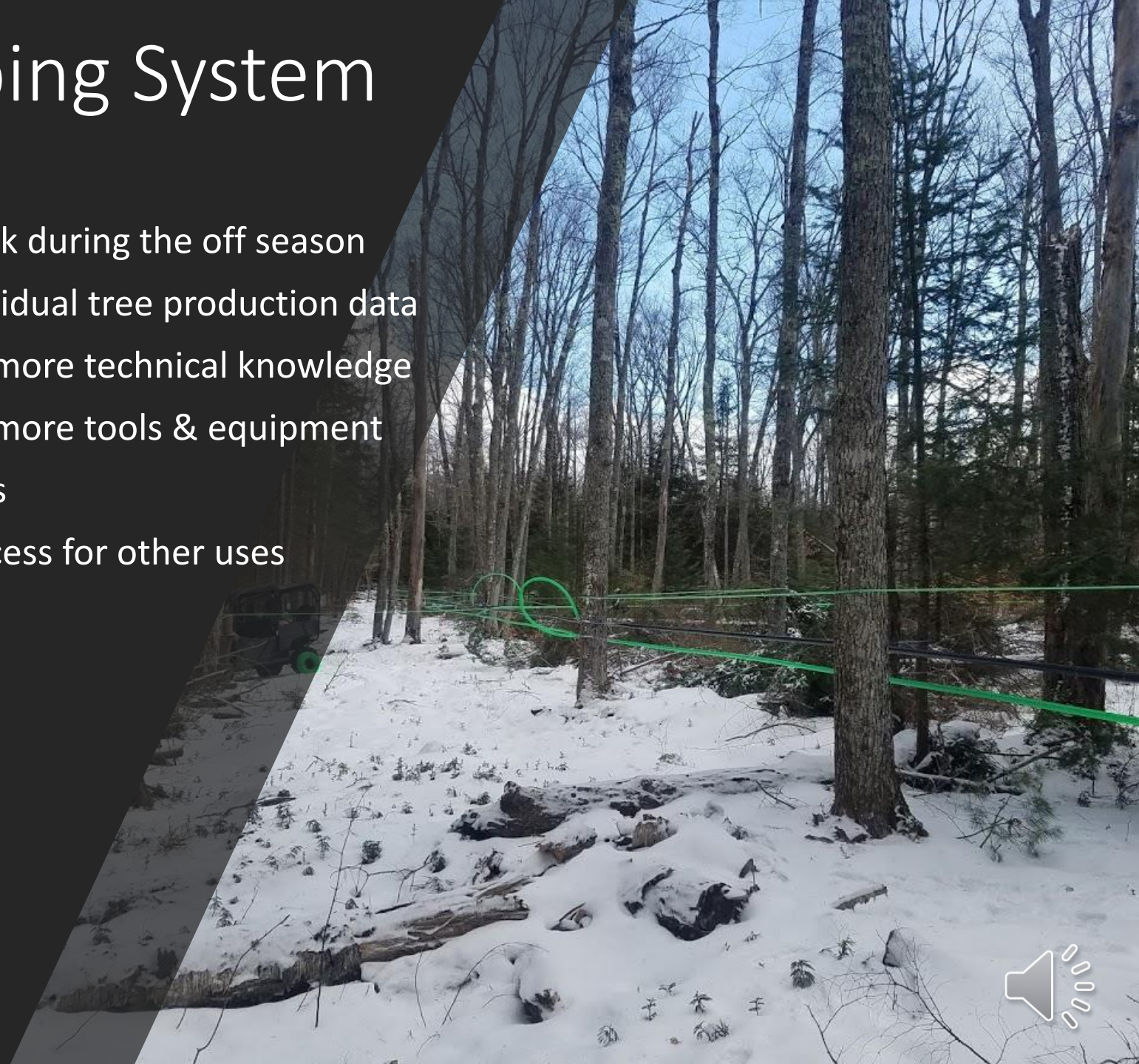
# Pros & Cons of a Tubing System

Pro:

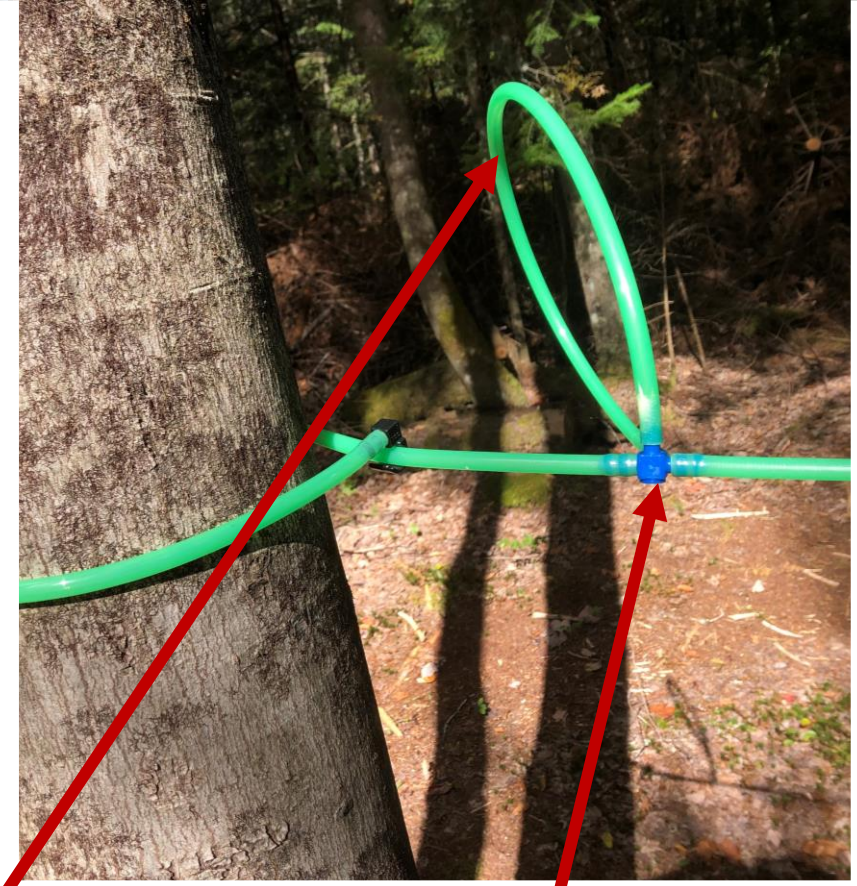
- Less work during the season
- Increase yield
- Access to hard to reach areas
- Ability to increase tap count
- Protects soil from equipment travel during mud season

Con:

- More work during the off season
- Lose individual tree production data
- Requires more technical knowledge
- Requires more tools & equipment
- Aesthetics
- Forest access for other uses




Parts of a Tubing System



Spout

Dropline

“T”

