

# **Shrub Willow Living Snow Fences**

show potential for snow trapping and  
reduced drift length shortly after planting

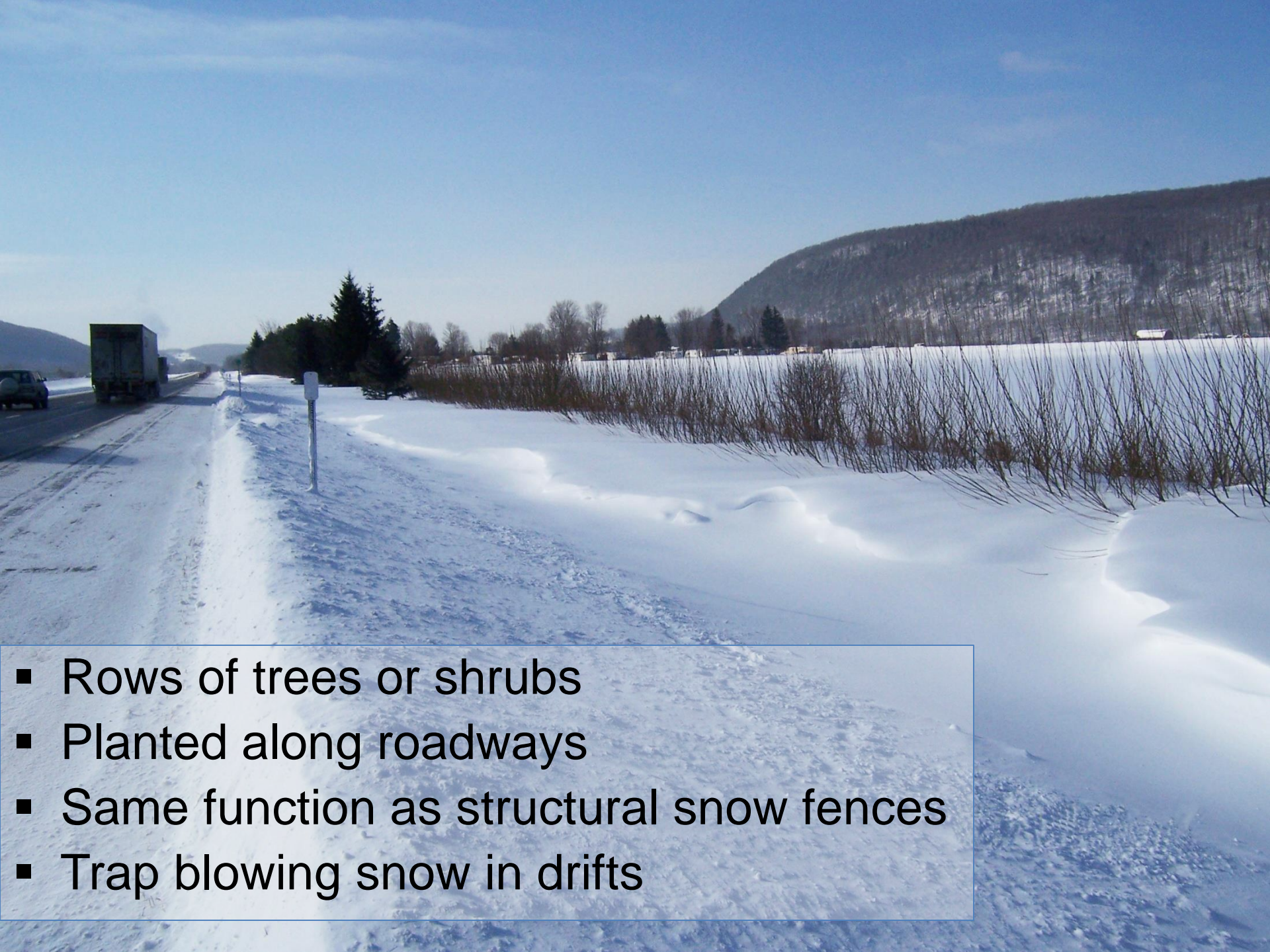


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**International Poplar Symposium VI – Vancouver, BC – July 2014**





- Rows of trees or shrubs
- Planted along roadways
- Same function as structural snow fences
- Trap blowing snow in drifts

