Modeling Snowdrift Accumulation to Determine Snow Fence Performance in Wyoming

Chad Flynn
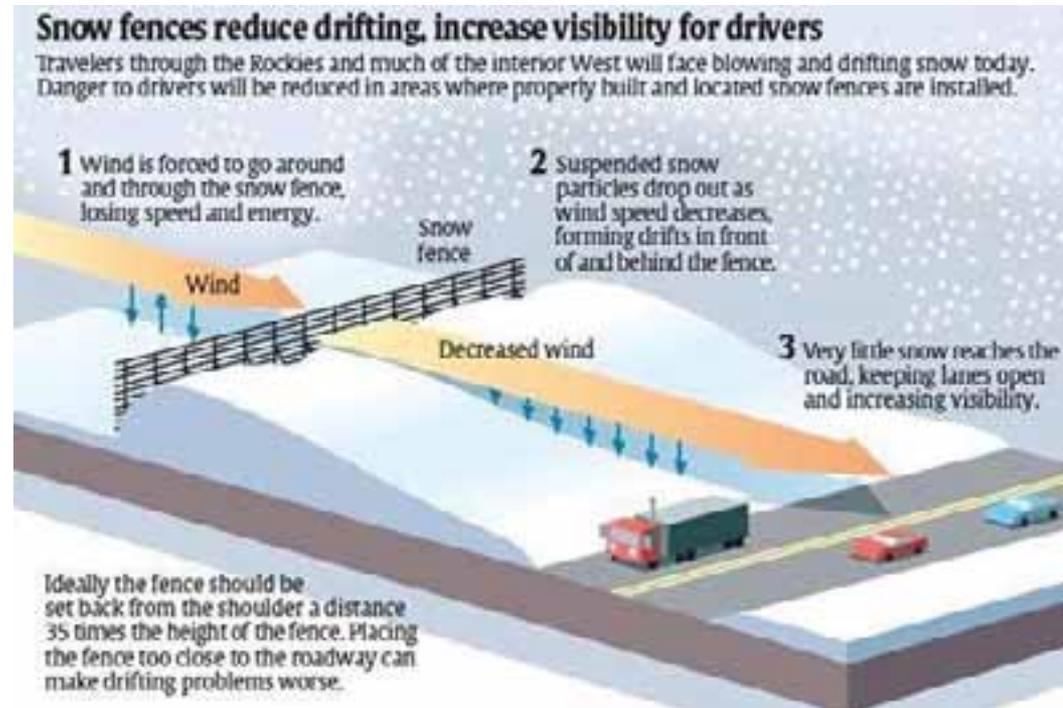Jim Vanderweide

Introductions

- Chad Flynn
  - GIS Analyst, Project Manager
- Jim Vanderweide
  - IT Program Manager

- Trihydro
  - Engineering consulting and environmental planning services
  - Headquarters in Laramie, Wyoming
  - Offices nationwide
  - Esri business partner

What's a Snow Fence?

- Snowy and windy conditions causes snow to accumulate in snowdrifts

- Frequent road closures

- Snow fences are designed and built to keep roads clear

Snow fences reduce drifting, increase visibility for drivers
Travelers through the Rockies and much of the interior West will face blowing and drifting snow today. Danger to drivers will be reduced in areas where properly built and located snow fences are installed.

1 Wind is forced to go around and through the snow fence, losing speed and energy.

2 Suspended snow particles drop out as wind speed decreases, forming drifts in front of and behind the fence.

Snow fence

Wind

Decreased wind

3 Very little snow reaches the road, keeping lanes open and increasing visibility.

Ideally the fence should be set back from the shoulder a distance 35 times the height of the fence. Placing the fence too close to the roadway can make drifting problems worse.