Lateral Line

# Starting at the Tree

# Lateral Line Connection

Hooked Connector

Manifold/ Saddle

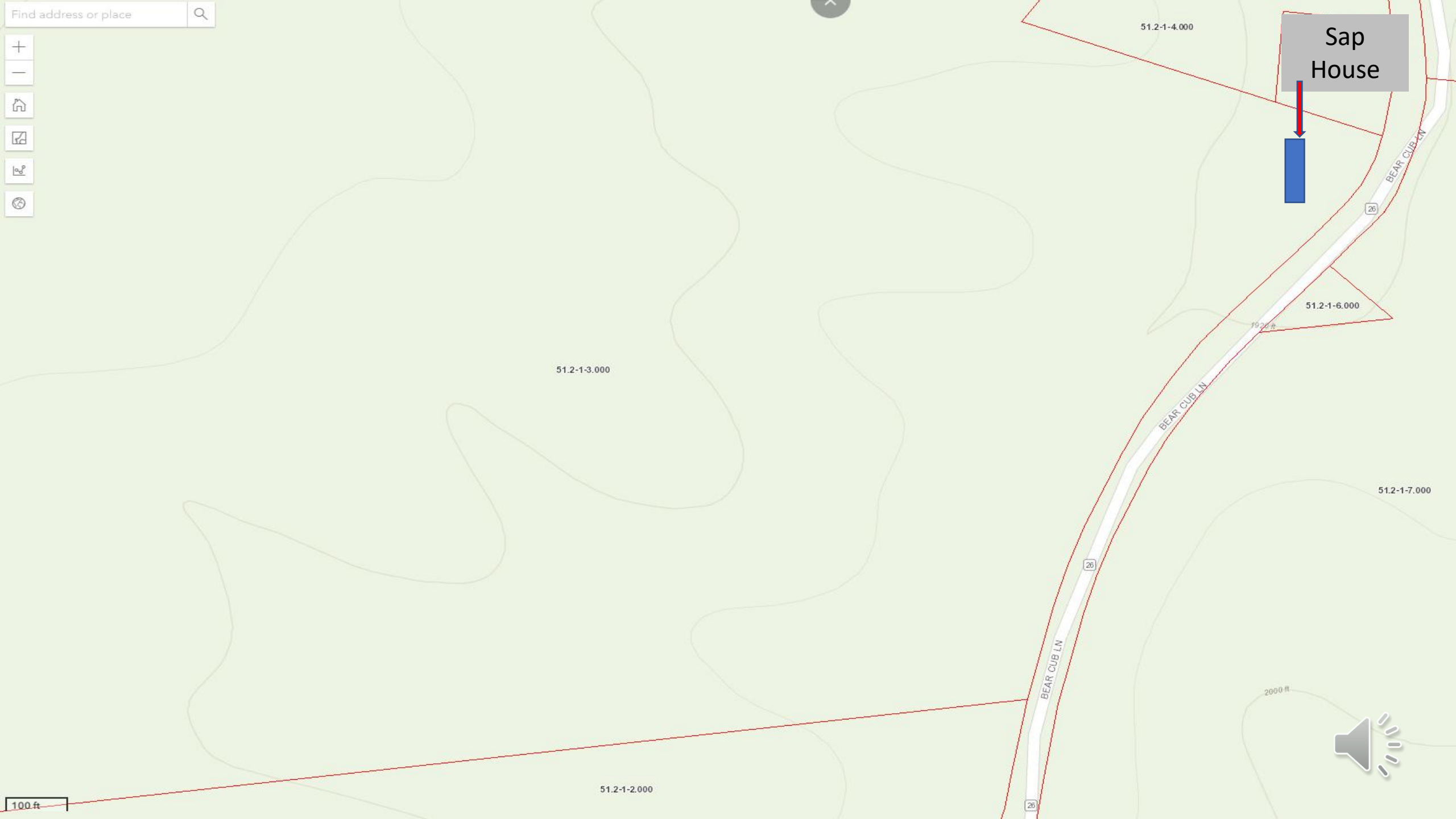
Mainline

Mainlines are suspended from high tensile wire


Spur
Mainline
BZA

# Mainlines feed into sap tanks

# Designing a Maple Tubing System


Find address or place
Sap House
51.2-1-4.000
51.2-1-6.000
51.2-1-3.000
51.2-1-7.000
51.2-1-2.000
BEAR CUB LN
BEAR CUB LN
BEAR CUB LN
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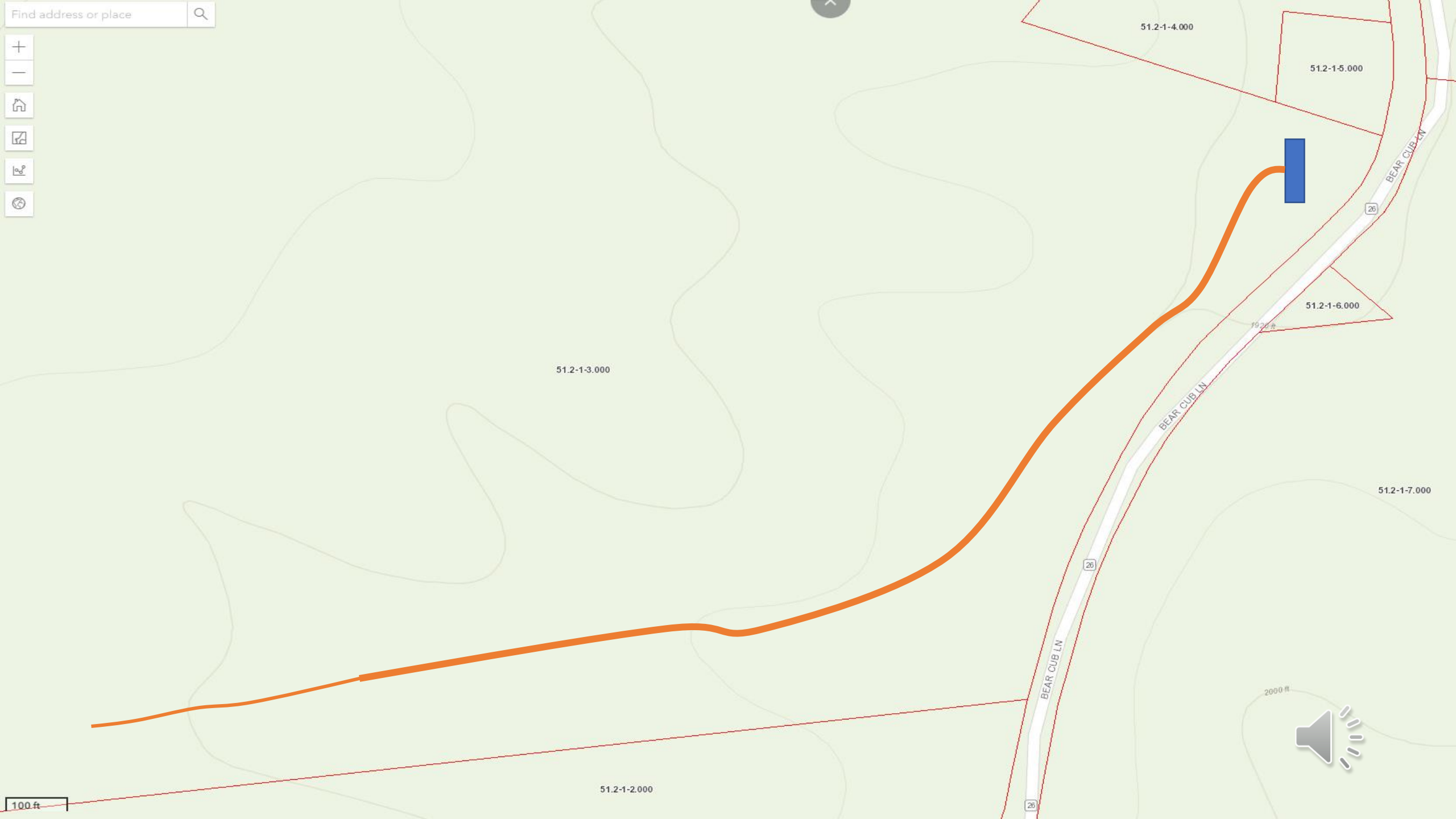
1920 ft
2000 ft
100 ft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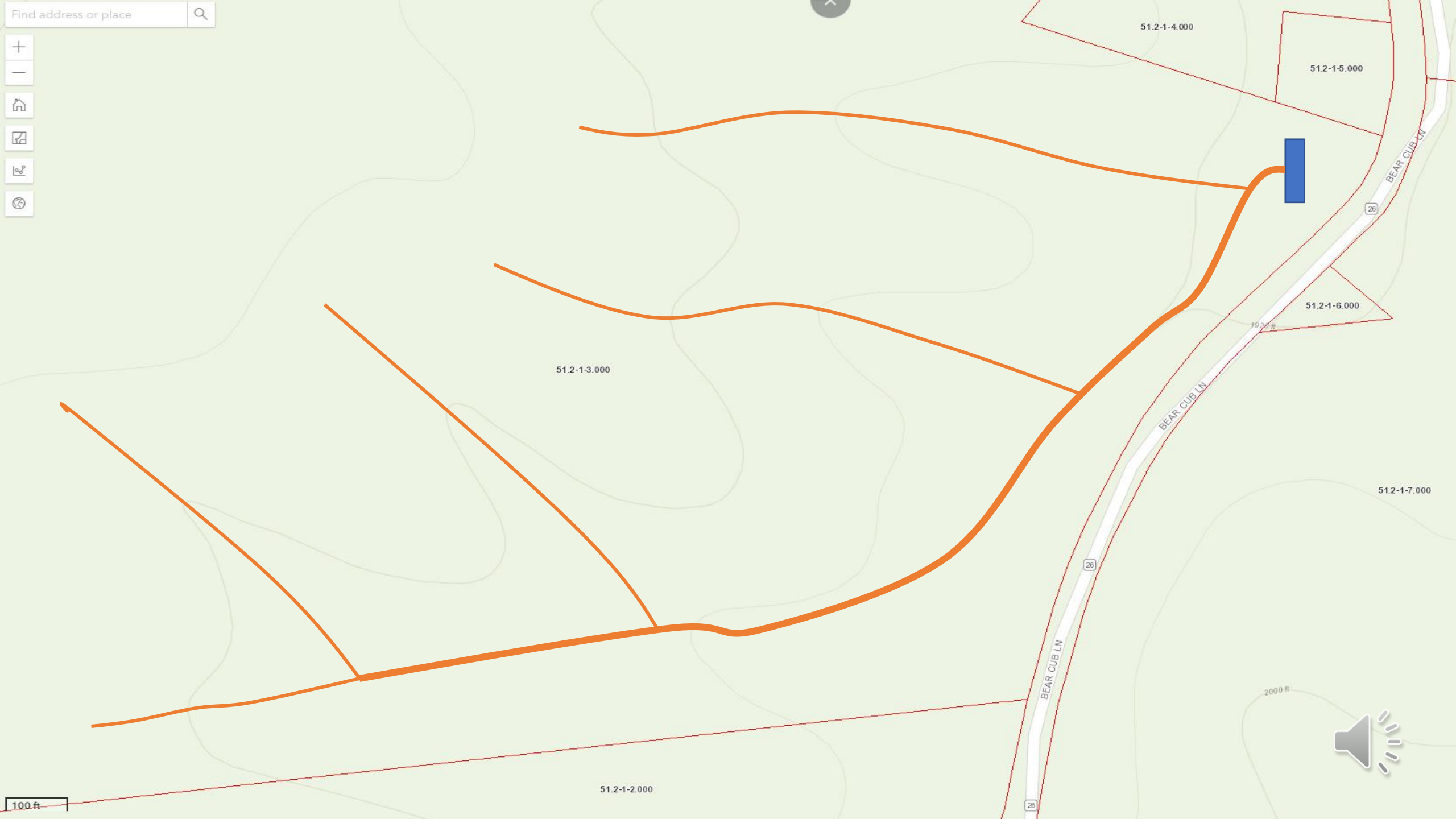
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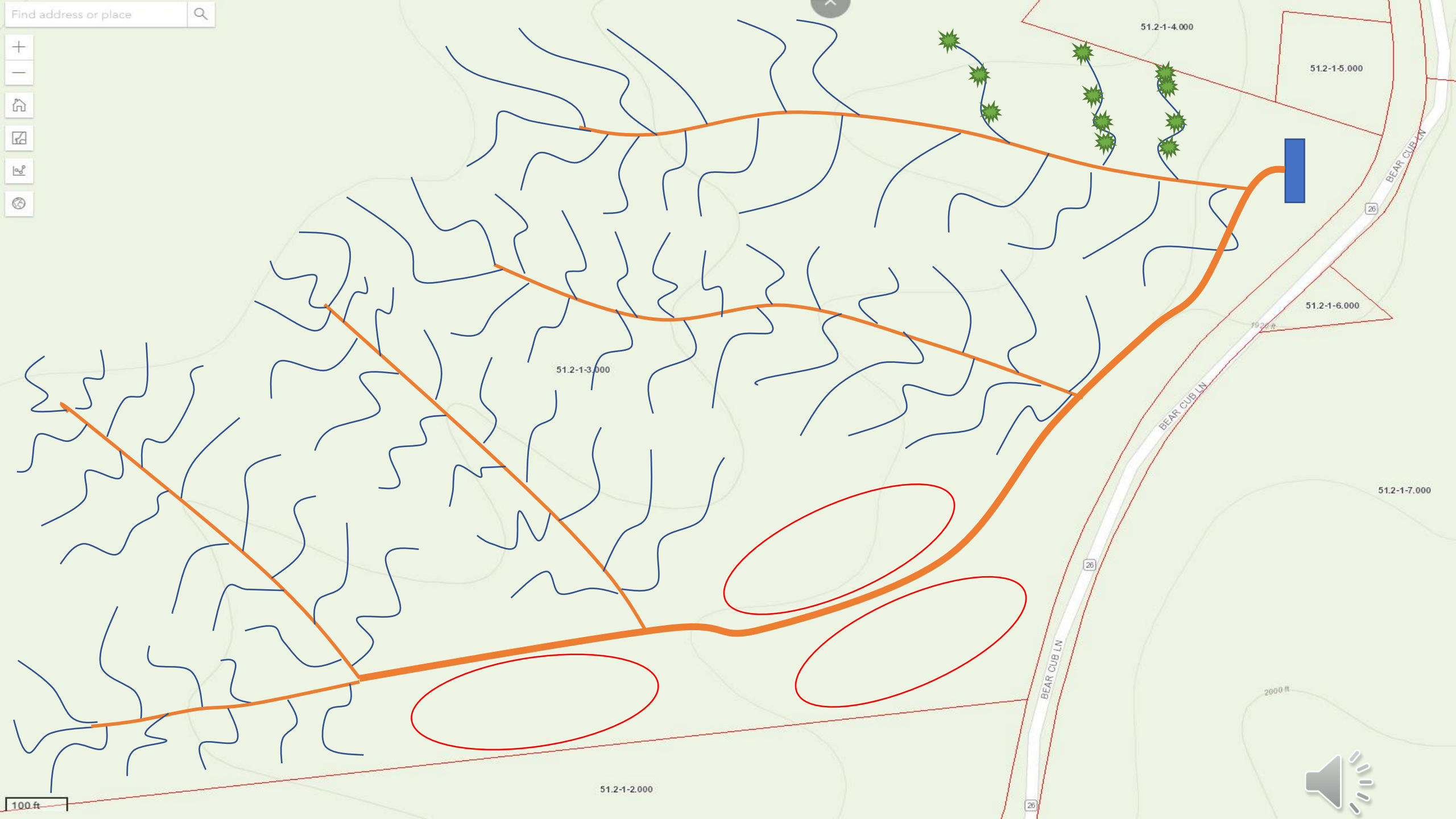
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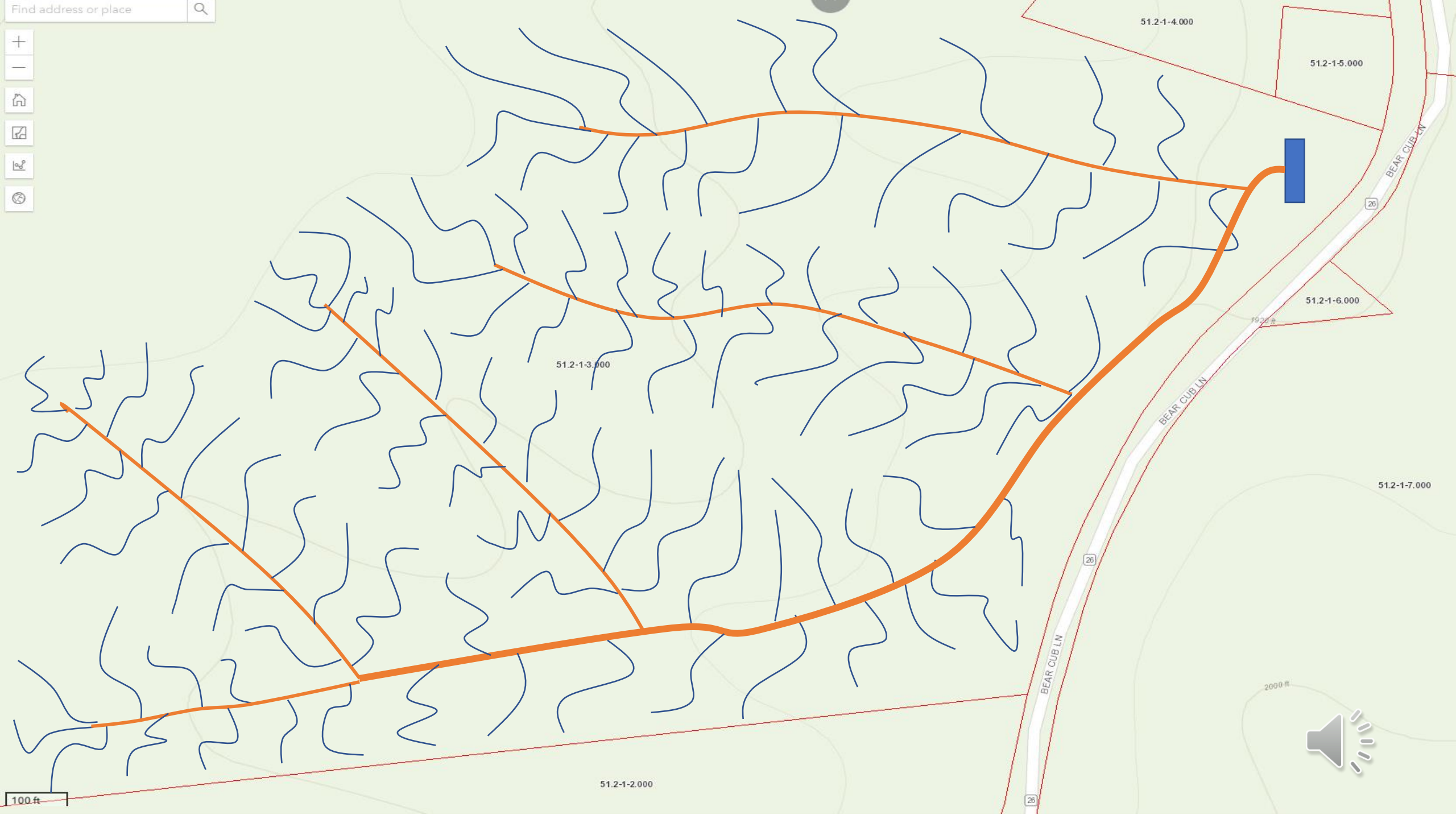
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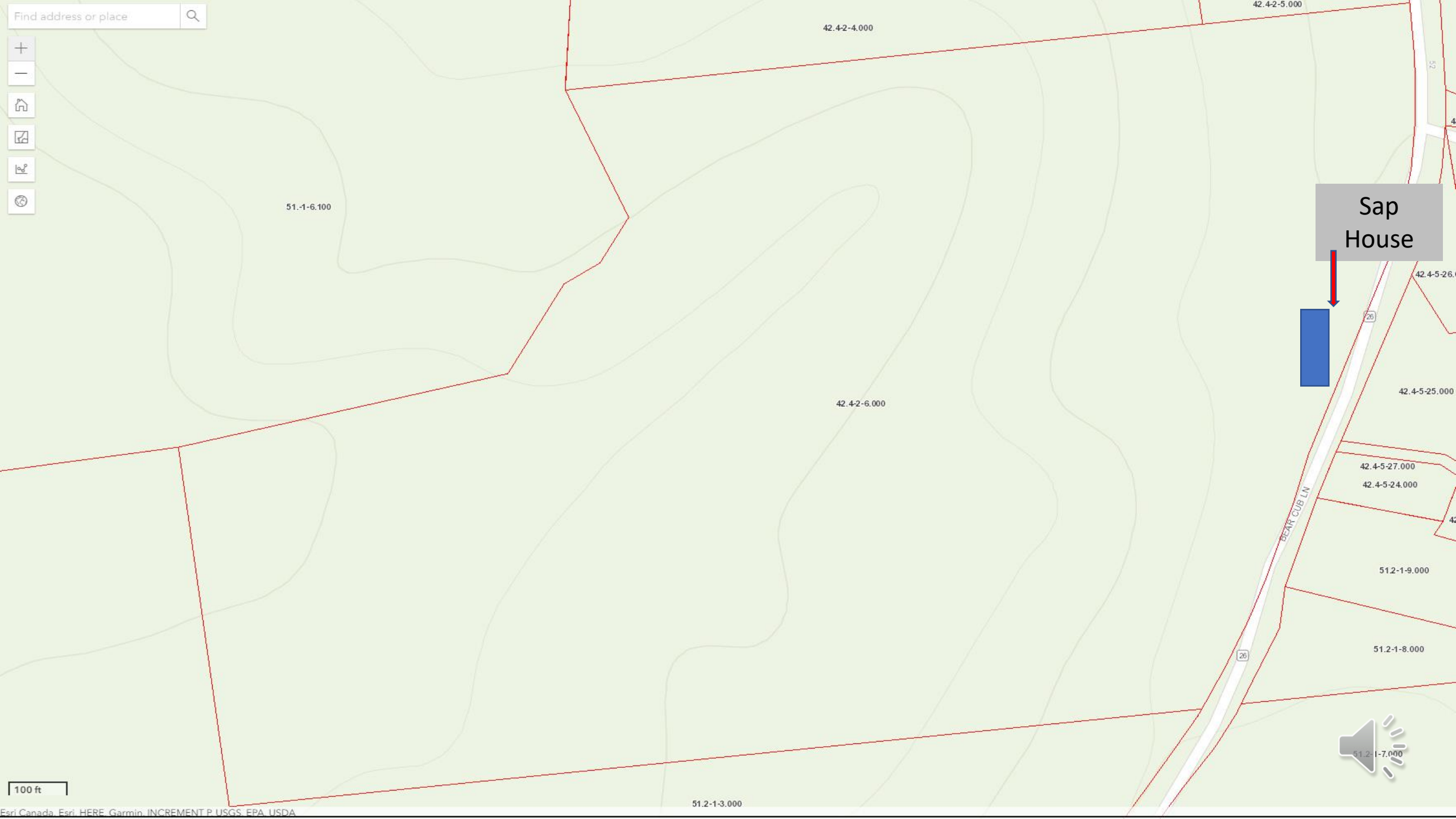
26
100 ft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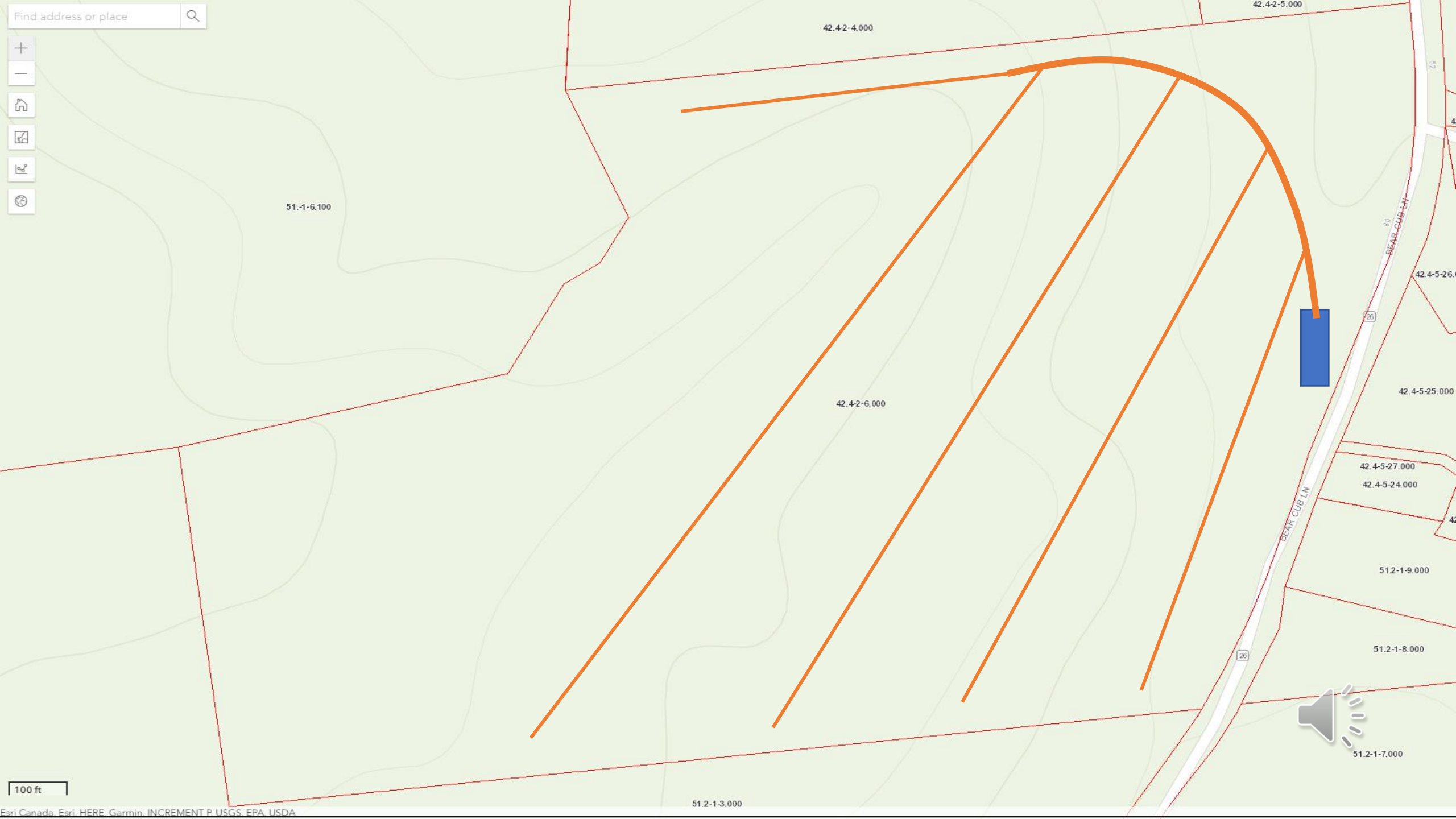
42.4-2-4.000
51.-1-6.100
Sap House
42.4-5-26.
42.4-2-6.000
42.4-5-25.000
42.4-5-27.000
42.4-5-24.000
BEAR CUB LN
51.2-1-9.000
51.2-1-8.000
51.2-1-7.000
51.2-1-3.000
100 ft
Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, EPA, USDA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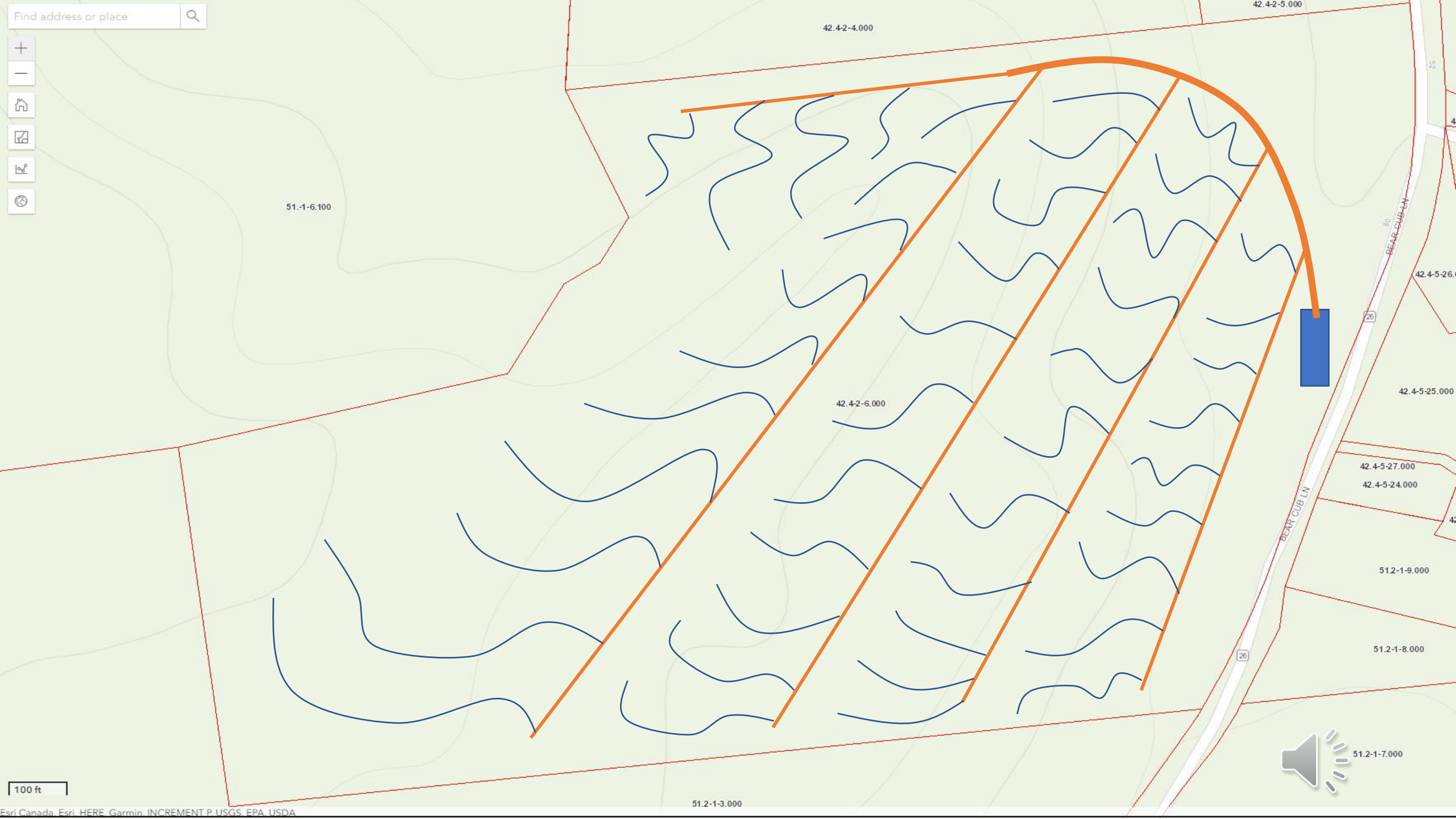
42.4-5-27.000
42.4-5-24.000
51.2-1-9.000
51.2-1-8.000
51.2-1-7.000
51.2-1-3.000
26
100 ft
Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, EPA, USDA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# Access!