# Support

USDOT



NYSDOT

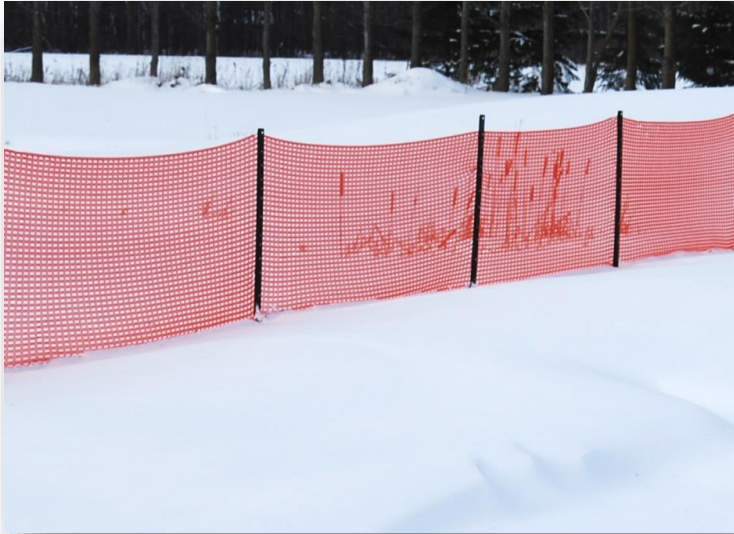


New York State  
Department of Transportation

“Developing and Implementing a Living Snow  
Fence Program for New York State”