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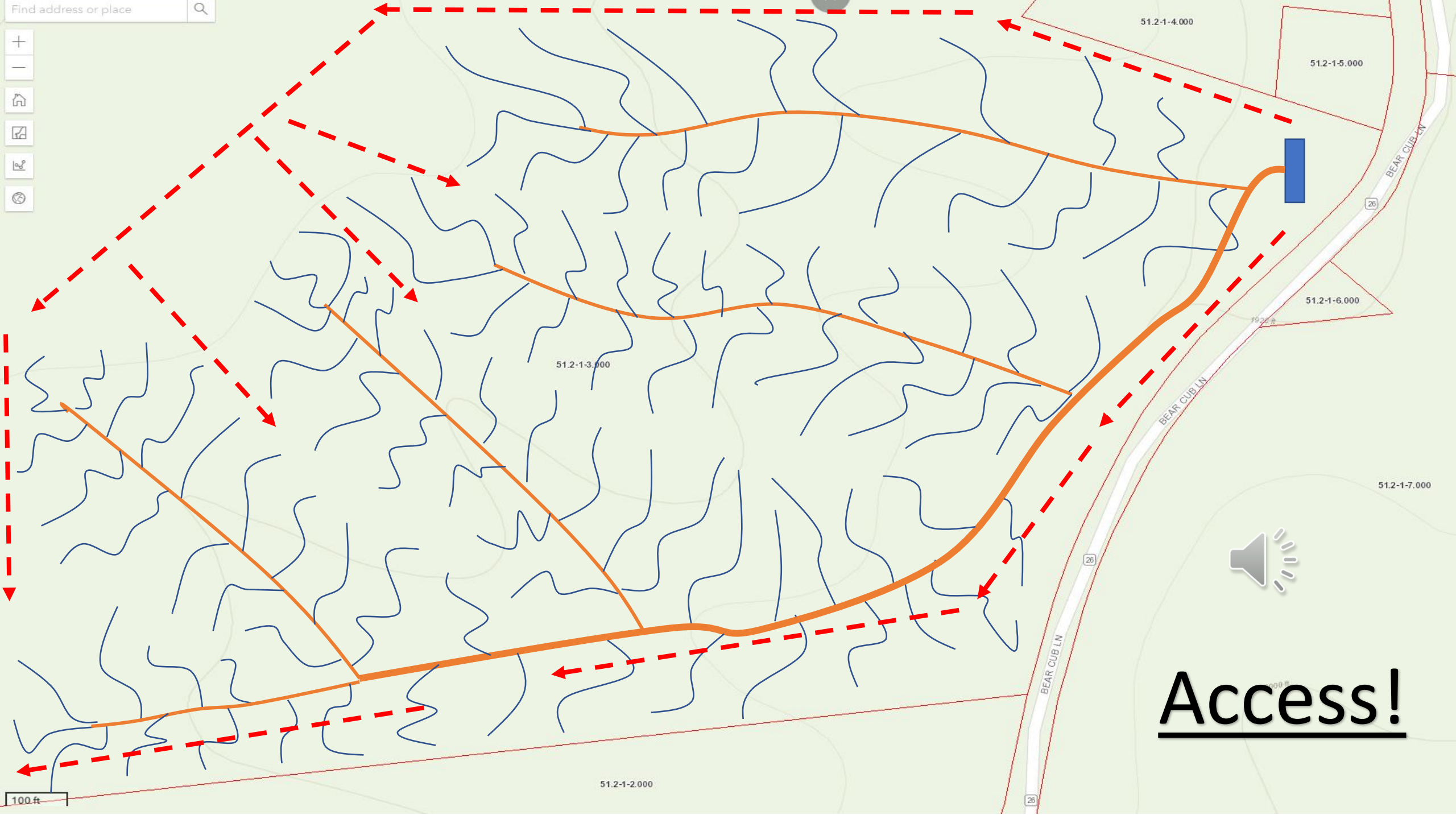
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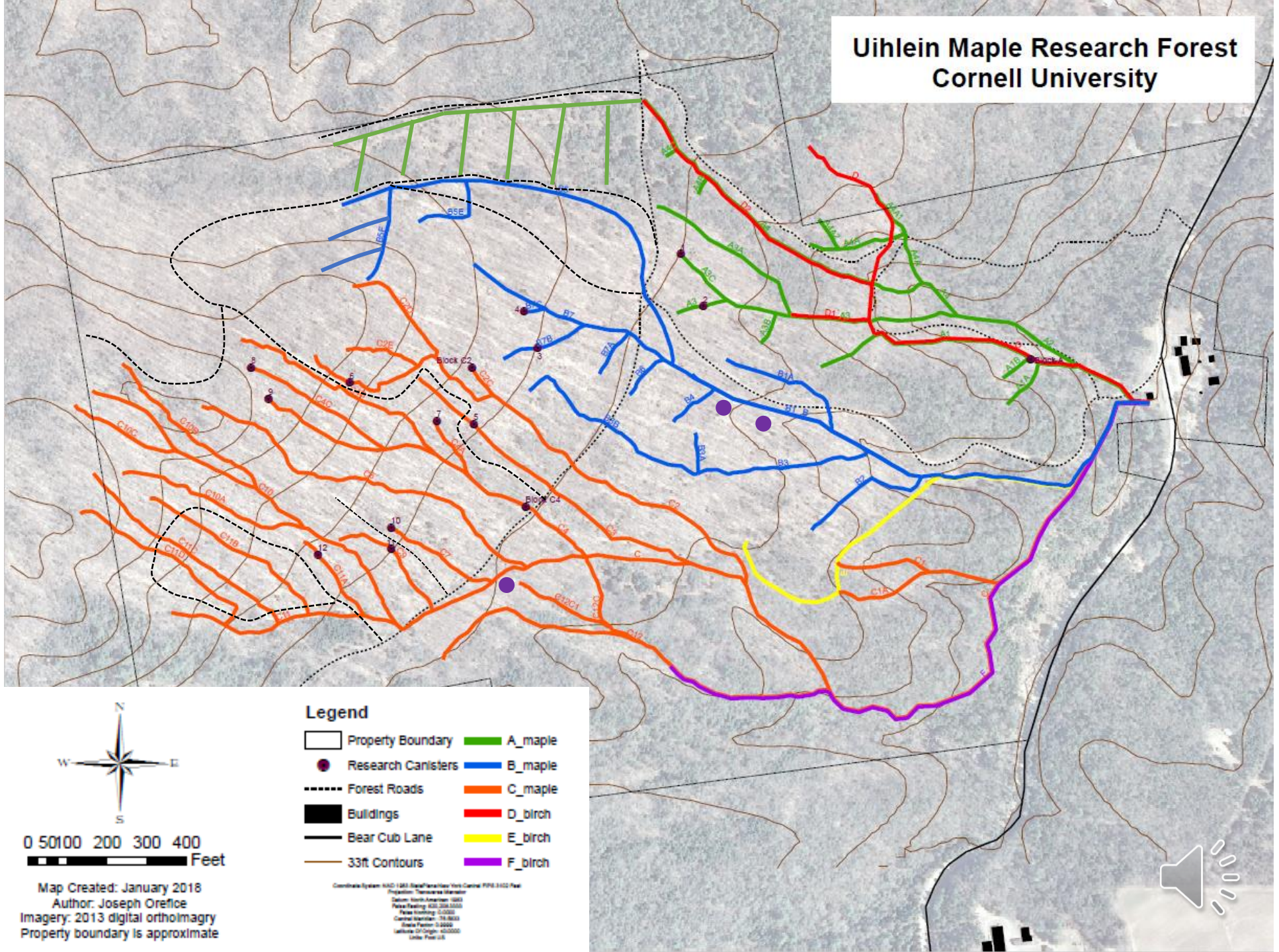

Uihlein Maple Research Forest
Cornell University
N
W
E
S
0 50100 200 300 400
Feet
Map Created: January 2018
Author: Joseph Orefice
Imagery: 2013 digital orthoimagry
Property boundary is approximate
Legend
Property Boundary
Research Canisters
Forest Roads
Buildings
Bear Cub Lane
33ft Contours
A_maple
B_maple
C_maple
D_birch
E_birch
F_birch

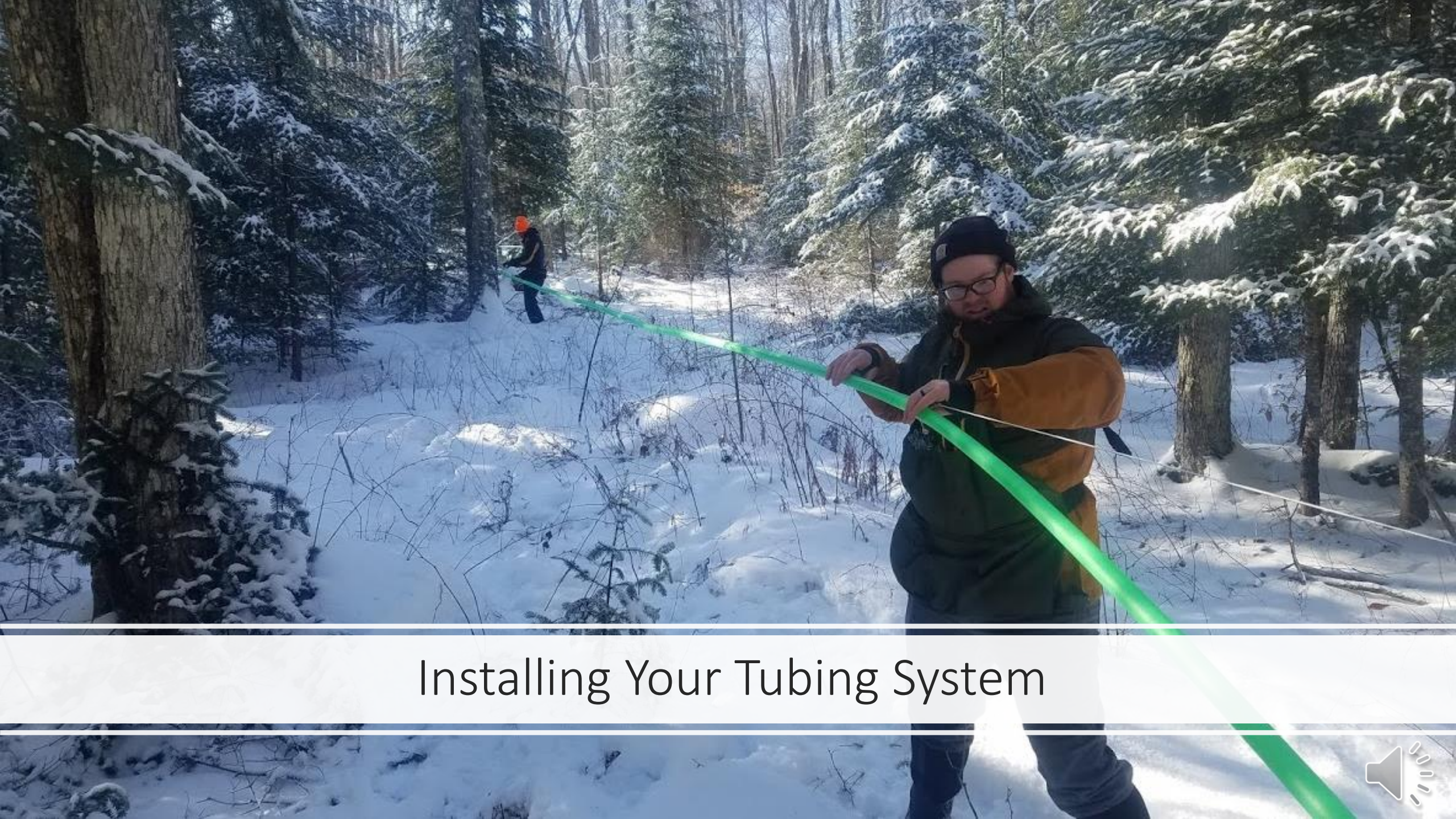

HONDA

# Sap Ladder

# Tubing Cost

- ~$5.00 per tap
- ~$400 per acre
  - Does not include vacuum pump or tanks
- ~$15 a tap If Paying someone to install

[Maple Tubing Cost Calculator](www.cornellmaple.com)
www.cornellmaple.com



# Installing Your Tubing System

# Clear out underbrush or trees to be thinned first

# High Tensile Wire

(12-gauge)


Tree wrap
with a
strainer

# Tree Anchor with a Wire Strainer

# Tree Wrap with a Gripple

# Wire Crimp

# Tree Wrap Too Tight


Not enough protection on this tree wrap
Good tree anchor

# Girdling in a tree from unprotected wire

# Pulling out the Tubing

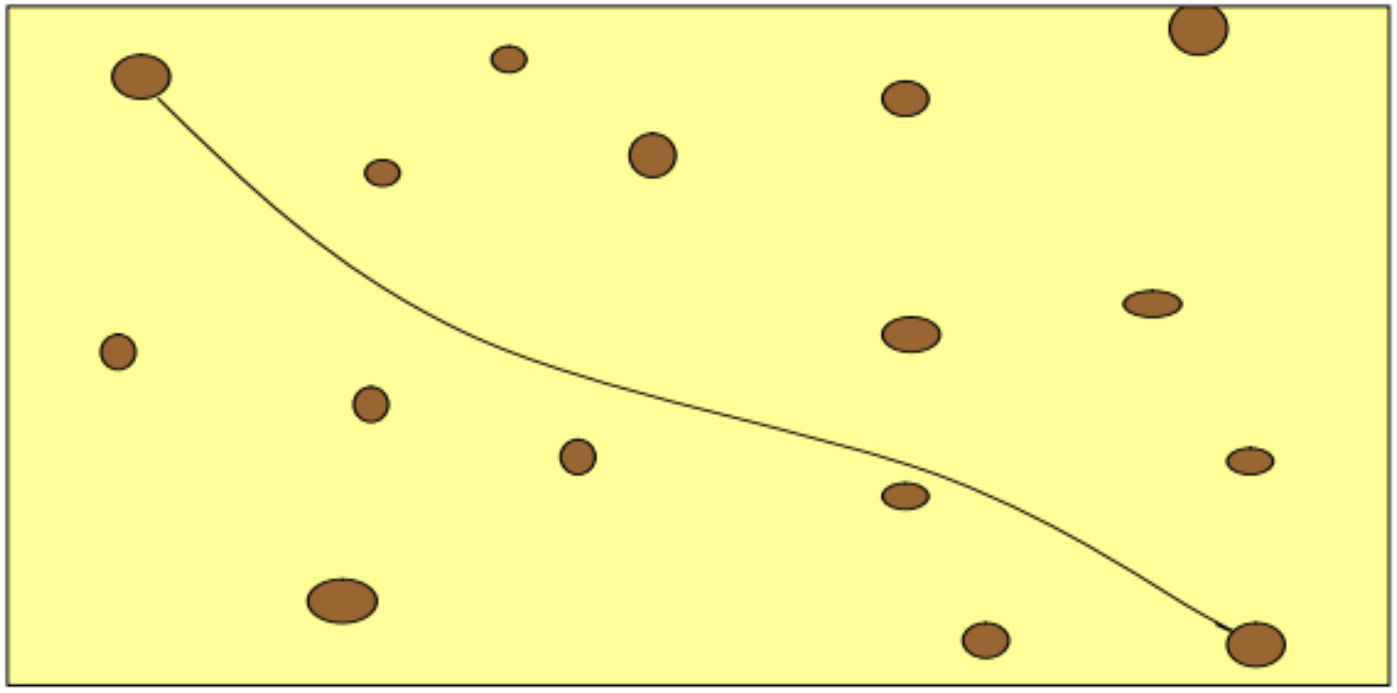
# Pulling out the tubing

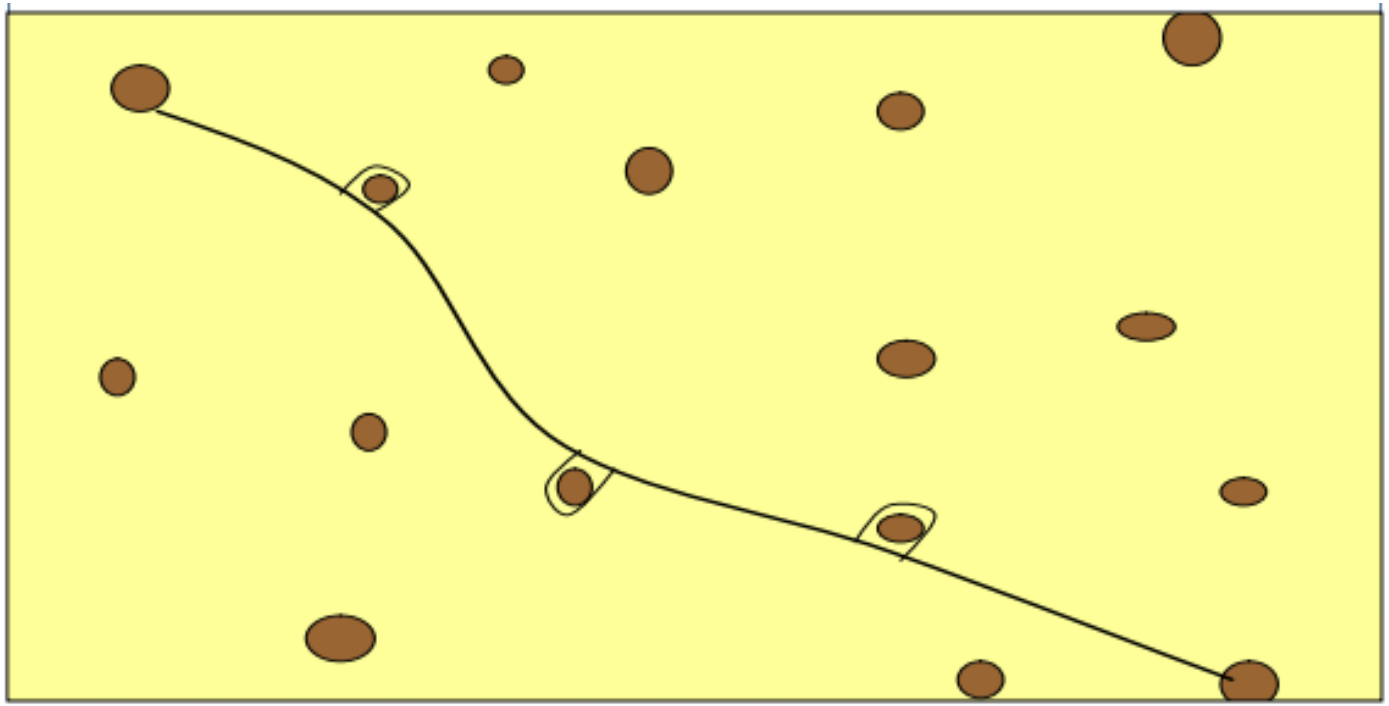

KUBOTA
LA524


Hanging the Tubing

# Wire twist ties every 18 inches

# Tightening your line





Pull the line over with “side ties” to tighten the line

# Side Tie Wire

(14-gauge wire)

# Nailing to trees?
# -Avoid when possible

# Posting in areas with few trees

# Posting in areas with few trees

Important in areas with minimal pitch

Need to maintain at least 2% pitch

# Posting in areas with few trees or small trees

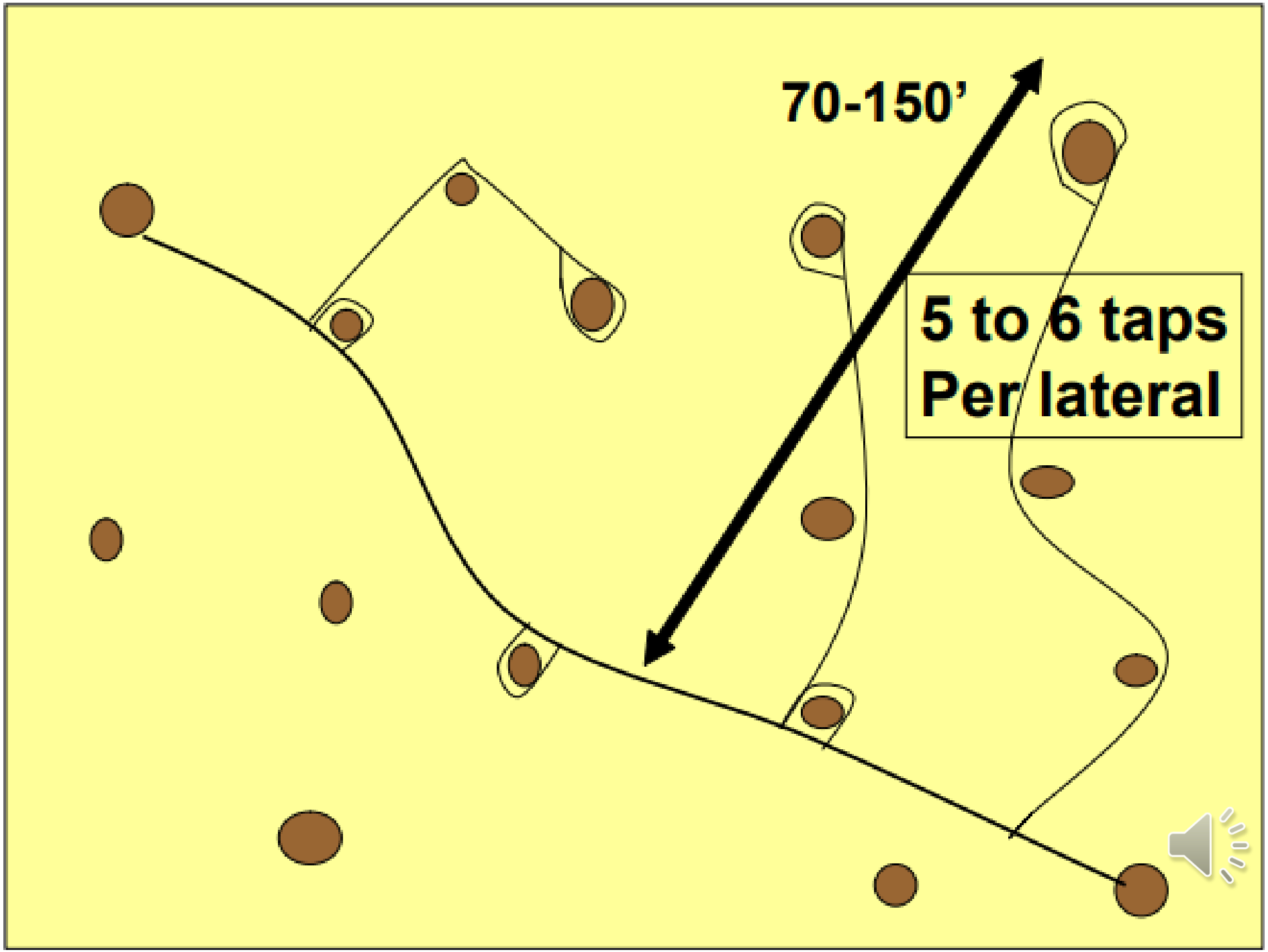
# Ends of mainline can be capped off or have a closed valve


# Stainless steel or plastic connectors and valves?

# Mainline Tool

# Lateral Lines

Strive for
5 no more
than 10



# Pulling Out Lateral Line on Spooler

## End Ring
(~$0.25)

## End Hook
(~$0.25)

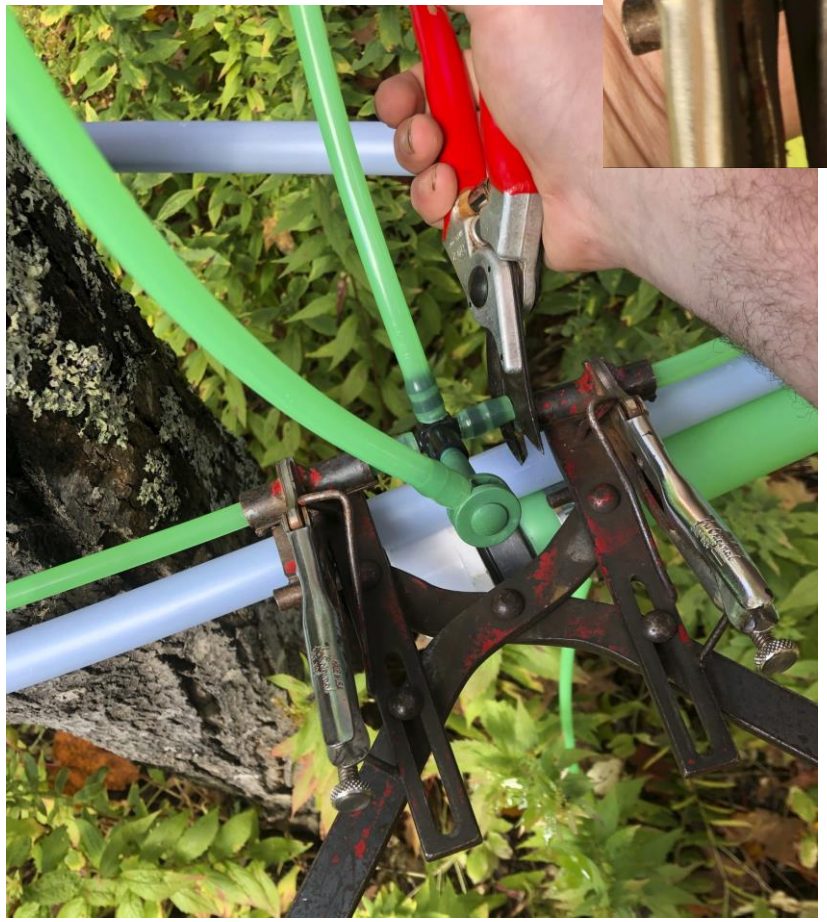
## End Hook T
(~$0.50)

# Friction against trees holds the tubing up

# Sliding Connector
(~$0.50)

# Hooked Coupler
(~$0.25)

# Two Hand Tubing Tool



# One Handed Tubing Tool



# Manifolds (~$2.50)

-Where most vacuum leaks occur

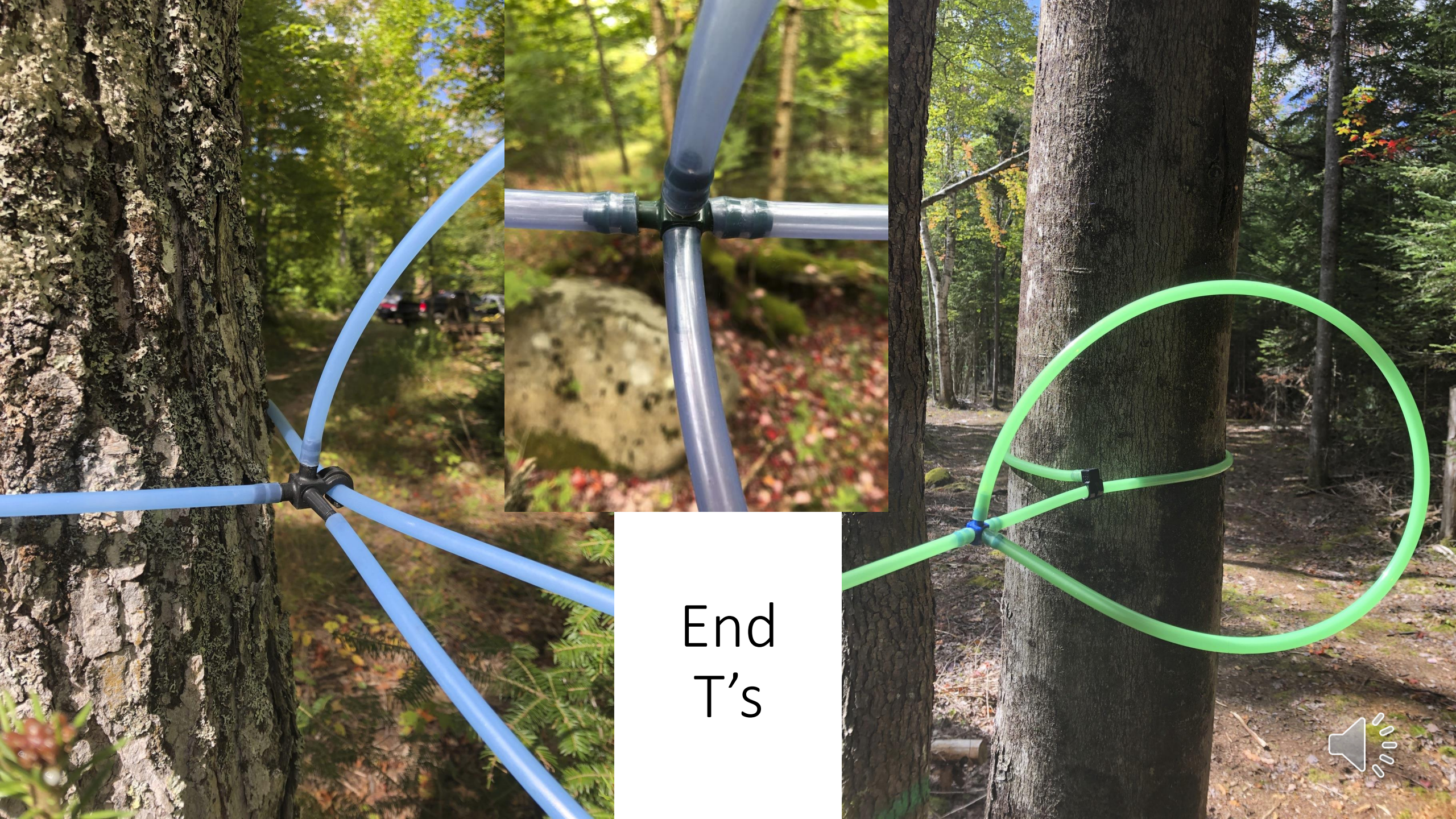
# SpinSeal Manifolds

($0.79 plus machine cost)

Friction from spinning melts the two plastics together.