# A Living Alternative



## Structural Snow Fences

Effective immediately

Lifecycle 1 - 15 years

Capacity = Height and Porosity

Constant over time

## Living Snow Fences

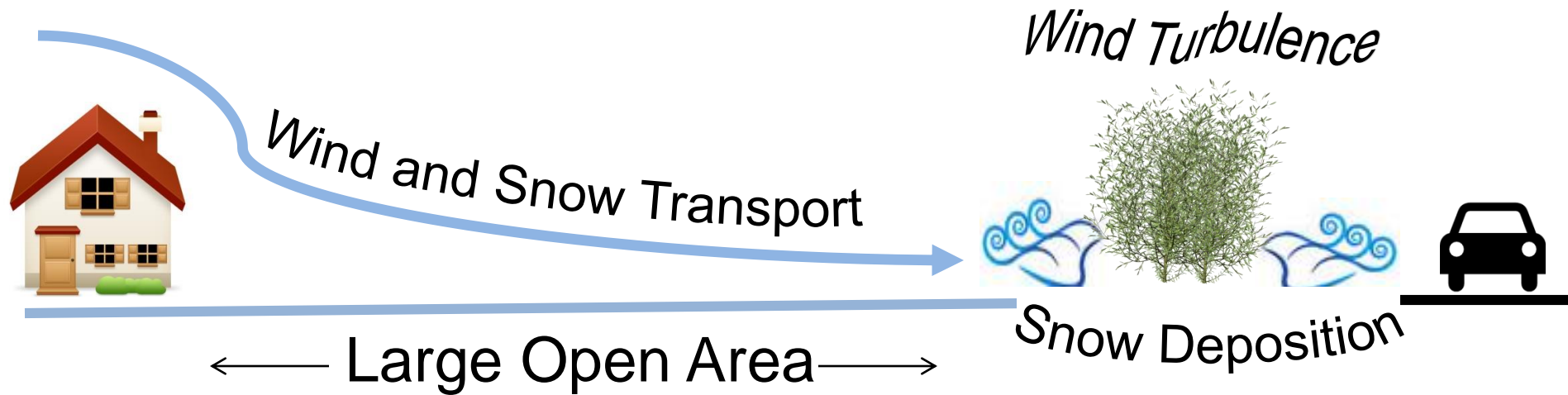
Some years after planting

20 - 30 years or more

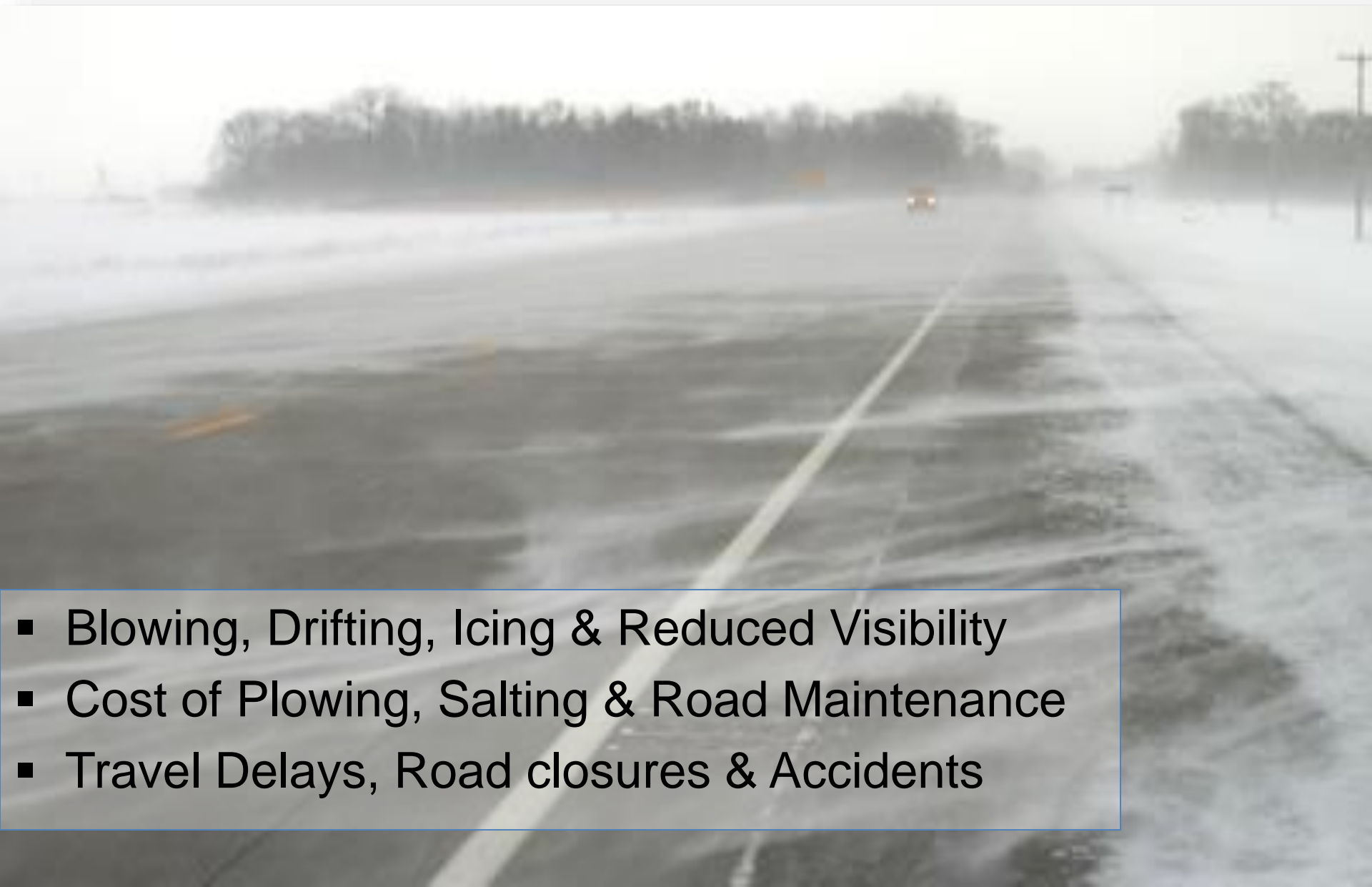
Capacity = Height and Porosity

Changes as plants grow

# How Do Snow Fences Work?



# Problem



- Blowing, Drifting, Icing & Reduced Visibility
- Cost of Plowing, Salting & Road Maintenance
- Travel Delays, Road closures & Accidents

# Opportunity

## Reduce Cost of Snow Control

- \$2.3 billion annually in the US
- \$300 million annually in New York State

## Improve Road Safety

- Driving conditions
- Accidents rates
- Save lives

## Provide Additional Benefits

- Travel time savings
- Environmental benefits
- Aesthetics
- Value-added products