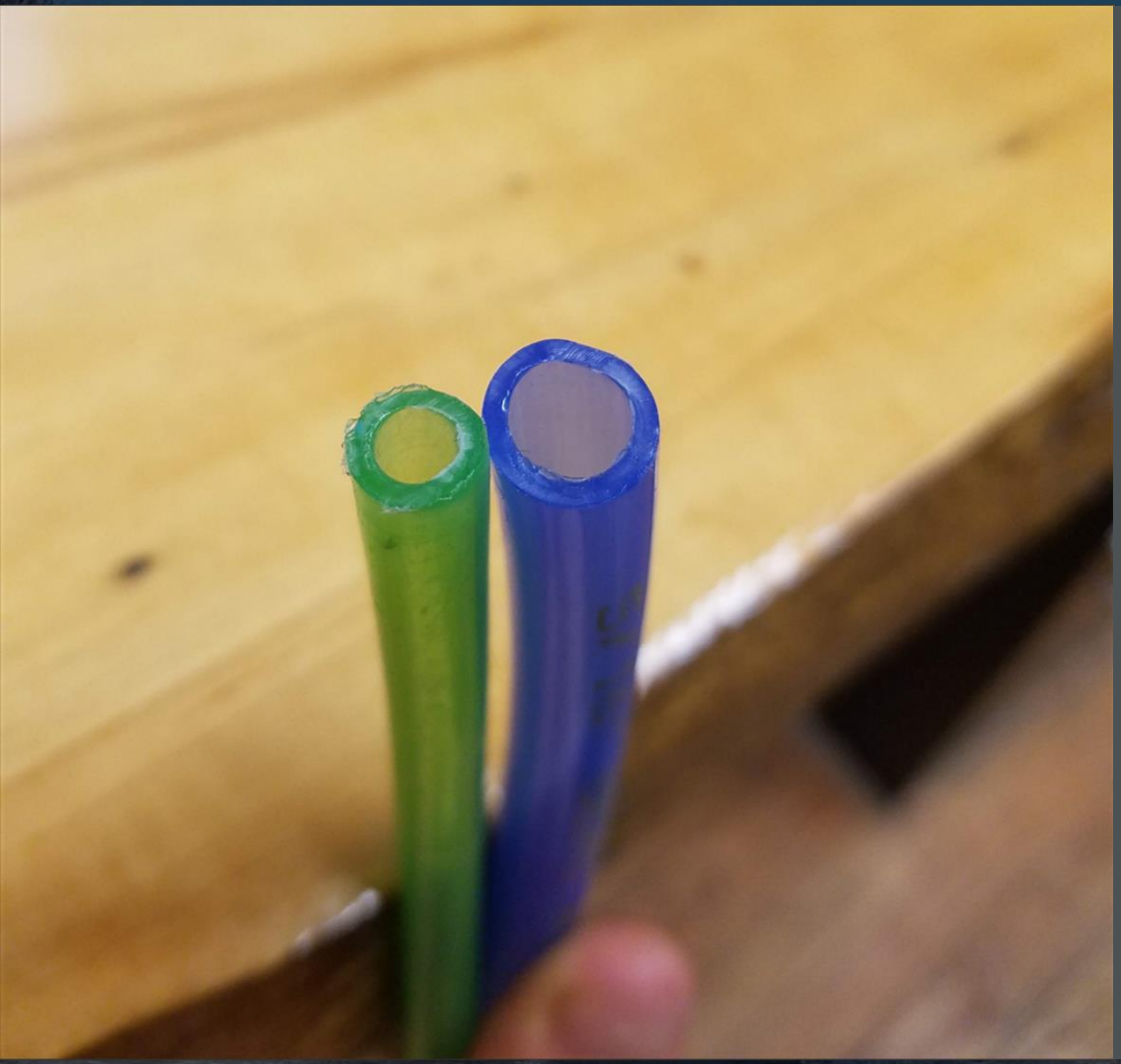

Soudeuse
Spinal
Welder

# T’s


End
T’s

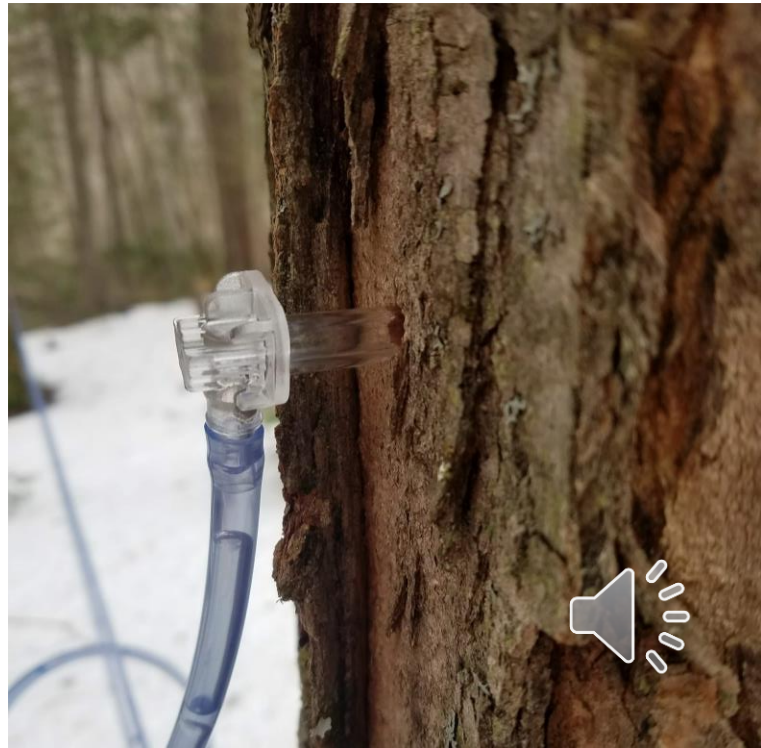
# Quick Connect Couplers

# 3/16” Tubing

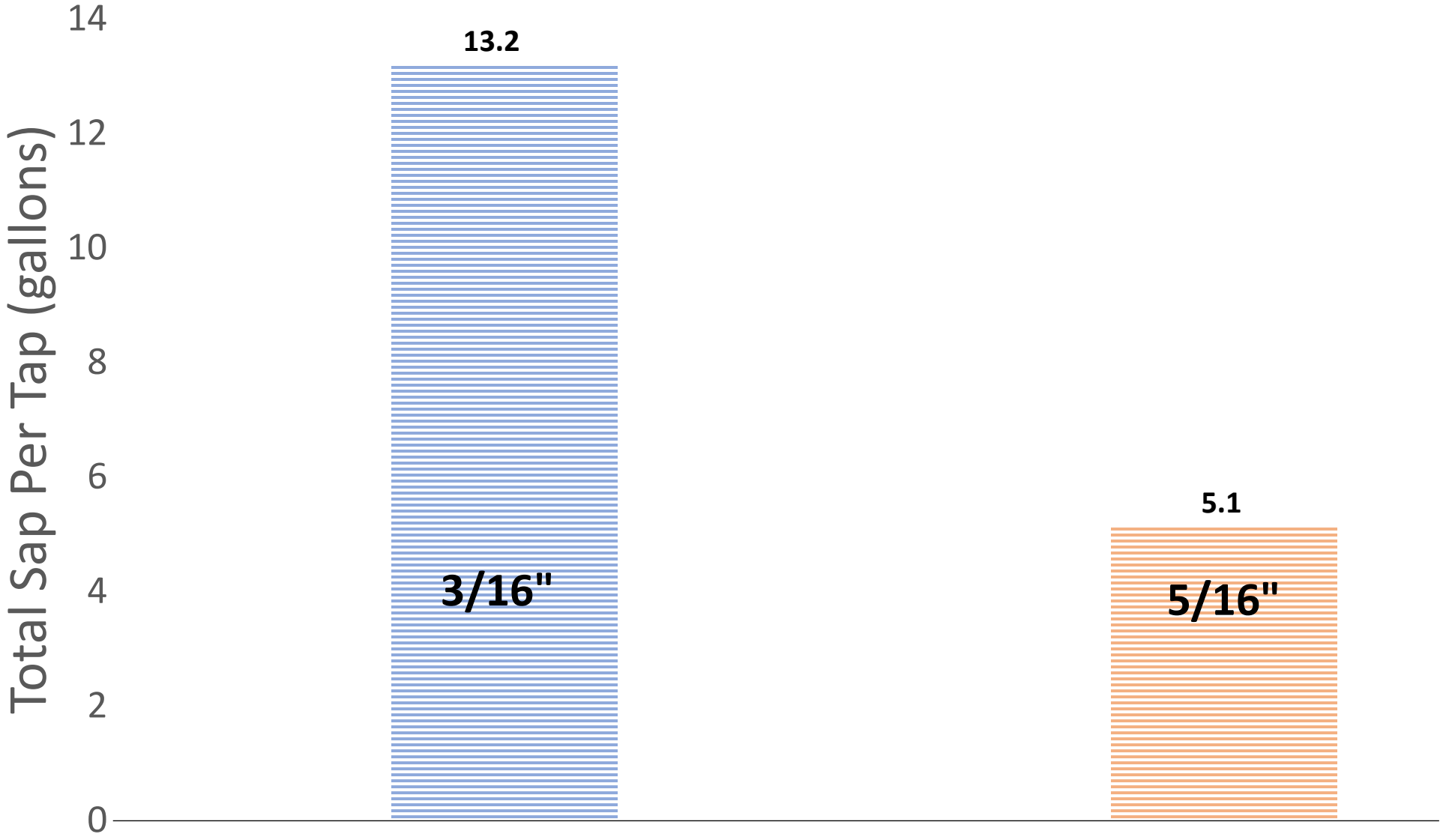


- 36% volume of 5/16” tubing
- creates a full column of sap
- weight of the sap dropping in elevation creates a natural vacuum
  - 0.88”/hg for every 1-foot drop in elevation
- More trees are better
- Easier to install

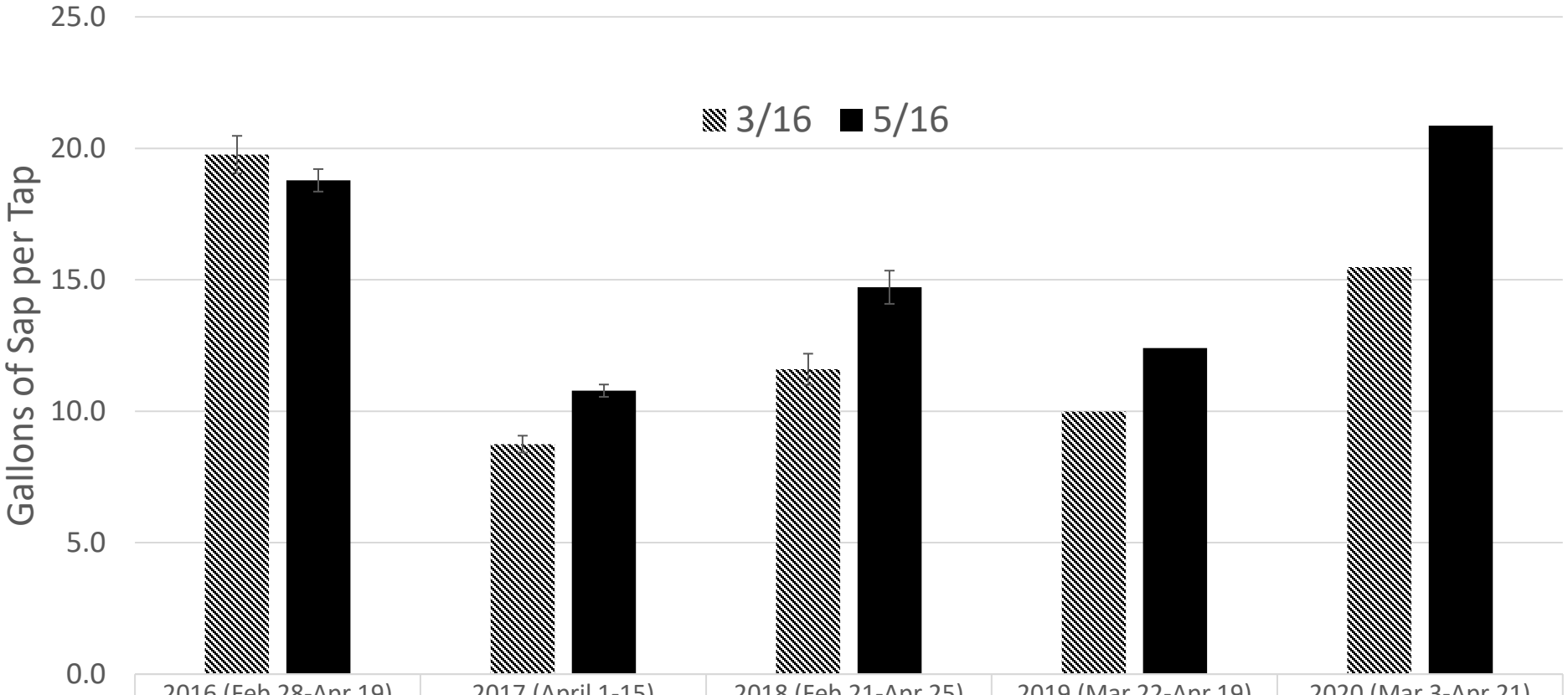
# 3/16” Tubing

# Brand-new 3/16” & 5/16” tubing with 8 taps per lateral line under gravity.



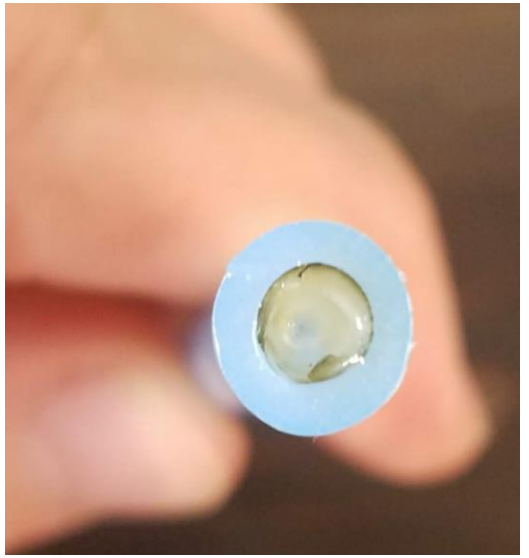
Annual sap yield per tap with 3/16" vs 5/16" tubing on a vacuum system.
Tubing was brand-new in year one. Only spouts were changed each year.




| | 2016 (Feb 28-Apr 19) | 2017 (April 1-15) | 2018 (Feb 21-Apr 25) | 2019 (Mar 22-Apr 19) | 2020 (Mar 3-Apr 21) |
|---|---|---|---|---|---|
| 3/16 | 19.8 | 8.7 | 11.6 | 10.0 | 15.5 |
| 5/16 | 18.8 | 10.8 | 14.7 | 12.4 | 20.9 |

**Year 1** **Year 2** **Year 3** **Year 4** **Year 5**

# Plugging in 3/16” tubing



# Adding Vacuum

For every 1”/hg increase, gain 4-6% in production

| Costs and Returns with Vacuum Systems | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| # of taps | 1000 | Yield of sap/tap | 10 | | | | | |
| Vacuum level | | | 0" | | 15" | | 20" | 25" |
| Sap yield | | | 10000 | | 17500 | | 20000 | 22500 |
| cfm required | | | 0 | | 10 | | 16.7 | 50.0 |
| value of syrup | | | $ | 5,460.47 | $ | 9,555.81 | $ 10,920.93 | $ 12,286.05 |
| Annual cost of vacuum pump | | | $ | - | $ | 240.00 | $ 400.00 | $ 1,200.00 |
| Net return | | | $ | 5,460.47 | $ | 9,315.81 | $ 10,520.93 | $ 11,086.05 |
| Difference | | | $ | - | $ | 3,855.35 | $ 5,060.47 | $ 5,625.58 |

Basic rules of thumb

for each 1" increase in vacuum the cfm is reduced by 8%

for each 1" increase in vacuum sap volume is increased by 5%

1 cfm of pump capacity required for each 100 taps at the desired vacuum

vacuum cost estimated at $200 per cfm depreciated 100% over 10 years with 20% added for electric

cfm capacity of pump as rated at 15" of vacuum

sap converted to syrup at 43 gallons of sap per gallon of syrup

priced at bulk value of $2.10 per pound

Refer to the “Tubing Notebook” for sizing your tubing system and vacuum pumps

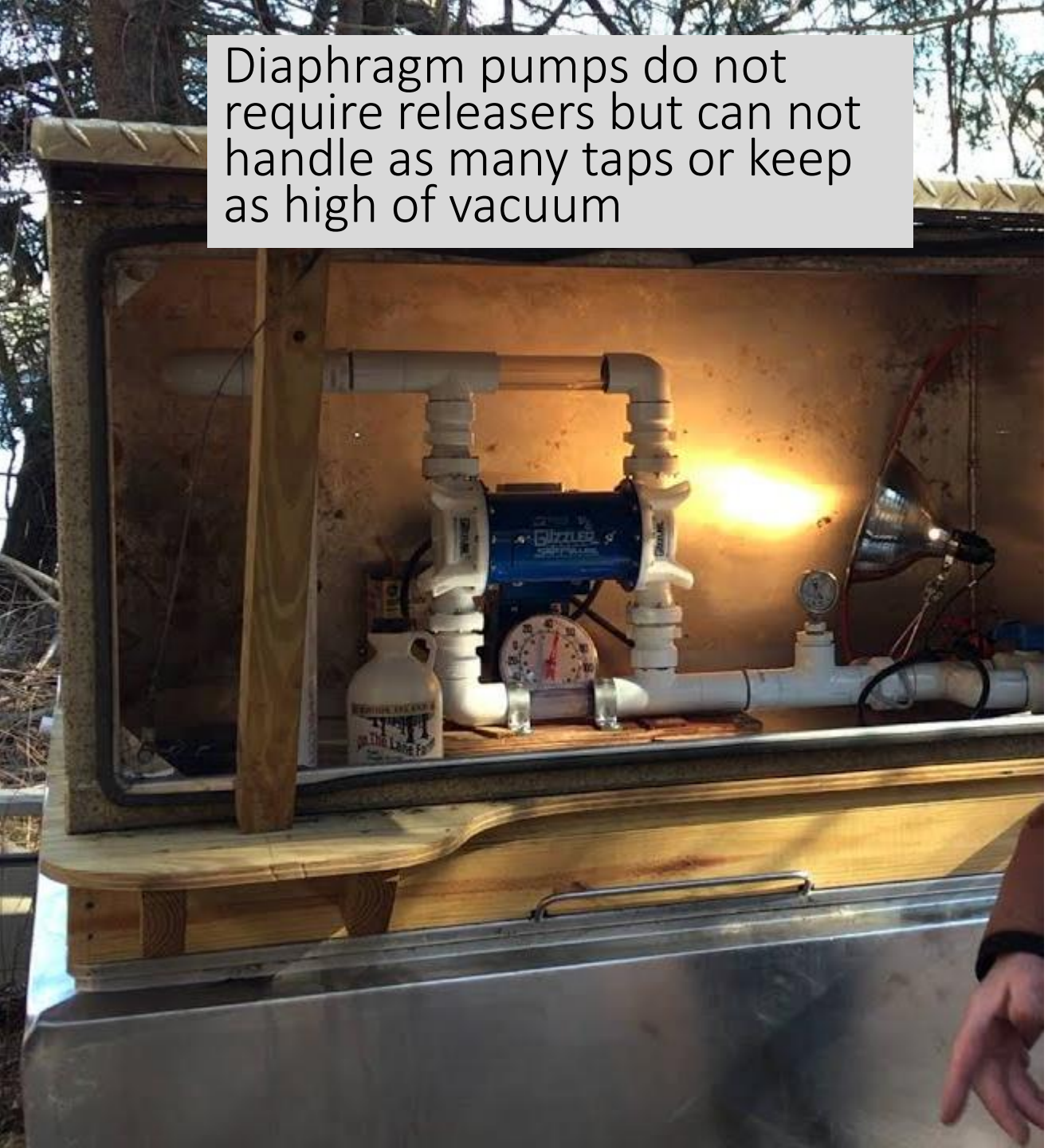
www.cornellmaple.com

# New York State Maple Tubing and Vacuum System Notebook

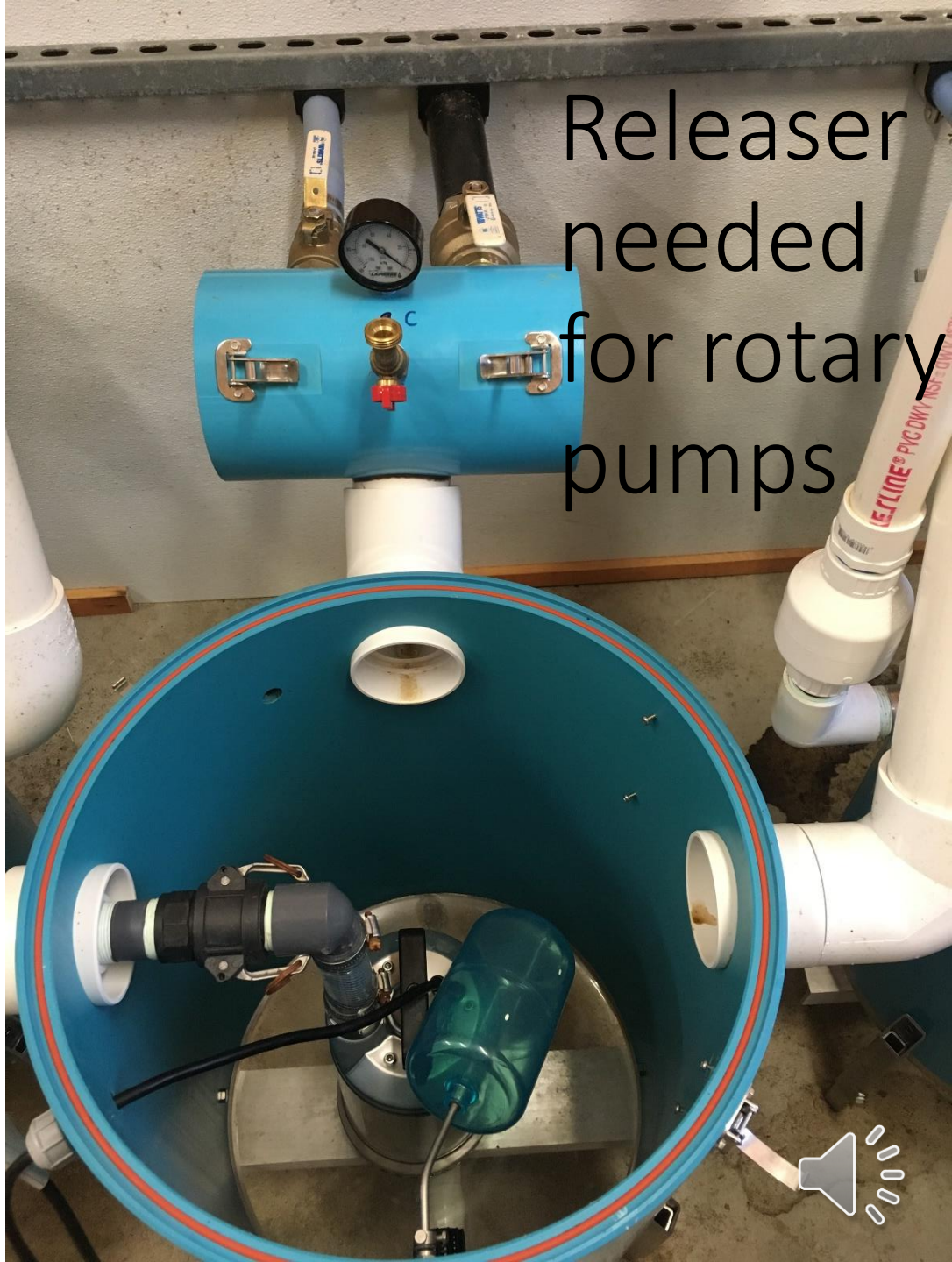
Cornell Maple Program,
County Cornell Cooperative Extension and the
New York State Farm Viability Institute

Cornell University
Cooperative Extension

Diaphragm pumps do not require releasers but can not handle as many taps or keep as high of vacuum

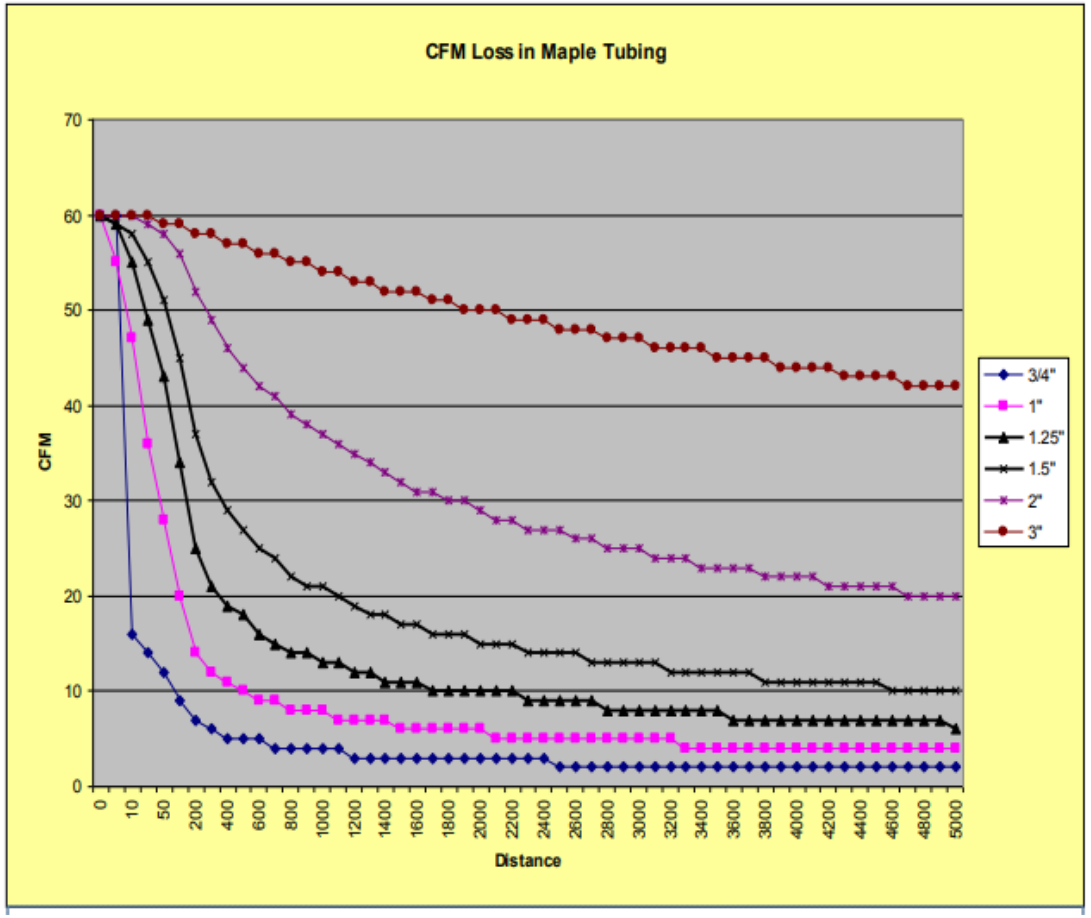


Releaser needed for rotary pumps



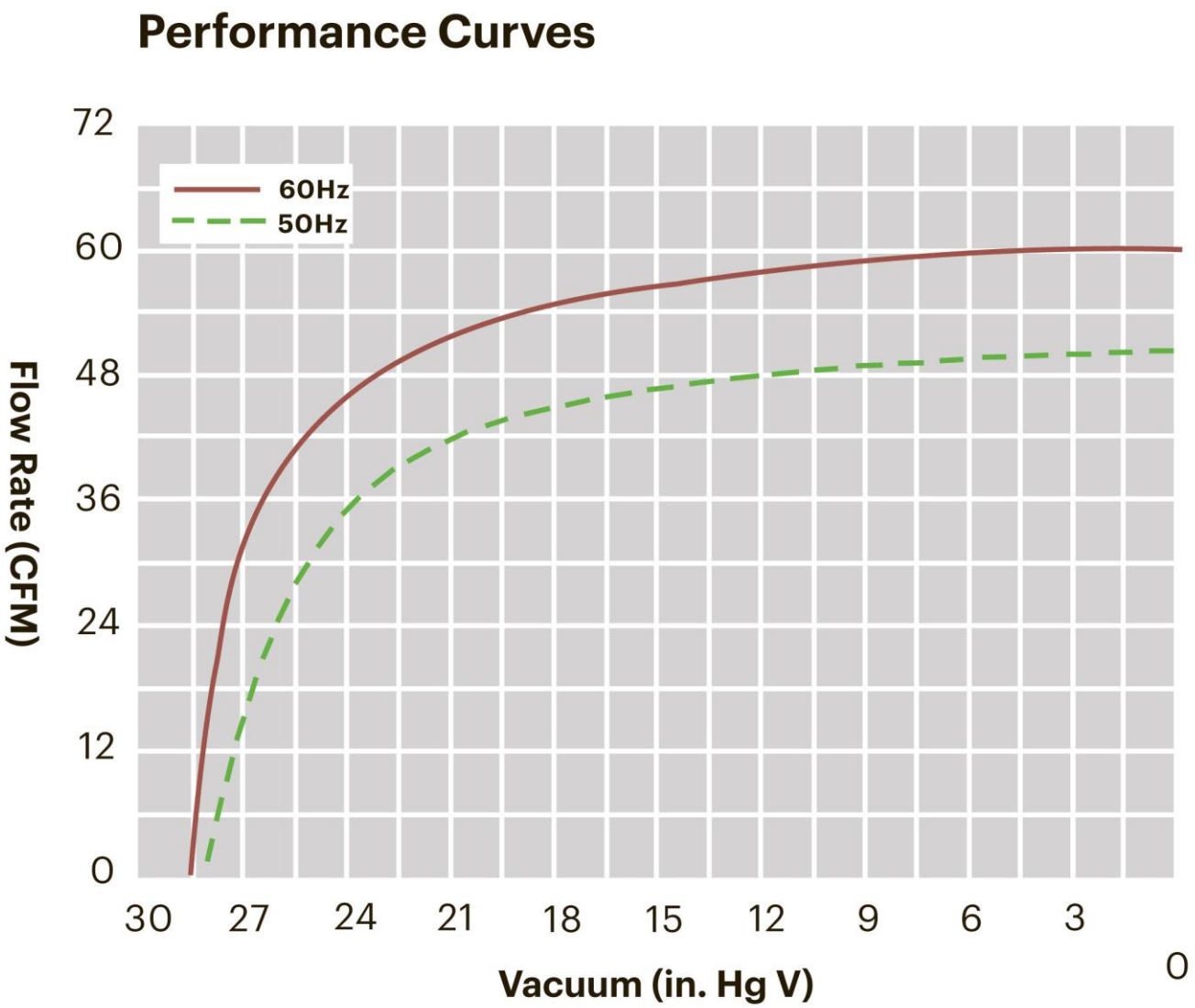
# Evacuation of air in tubing over distance

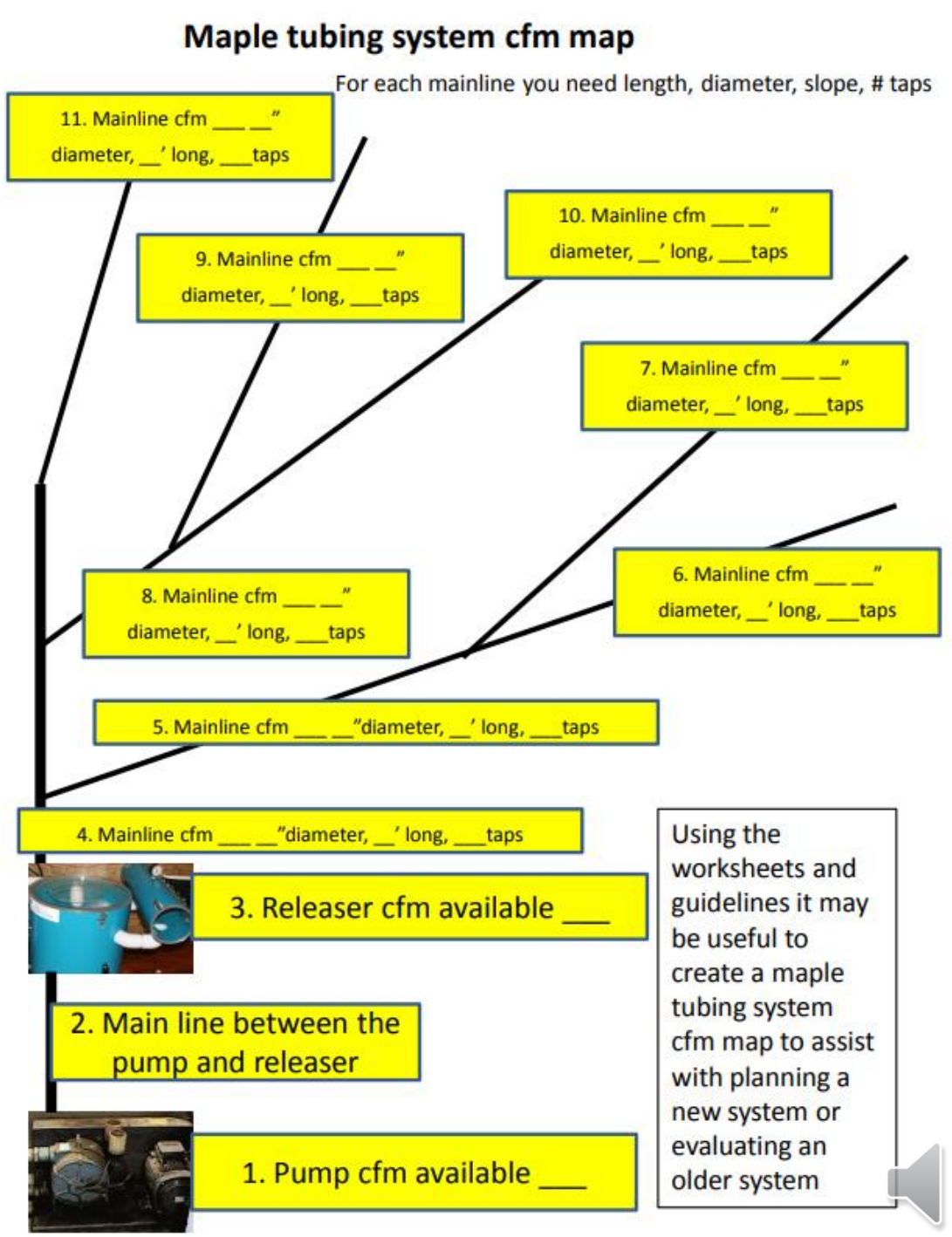
Vacuum pump capacity is measured in cubic feet per minute (CFM)