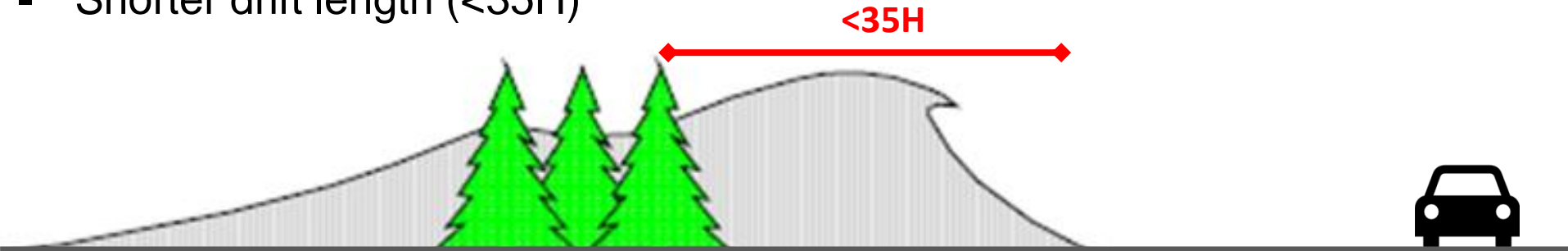


# Plant Growth & Drift Length

- Small plants
- Small snow storage capacity
- Fences fill to capacity
- Long drift length ( $35H$ )



- Same quantity of blowing snow...
- Larger plants
- More snow storage capacity
- Fences *do not* fill to capacity
- Shorter drift length ( $<35H$ )





# Objectives

## 1. Measure...

- Fence Height
- Porosity
- Site and climate variables

## 2. Model...

- Snow storage capacity of fences
- Snow transport (blowing snow at each site)
- Downwind drift length

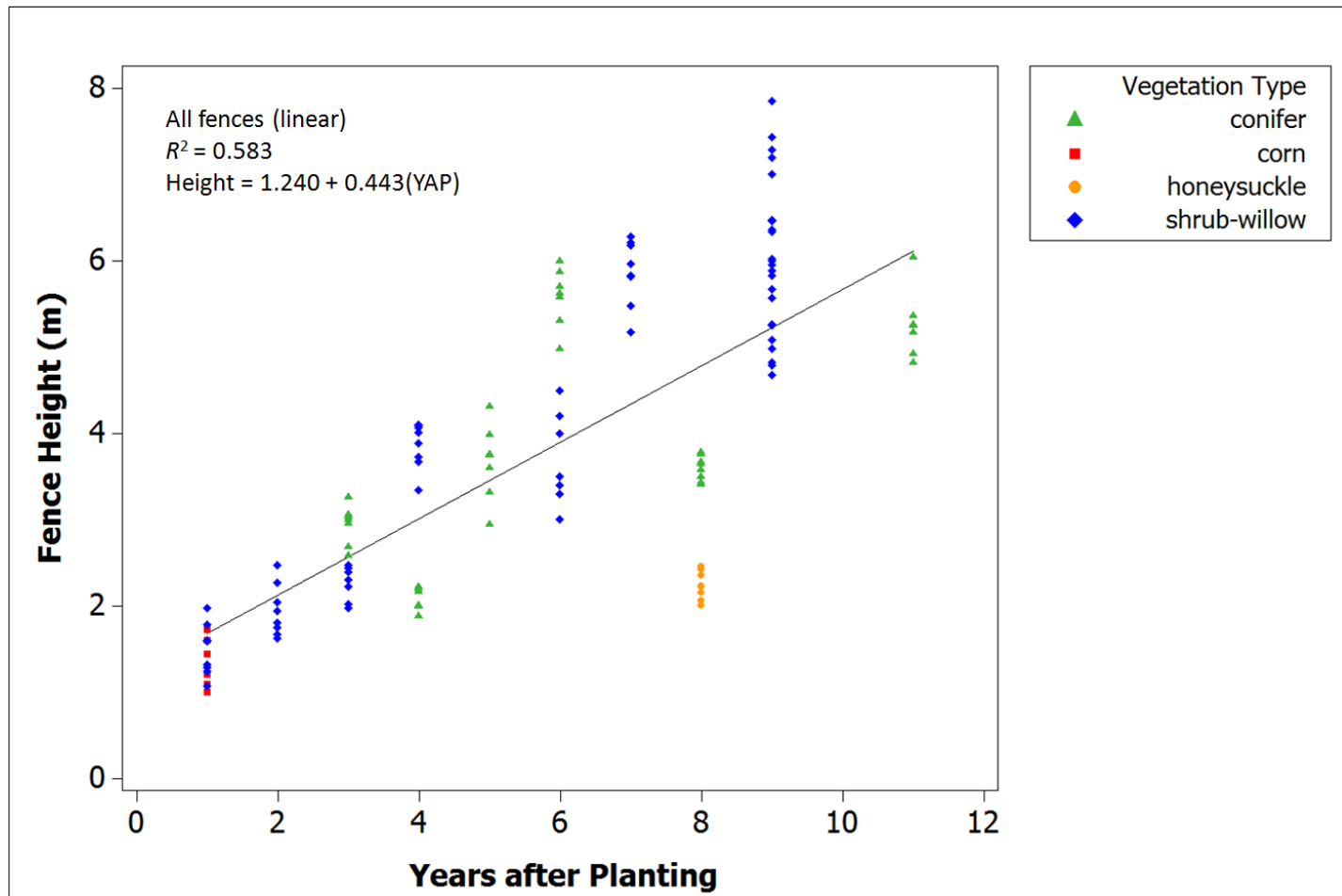
# 18 Living Snow Fences

- 10 shrub willow
- 6 conifer
- 1 corn and honeysuckle
- 1 - 11 years after planting



# Height Over Time

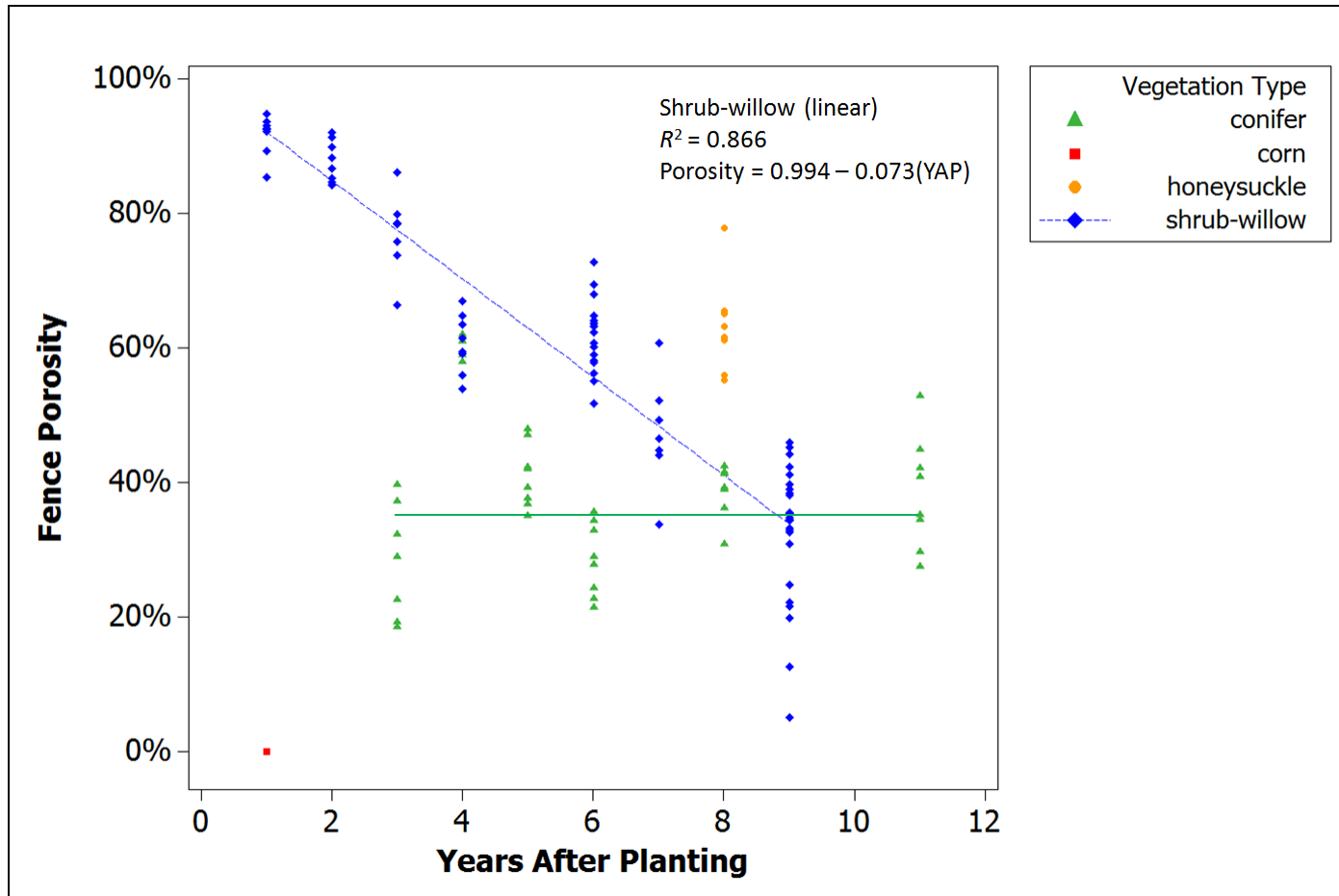
- 1 m - 8 m increased linearly over time ( $P < 0.001$ )
- Height of **conifer** fences was similar to **willow** at various YAP