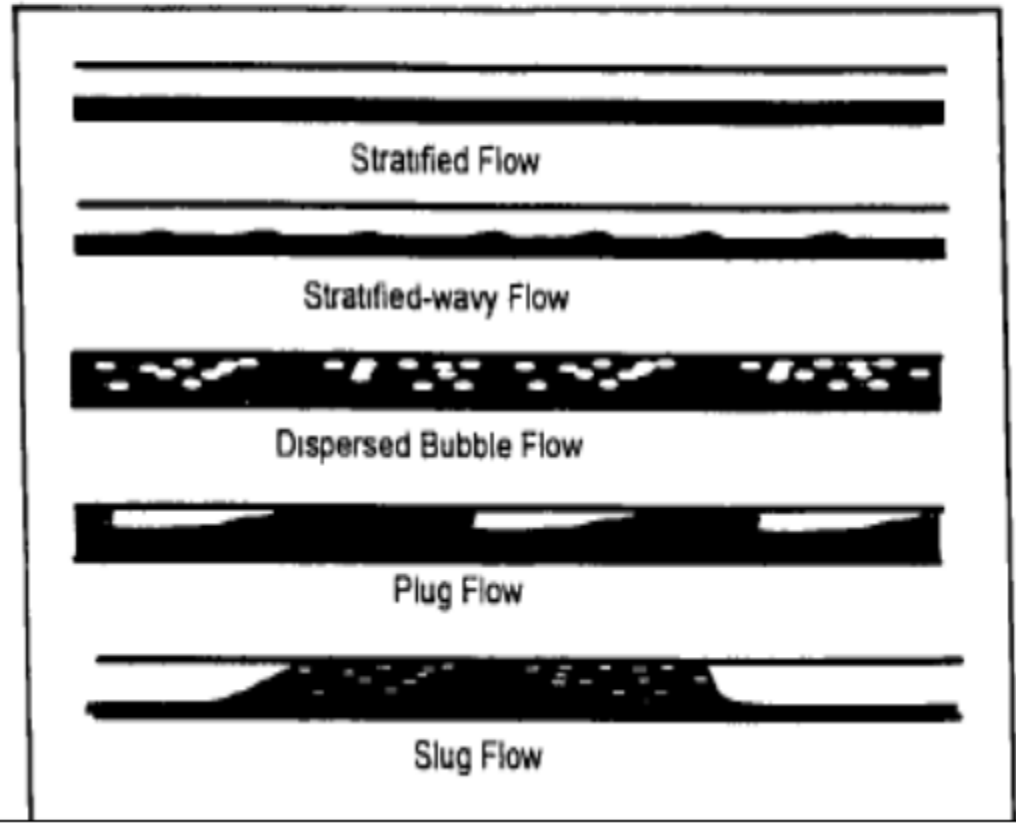

| | 60 cfm at 15 inch hg | | | | | | 30 cfm at 15 inch hg | | | | | | 15 cfm at 15 inch hg | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distance (feet) | 3/4 in | 1 in | 1 1/4 in | 1 1/2 in | 2 in | 3 in | 3/4 in | 1 in | 1 1/4 in | 1 1/2 in | 2 in | 3 in | 3/4 in | 1 in | 1 1/4 in | 1 1/2 in | 2 in | 3 in |
| 0 | 60 | 60 | 60 | 60 | 60 | 60 | 30 | 30 | 30 | 30 | 30 | 30 | 15 | 15 | 15 | 15 | 15 | 15 |
| 3 | 38 | 55 | 59 | 59 | 60 | 60 | 24 | 29 | 30 | 30 | 30 | 30 | 15 | 15 | 15 | 15 | 15 | 15 |
| 5 | 16 | 47 | 55 | 58 | 60 | 60 | 15 | 28 | 29 | 30 | 30 | 30 | 14 | 15 | 15 | 15 | 15 | 15 |
| 25 | 14 | 36 | 49 | 55 | 59 | 60 | 14 | 26 | 29 | 29 | 30 | 30 | 13 | 14 | 15 | 15 | 15 | 15 |
| 50 | 12 | 28 | 43 | 51 | 58 | 60 | 12 | 23 | 27 | 29 | 30 | 30 | 11 | 14 | 14 | 15 | 15 | 15 |
| 100 | 9 | 20 | 34 | 45 | 56 | 59 | 9 | 19 | 25 | 28 | 29 | 30 | 9 | 13 | 14 | 15 | 15 | 15 |
| 200 | 7 | 14 | 25 | 37 | 52 | 59 | 7 | 14 | 21 | 26 | 29 | 30 | 7 | 11 | 13 | 14 | 15 | 15 |
| 300 | 6 | 12 | 21 | 32 | 49 | 58 | 6 | 12 | 19 | 24 | 28 | 30 | 6 | 10 | 13 | 14 | 15 | 15 |
| 400 | 5 | 11 | 19 | 29 | 46 | 58 | 5 | 11 | 18 | 23 | 28 | 30 | 5 | 10 | 12 | 14 | 15 | 15 |
| 500 | 5 | 10 | 18 | 27 | 44 | 57 | 5 | 10 | 16 | 22 | 27 | 30 | 5 | 9 | 12 | 14 | 15 | 15 |
| 600 | 5 | 9 | 16 | 25 | 42 | 57 | 5 | 9 | 15 | 21 | 27 | 30 | 5 | 8 | 11 | 13 | 15 | 15 |
| 700 | 4 | 9 | 15 | 24 | 41 | 56 | 4 | 8 | 14 | 20 | 27 | 29 | 4 | 8 | 11 | 13 | 15 | 15 |
| 800 | 4 | 8 | 14 | 22 | 39 | 56 | 4 | 8 | 14 | 19 | 26 | 29 | 4 | 8 | 11 | 13 | 14 | 15 |
| 900 | 4 | 8 | 14 | 21 | 38 | 55 | 4 | 8 | 13 | 19 | 26 | 29 | 4 | 7 | 10 | 13 | 14 | 15 |
| 1000 | 4 | 8 | 13 | 21 | 37 | 55 | 4 | 8 | 13 | 18 | 25 | 29 | 4 | 7 | 10 | 13 | 14 | 15 |
| 1100 | 4 | 7 | 13 | 20 | 36 | 54 | 4 | 7 | 12 | 18 | 25 | 29 | 4 | 7 | 10 | 12 | 14 | 15 |
| 1200 | 3 | 7 | 12 | 19 | 35 | 54 | 3 | 7 | 12 | 17 | 25 | 29 | 3 | 7 | 10 | 12 | 14 | 15 |
| 1300 | 3 | 7 | 12 | 18 | 34 | 53 | 3 | 7 | 11 | 17 | 24 | 29 | 3 | 6 | 9 | 12 | 14 | 15 |
| 1400 | 3 | 7 | 11 | 18 | 33 | 53 | 3 | 7 | 11 | 16 | 24 | 29 | 3 | 6 | 9 | 12 | 14 | 15 |
| 1500 | 3 | 6 | 11 | 17 | 32 | 52 | 3 | 6 | 11 | 16 | 24 | 29 | 3 | 6 | 9 | 12 | 14 | 15 |
| 1600 | 3 | 6 | 11 | 17 | 31 | 52 | 3 | 6 | 10 | 15 | 23 | 29 | 3 | 6 | 9 | 12 | 14 | 15 |
| 1700 | 3 | 6 | 10 | 16 | 31 | 52 | 3 | 6 | 10 | 15 | 23 | 29 | 3 | 6 | 9 | 11 | 14 | 15 |
| 1800 | 3 | 6 | 10 | 16 | 30 | 51 | 3 | 6 | 10 | 15 | 23 | 29 | 3 | 6 | 9 | 11 | 14 | 15 |
| 1900 | 3 | 6 | 10 | 16 | 30 | 51 | 3 | 6 | 10 | 14 | 23 | 29 | 3 | 6 | 9 | 11 | 14 | 15 |
| 2000 | 3 | 6 | 10 | 15 | 29 | 50 | 3 | 6 | 10 | 14 | 22 | 29 | 3 | 5 | 8 | 11 | 14 | 15 |
| 2100 | 3 | 5 | 10 | 15 | 28 | 50 | 3 | 5 | 10 | 14 | 22 | 28 | 3 | 5 | 8 | 11 | 14 | 15 |
| 2200 | 3 | 5 | 9 | 15 | 28 | 50 | 3 | 5 | 9 | 14 | 22 | 28 | 3 | 5 | 8 | 11 | 14 | 15 |
| 2300 | 3 | 5 | 9 | 14 | 27 | 49 | 3 | 5 | 9 | 13 | 22 | 28 | 3 | 5 | 8 | 11 | 14 | 15 |
| 2400 | 3 | 5 | 9 | 14 | 27 | 49 | 3 | 5 | 9 | 13 | 21 | 28 | 3 | 5 | 8 | 11 | 13 | 15 |
| 2500 | 2 | 5 | 9 | 14 | 27 | 49 | 2 | 5 | 9 | 13 | 21 | 28 | 2 | 5 | 8 | 10 | 13 | 15 |
| 2600 | 2 | 5 | 9 | 14 | 26 | 48 | 2 | 5 | 9 | 13 | 21 | 28 | 2 | 5 | 8 | 10 | 13 | 15 |
| 2700 | 2 | 5 | 9 | 13 | 26 | 48 | 2 | 5 | 8 | 13 | 21 | 28 | 2 | 5 | 8 | 10 | 13 | 15 |
| 2800 | 2 | 5 | 8 | 13 | 25 | 48 | 2 | 5 | 8 | 12 | 21 | 28 | 2 | 5 | 8 | 10 | 13 | 15 |
| 2900 | 2 | 5 | 8 | 13 | 25 | 47 | 2 | 5 | 8 | 12 | 20 | 28 | 2 | 5 | 7 | 10 | 13 | 15 |
| 3000 | 2 | 5 | 8 | 13 | 25 | 47 | 2 | 5 | 8 | 12 | 20 | 28 | 2 | 5 | 7 | 10 | 13 | 15 |
| 3100 | 2 | 5 | 8 | 13 | 24 | 47 | 2 | 5 | 8 | 12 | 20 | 28 | 2 | 4 | 7 | 10 | 13 | 15 |

# The larger your sap collection system, the more CFM are needed



# Main Lines Must Be Sized for Sap and Air Flow

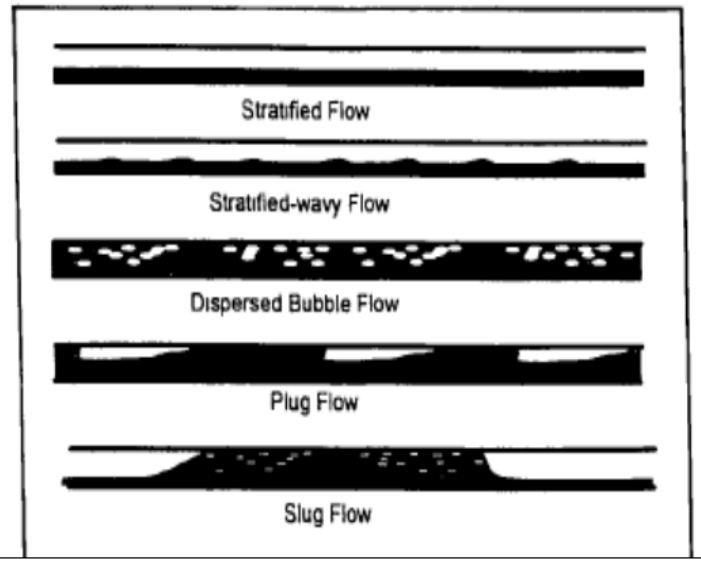



How many taps can a 1” line handle if the mainline is 2,000 ft?

**Guidelines for 1" line at 2%, 6%, 10% and 15% slope, 15 cfm**

| | | | 2% slope | 6% slope | 10% slope | 15%slope |
|---|---|---|---|---|---|---|
| | 1" | 1" | 1" | 1" | 1" | 1" |
| | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm |
| Distance (feet) | 15cfm | Capacity for taps on dryline | Maximum number of taps | Maximum number of taps | Maximum number of taps | Maximum number of taps |
| 0 | 15 | 1500 | 693 | 834 | 877 | 913 |
| 3 | 15 | 1500 | 693 | 834 | 877 | 913 |
| 5 | 15 | 1500 | 693 | 834 | 877 | 913 |
| 25 | 14 | 1400 | 693 | 834 | 877 | 913 |
| 50 | 14 | 1400 | 693 | 834 | 877 | 913 |
| 100 | 13 | 1300 | 693 | 834 | 877 | 913 |
| 200 | 11 | 1100 | 693 | 834 | 877 | 913 |
| 300 | 10.2 | 1020 | 659 | 786 | 825 | 857 |
| 400 | 9.8 | 980 | 641 | 762 | 798 | 828 |
| 500 | 9 | 900 | 604 | 712 | 744 | 770 |
| 600 | 8.5 | 850 | 580 | 680 | 709 | 733 |
| 700 | 8.1 | 810 | 560 | 654 | 681 | 703 |
| 800 | 7.7 | 770 | 539 | 627 | 652 | 672 |
| 900 | 7.4 | 740 | 524 | 607 | 631 | 649 |
| 1000 | 7.2 | 720 | 513 | 593 | 616 | 634 |
| 1100 | 7 | 700 | 502 | 580 | 601 | 618 |
| 1200 | 6.8 | 680 | 491 | 566 | 586 | 603 |
| 1300 | 6.5 | 650 | 475 | 545 | 564 | 579 |
| 1400 | 6.3 | 630 | 464 | 530 | 549 | 563 |
| 1500 | 6.2 | 620 | 458 | 523 | 541 | 555 |
| 1600 | 6 | 600 | 447 | 509 | 526 | 539 |
| 1700 | 5.9 | 590 | 441 | 502 | 518 | 531 |
| 1800 | 5.7 | 570 | 429 | 487 | 502 | 514 |
| 1900 | 5.6 | 560 | 423 | 480 | 495 | 506 |
| 2000 | 5.5 | 550 | 418 | 472 | 487 | 498 |
| 2100 | 5.4 | 540 | 412 | 465 | 479 | 490 |
| 2200 | 5.3 | 530 | 406 | 457 | 471 | 482 |
| 2300 | 5.2 | 520 | 400 | 450 | 463 | 473 |
| 2400 | 5.1 | 510 | 394 | 442 | 455 | 465 |
| 2500 | 5 | 500 | 387 | 435 | 447 | 457 |
| 2600 | 4.9 | 490 | 381 | 427 | 439 | 448 |
| 2700 | 4.8 | 480 | 375 | 420 | 431 | 440 |
| 2800 | 4.7 | 470 | 369 | 412 | 423 | 432 |
| 2900 | 4.6 | 460 | 363 | 404 | 415 | 423 |

## Main Lines Must Be Sized for Sap and Air Flow




How many taps can a 1” line handle if the mainline is 2,000 ft?

What if we actually had 750 taps within that distance?

**Guidelines for 1" line at 2%, 6%, 10% and 15% slope, 15 cfm**

| | | | 2% slope | 6% slope | 10% slope | 15%slope |
|---|---|---|---|---|---|---|
| | 1" | 1" | 1" | 1" | 1" | 1" |
| | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm |
| Distance (feet) | 15cfm | Capacity for taps on dryline | Maximum number of taps | Maximum number of taps | Maximum number of taps | Maximum number of taps |
| 0 | 15 | 1500 | 693 | 834 | 877 | 913 |
| 3 | 15 | 1500 | 693 | 834 | 877 | 913 |
| 5 | 15 | 1500 | 693 | 834 | 877 | 913 |
| 25 | 14 | 1400 | 693 | 834 | 877 | 913 |
| 50 | 14 | 1400 | 693 | 834 | 877 | 913 |
| 100 | 13 | 1300 | 693 | 834 | 877 | 913 |
| 200 | 11 | 1100 | 693 | 834 | 877 | 913 |
| 300 | 10.2 | 1020 | 659 | 786 | 825 | 857 |
| 400 | 9.8 | 980 | 641 | 762 | 798 | 828 |
| 500 | 9 | 900 | 604 | 712 | 744 | 770 |
| 600 | 8.5 | 850 | 580 | 680 | 709 | 733 |
| 700 | 8.1 | 810 | 560 | 654 | 681 | 703 |
| 800 | 7.7 | 770 | 539 | 627 | 652 | 672 |
| 900 | 7.4 | 740 | 524 | 607 | 631 | 649 |
| 1000 | 7.2 | 720 | 513 | 593 | 616 | 634 |
| 1100 | 7 | 700 | 502 | 580 | 601 | 618 |
| 1200 | 6.8 | 680 | 491 | 566 | 586 | 603 |
| 1300 | 6.5 | 650 | 475 | 545 | 564 | 579 |
| 1400 | 6.3 | 630 | 464 | 530 | 549 | 563 |
| 1500 | 6.2 | 620 | 458 | 523 | 541 | 555 |
| 1600 | 6 | 600 | 447 | 509 | 526 | 539 |
| 1700 | 5.9 | 590 | 441 | 502 | 518 | 531 |
| 1800 | 5.7 | 570 | 429 | 487 | 502 | 514 |
| 1900 | 5.6 | 560 | 423 | 480 | 495 | 506 |
| 2000 | 5.5 | 550 | 418 | 472 | 487 | 498 |
| 2100 | 5.4 | 540 | 412 | 465 | 479 | 490 |
| 2200 | 5.3 | 530 | 406 | 457 | 471 | 482 |
| 2300 | 5.2 | 520 | 400 | 450 | 463 | 473 |
| 2400 | 5.1 | 510 | 394 | 442 | 455 | 465 |
| 2500 | 5 | 500 | 387 | 435 | 447 | 457 |
| 2600 | 4.9 | 490 | 381 | 427 | 439 | [illegible] |
| 2700 | 4.8 | 480 | 375 | 420 | 431 | [illegible] |
| 2800 | 4.7 | 470 | 369 | 412 | 423 | [illegible] |
| 2900 | 4.6 | 460 | 363 | 404 | 415 | 423 |