# Porosity Over Time

- 40% - 60% ideal - anything <80% sufficient
- Willow ranged from 90% to 10% - effective 3 YAP
- Conifer did not change - generally lower than willow



# Capacity versus Transport

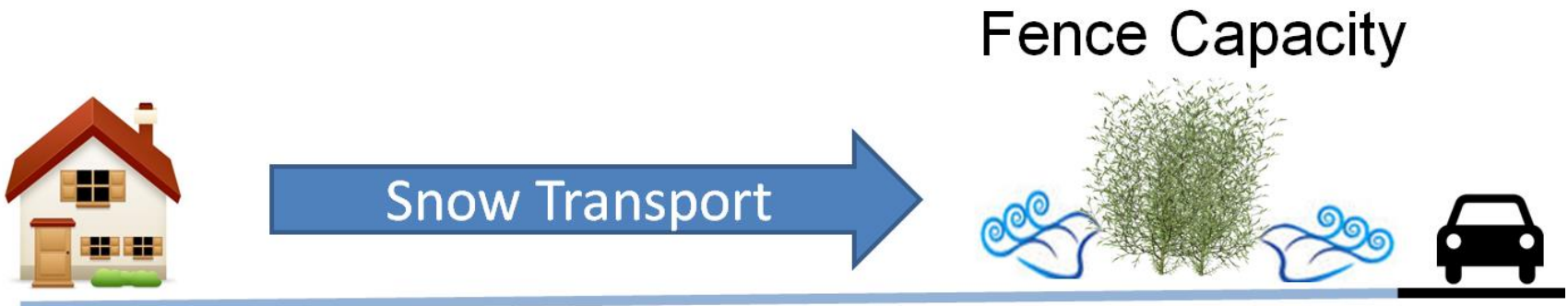
**Fence Capacity** (Snow Storage Available)