## Guidelines for1¼" line at 2%, 6%, 10% and 15% slope, 15 cfm

| | | | 2% slope | 6% slope | 10% slope | 15%slope |
|---|---|---|---|---|---|---|
| | 1¼" | 1¼" | 1¼" | 1¼" | 1¼" | 1¼" |
| | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm |
| Distance (feet) | 15cfm | Capacity for taps on dryline | Maximum number of taps | Maximum number of taps | Maximum number of taps | Maximum number of taps |
| 0 | 15 | 1500 | 1130 | 1228 | 1282 | 1282 |
| 3 | 15 | 1500 | 1130 | 1228 | 1282 | 1282 |
| 5 | 15 | 1500 | 1130 | 1228 | 1282 | 1282 |
| 25 | 14.9 | 1490 | 1125 | 1221 | 1275 | 1275 |
| 50 | 14.5 | 1450 | 1101 | 1194 | 1245 | 1245 |
| 100 | 14.2 | 1420 | 1083 | 1173 | 1223 | 1223 |
| 200 | 13.3 | 1330 | 1029 | 1111 | 1155 | 1155 |
| 300 | 12.8 | 1280 | 998 | 1075 | 1117 | 1117 |
| 400 | 12.3 | 1230 | 967 | 1040 | 1079 | 1079 |
| 500 | 11.8 | 1180 | 935 | 1003 | 1040 | 1040 |
| 600 | 11.5 | 1150 | 916 | 981 | 1017 | 1017 |
| 700 | 11.1 | 1110 | 890 | 952 | 985 | 985 |
| 800 | 10.8 | 1080 | 870 | 930 | 962 | 962 |
| 900 | 10.5 | 1050 | 850 | 907 | 938 | 938 |
| 1000 | 10.3 | 1030 | 837 | 892 | 922 | 922 |
| 1100 | 10 | 1000 | 817 | 870 | 898 | 898 |
| 1200 | 9.7 | 970 | 797 | 847 | 873 | 873 |
| 1300 | 9.5 | 950 | 783 | 832 | 857 | 857 |
| 1400 | 9.3 | 930 | 769 | 816 | 841 | 841 |
| 1500 | 9.1 | 910 | 755 | 801 | 824 | 824 |
| 1600 | 9 | 900 | 748 | 793 | 816 | 816 |
| 1700 | 8.9 | 890 | 741 | 785 | 808 | 808 |
| 1800 | 8.7 | 870 | 727 | 769 | 791 | 791 |
| 1900 | 8.6 | 860 | 720 | 762 | 783 | 783 |
| 2000 | 8.5 | 850 | 713 | 754 | 775 | 775 |
| 2100 | 8.3 | 830 | 699 | 738 | 758 | 758 |
| 2200 | 8.2 | 820 | 692 | 730 | 750 | 750 |
| 2300 | 8.1 | 810 | 685 | 722 | 741 | 741 |
| 2400 | 8 | 800 | 677 | 714 | 733 | 733 |
| 2500 | 7.9 | 790 | 670 | 706 | 724 | 724 |
| 2600 | 7.8 | 780 | 663 | 698 | 716 | 716 |
| 2700 | 7.7 | 770 | 656 | 690 | 708 | 708 |
| 2800 | 7.6 | 760 | 648 | 682 | 699 | 699 |
| 2900 | 7.5 | 750 | 641 | 674 | 691 | 691 |

We could increase the tubing size to handle 750 taps

## Guidelines for1½" line at 2%, 6%, 10% and 15% slope, 15 cfm

| | | | 2% slope | 6% slope | 10% slope | 15%slope |
|---|---|---|---|---|---|---|
| | 1½" | 1½" | 1½" | 1½" | 1½" | 1½" |
| | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm |
| Distance (feet) | 15cfm | Capacity for taps on dryline | Maximum number of taps | Maximum number of taps | Maximum number of taps | Maximum number of taps |
| 0 | 15 | 1500 | 1225 | 1299 | 1342 | 1371 |
| 3 | 15 | 1500 | 1225 | 1299 | 1342 | 1371 |
| 5 | 15 | 1500 | 1225 | 1299 | 1342 | 1371 |
| 25 | 15 | 1500 | 1225 | 1299 | 1342 | 1371 |
| 50 | 14.8 | 1480 | 1211 | 1284 | 1326 | 1354 |
| 100 | 14.6 | 1460 | 1197 | 1269 | 1310 | 1338 |
| 200 | 14.4 | 1440 | 1184 | 1254 | 1293 | 1321 |
| 300 | 14.2 | 1420 | 1170 | 1239 | 1277 | 1304 |
| 400 | 14 | 1400 | 1156 | 1223 | 1261 | 1287 |
| 500 | 13.8 | 1380 | 1143 | 1208 | 1245 | 1270 |
| 600 | 13.5 | 1350 | 1122 | 1185 | 1220 | 1245 |
| 700 | 13.3 | 1330 | 1108 | 1169 | 1204 | 1228 |
| 800 | 13.1 | 1310 | 1094 | 1154 | 1187 | 1211 |
| 900 | 12.9 | 1290 | 1080 | 1138 | 1171 | 1193 |
| 1000 | 12.7 | 1270 | 1066 | 1123 | 1154 | 1176 |
| 1100 | 12.5 | 1250 | 1051 | 1107 | 1138 | 1159 |
| 1200 | 12.3 | 1230 | 1037 | 1091 | 1121 | 1142 |
| 1300 | 12.1 | 1210 | 1023 | 1076 | 1105 | 1125 |
| 1400 | 11.9 | 1190 | 1008 | 1060 | 1088 | 1107 |
| 1500 | 11.7 | 1170 | 994 | 1044 | 1071 | 1090 |
| 1600 | 11.6 | 1160 | 987 | 1036 | 1063 | 1081 |
| 1700 | 11.4 | 1140 | 972 | 1020 | 1046 | 1064 |
| 1800 | 11.3 | 1130 | 965 | 1012 | 1038 | 1055 |
| 1900 | 11.2 | 1120 | 957 | 1004 | 1029 | 1046 |
| 2000 | 11 | 1100 | 943 | 988 | 1012 | 1029 |
| 2100 | 10.8 | 1080 | 928 | 971 | 995 | 1011 |
| 2200 | 10.7 | 1070 | 920 | 963 | 987 | 1003 |
| 2300 | 10.6 | 1060 | 913 | 955 | 978 | 994 |
| 2400 | 10.5 | 1050 | 906 | 947 | 970 | 985 |
| 2500 | 10.4 | 1040 | 898 | 939 | 961 | 976 |
| 2600 | 10.3 | 1030 | 891 | 931 | 953 | 967 |
| 2700 | 10.2 | 1020 | 883 | 923 | 944 | 959 |
| 2800 | 10.1 | 1010 | 876 | 914 | 935 | 950 |
| 2900 | 10 | 1000 | 868 | 906 | 927 | 941 |

# We can have a 1” line just for air (dry line) and a 1” line just for sap

Potential of 968 taps

**Wet line**. Multiply the number of taps by .2 gallons per hour, (line 1 above) 750 taps x .2 = 150 gallons of sap per hour during exceptional flow. Now check the water flow chart at your given slope (line 3 above) to see which wet line can carry that load per hour.

Water (gallons) per hour through plastic tubing at the designated slope.

| Slope | 2% | 6% | 10% | 15% | 20% |
|---|---|---|---|---|---|
| Gallons/hour ¾” line | 195 | 336 | 444 | 549 | 640 |
| Gallons/hour 1” line | 330 | 630 | 840 | 1050 | 1215 |

**Guidelines for 1" line at 2%, 6%, 10% and 15% slope, 15 cfm**

| | | | 2% slope | 6% slope | 10% slope | 15%slope |
|---|---|---|---|---|---|---|
| | 1" | 1" | 1" | 1" | 1" | 1" |
| | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm | 15cfm |
| Distance (feet) | 15cfm | Capacity for taps on dryline | Maximum number of taps | Maximum number of taps | Maximum number of taps | Maximum number of taps |
| 0 | 15 | 1500 | 693 | 834 | 877 | 913 |
| 3 | 15 | 1500 | 693 | 834 | 877 | 913 |
| 5 | 15 | 1500 | 693 | 834 | 877 | 913 |
| 25 | 14 | 1400 | 693 | 834 | 877 | 913 |
| 50 | 14 | 1400 | 693 | 834 | 877 | 913 |
| 100 | 13 | 1300 | 693 | 834 | 877 | 913 |
| 200 | 11 | 1100 | 693 | 834 | 877 | 913 |
| 300 | 10.2 | 1020 | 659 | 786 | 825 | 857 |
| 400 | 9.8 | 980 | 641 | 762 | 798 | 828 |
| 500 | 9 | 900 | 604 | 712 | 744 | 770 |
| 600 | 8.5 | 850 | 580 | 680 | 709 | 733 |
| 700 | 8.1 | 810 | 560 | 654 | 681 | 703 |
| 800 | 7.7 | 770 | 539 | 627 | 652 | 672 |
| 900 | 7.4 | 740 | 524 | 607 | 631 | 649 |
| 1000 | 7.2 | 720 | 513 | 593 | 616 | 634 |
| 1100 | 7 | 700 | 502 | 580 | 601 | 618 |
| 1200 | 6.8 | 680 | 491 | 566 | 586 | 603 |
| 1300 | 6.5 | 650 | 475 | 545 | 564 | 579 |
| 1400 | 6.3 | 630 | 464 | 530 | 549 | 563 |
| 1500 | 6.2 | 620 | 458 | 523 | 541 | 555 |
| 1600 | 6 | 600 | 447 | 509 | 526 | 539 |
| 1700 | 5.9 | 590 | 441 | 502 | 518 | 531 |
| 1800 | 5.7 | 570 | 429 | 487 | 502 | 514 |
| 1900 | 5.6 | 560 | 423 | 480 | 495 | 506 |
| 2000 | 5.5 | 550 | 418 | 472 | 487 | 498 |
| 2100 | 5.4 | 540 | 412 | 465 | 479 | 490 |
| 2200 | 5.3 | 530 | 406 | 457 | 471 | 482 |
| 2300 | 5.2 | 520 | 400 | 450 | 463 | 473 |
| 2400 | 5.1 | 510 | 394 | 442 | 455 | 465 |
| 2500 | 5 | 500 | 387 | 435 | 447 | 457 |
| 2600 | 4.9 | 490 | 381 | 427 | 439 | 448 |
| 2700 | 4.8 | 480 | 375 | 420 | 431 | 440 |
| 2800 | 4.7 | 470 | 369 | 412 | 423 | 432 |
| 2900 | 4.6 | 460 | 363 | 404 | 415 | 423 |

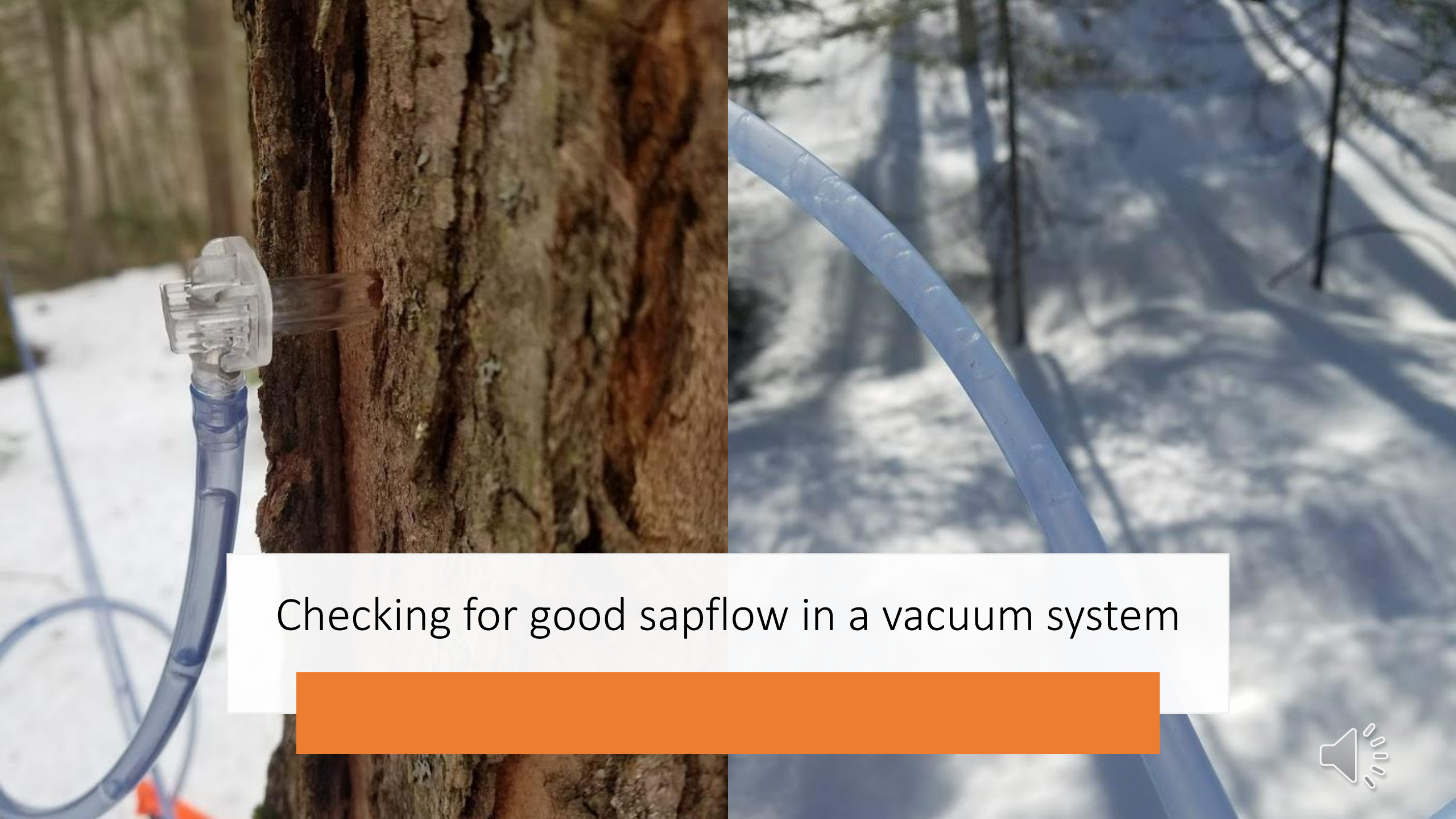
Vacuum Jumper

Dry Line

Mainline Spur

Sap Line

# Separate Dry Lines and Wet Lines



# Checking for good sapflow in a vacuum system

Slow paced air bubbles is a good sign in you tubing system

# Air leaks can create ice jams

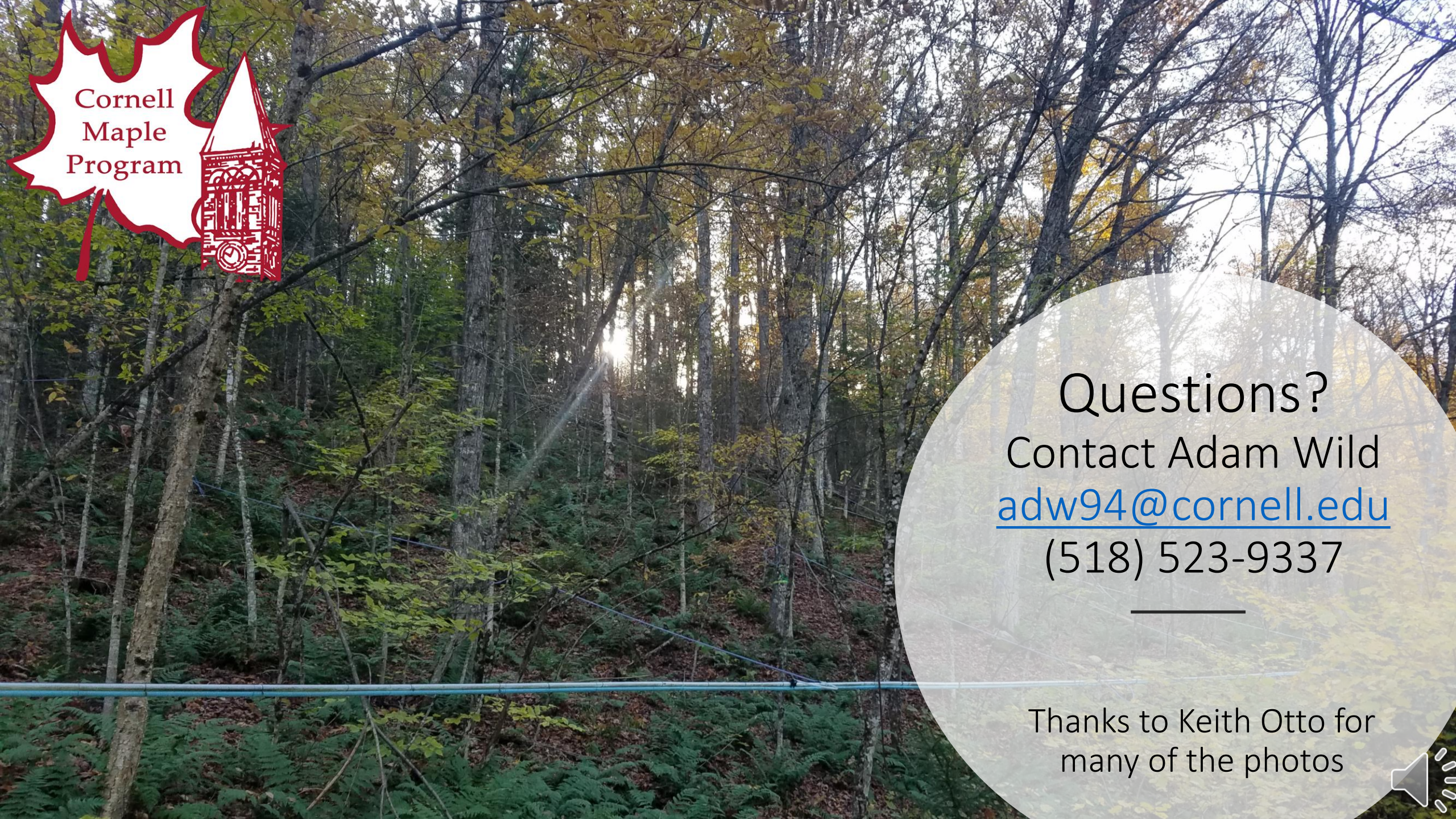
# Squirrel Chewing

# Woodpecker Damage

# Taphole Leak

# Tree Falls

When cutting off the tree be careful of tension on the tree from the tubing line.




# Questions?

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Thanks to Keith Otto for many of the photos