- Height and Porosity

**Snow Transport** (Blowing Snow in Avg. Year)

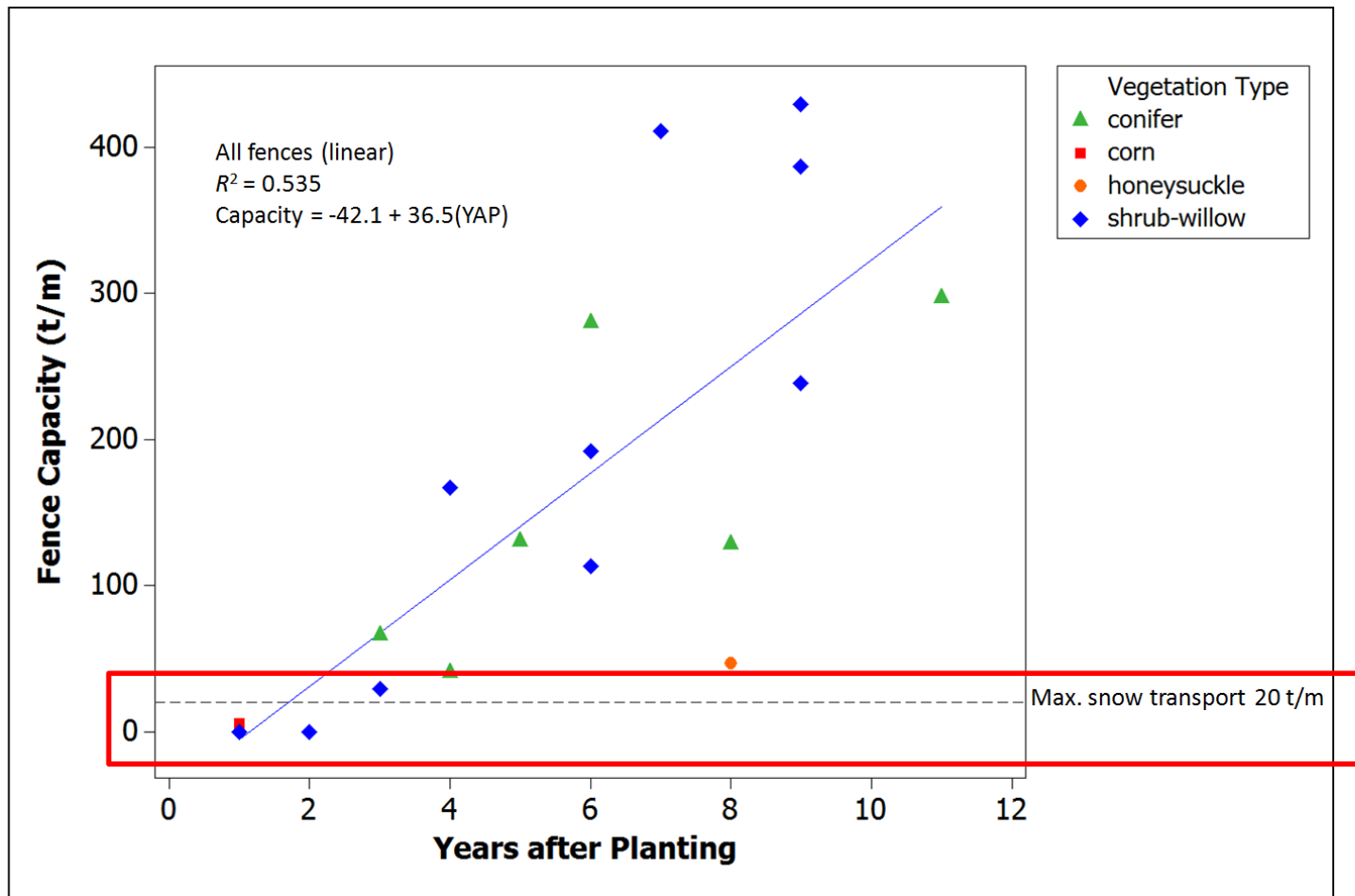
- Fallen snow and % relocated by wind

**Units of t/m** (tons of snow per linear meter of fence)



# Capacity Over Time

- Increased linearly with fence height 1 - 400 t/m
- Max. Snow Transport = 20 t/m
- 3 -11 YAP...Capacity = 2x to 100x transport





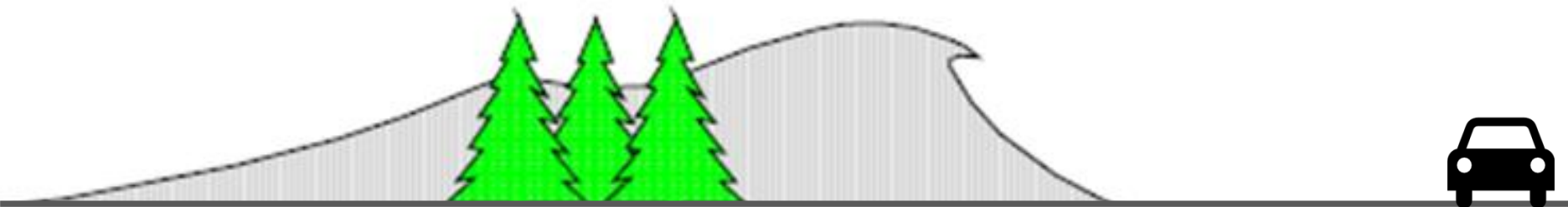
# Drift Length and C/T Ratio

## Drift length is a function of...

Snow storage capacity relative to annual snow transport

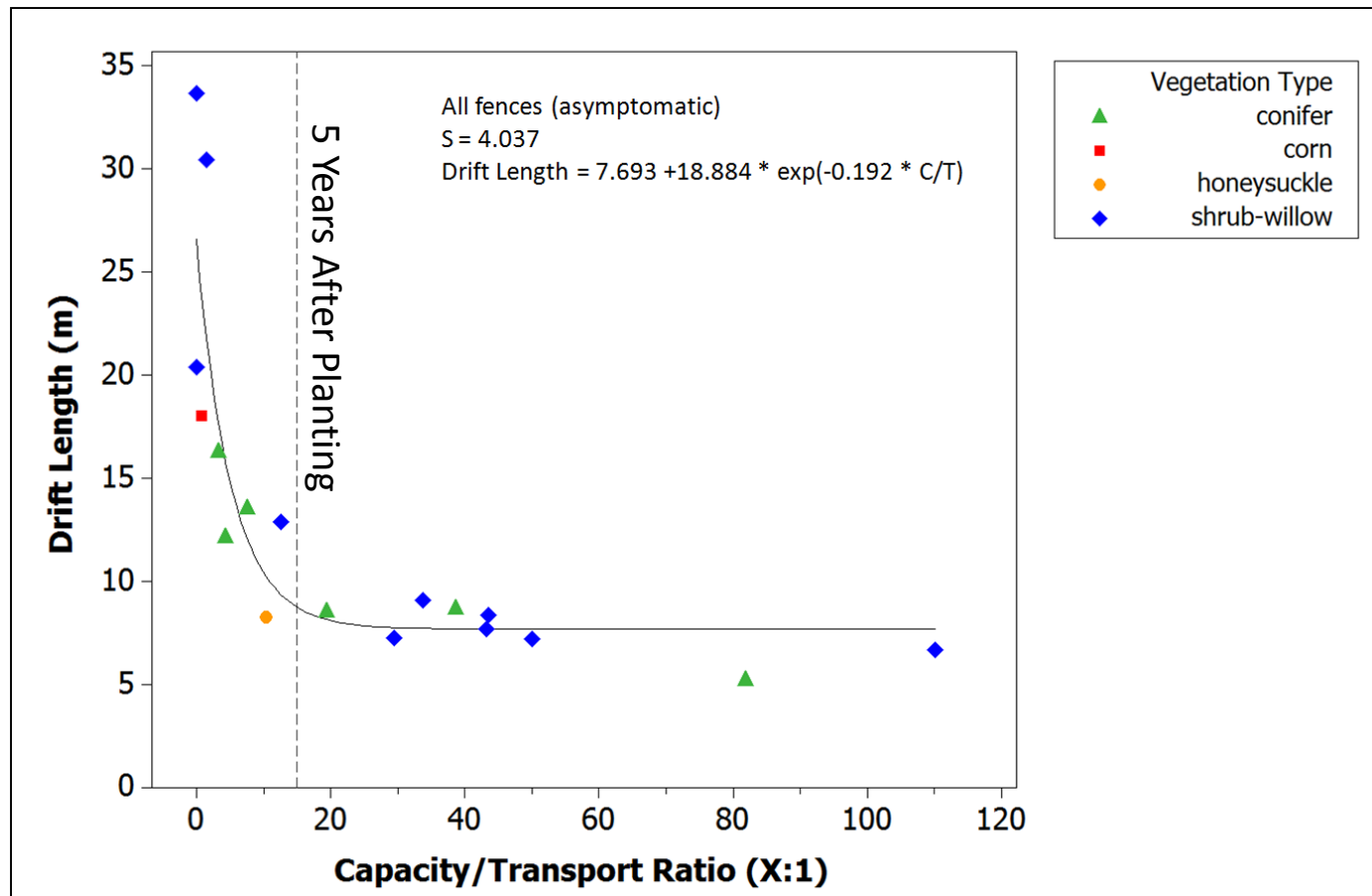
“Capacity/Transport Ratio” (X:1)

- As C/T increases, drift length decreases
- Drifts build up to height of fence before out towards road



# Drift Length and C/T Ratio (Time)

- C/T ratio increases over time as fences grow
- 0 - 4 YAP: C/T 1:1 - 10:1 Drift length decreases rapidly
- 5 -11 YAP: C/T 10:1 -100:1 Drift length <10 m



# Required Setback Distance

- Distance between fence and road
- Chosen based on estimated drift length



- **Estimated Drift Length:**  $<10$  m
- **Observed Setback Distances:** 10 - 100 m
- **Published Recommendations:** 30 - 180 m



# Implications

- Dynamics of LSF over time have not been well researched or publicized
- **Large C/T ratio = shorter drift lengths**
- More potential sites where planting space is limited (common in northeast)
- Need for improved design standards



Drift Edge

- Effective willow snow fence
- 3 years after planting
- Limited ROW space
- 10 m setback
- Drift length safely contained



# Shrub Willow Fences

## Ideal plant characteristics

- Numerous stems per plant (porosity)
- Rapid growth rate (capacity)
- Coppice ability, tolerance of high planting density

## Relatively low costs...

- Other shrub species
- Large conifer trees
- Structural fences

## Numerous Applications

- Windbreaks
- Noise & visual screens
- Buffers

## Best practices well developed

- SUNY ESF 2007 - 2013



# Conclusion

Shrub willows make highly effective LSF..

- Snow trapping just 3 years after planting
- Large storage capacity thereafter

Large capacity = shorter drift lengths...

- Reduced setback requirements
- More potential sites

This is leading to best practices and improved design standards that account for plant growth and snow trapping over time



[illegible]