GPS Field Inventory

- WYDOT contracted Trihydro to perform statewide inventory
- Assess snow fence location, design and current conditions
- Build predictive model of snow drifts and roadway protection

Proposed Solution

- Build a model using Python
  - Predict snow drift size and location
 - Define protected sections of highways

WIND

SNOW FENCE

PREDICTED SNOWDRIFT

35H

OFFSET

30°

30°

ROAD

AREA TO BE PROTECTED
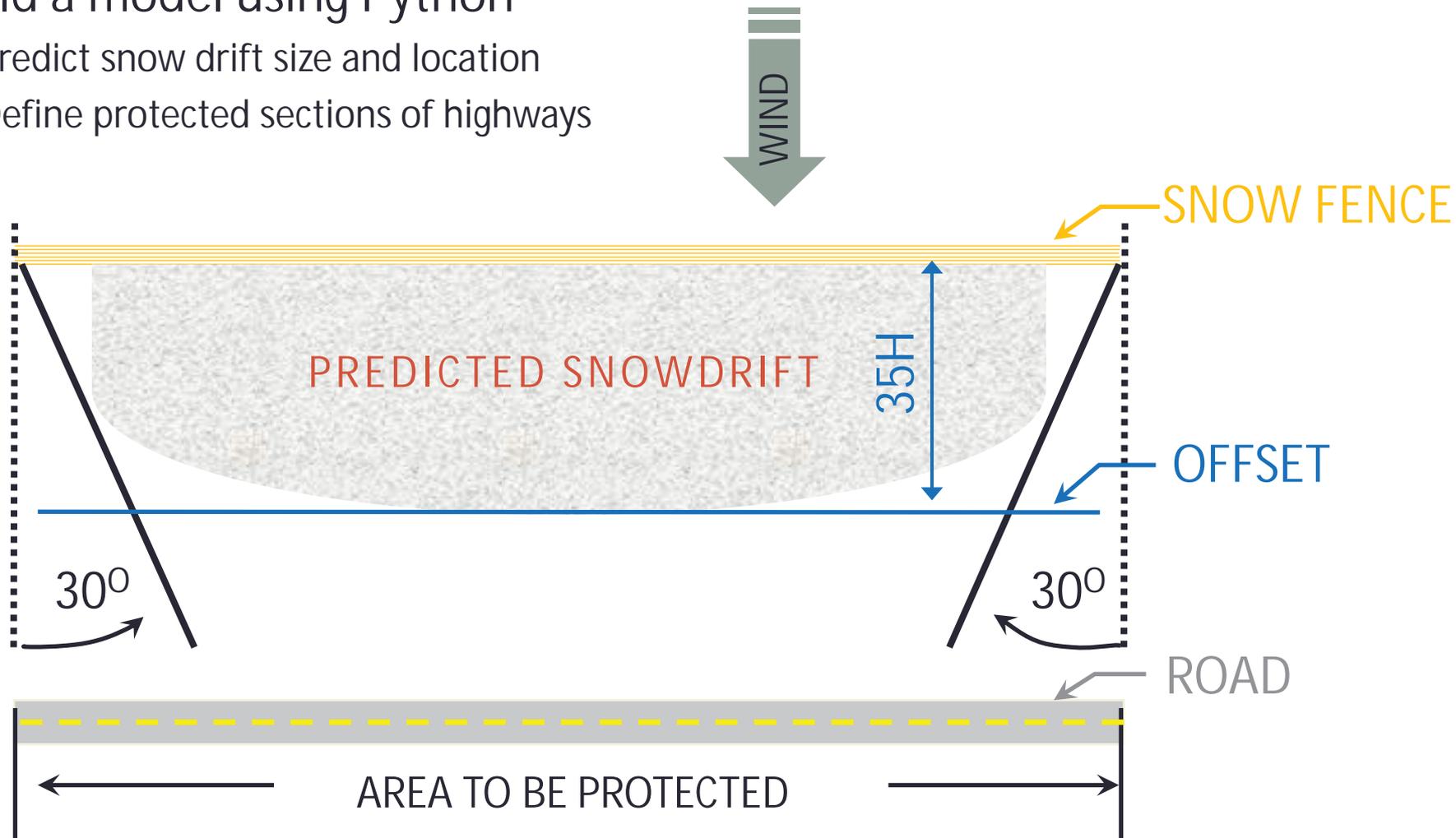
Development

- Compile data sources
  - Snow fence data
    - Our GPS snow fence inventory
    - Fence direction and height
  - Wind data
  - Roads data
    - WYDOT roads
    - Linear Referencing System
- Build a custom toolbox
  - Python scripts
  - Standard geoprocessing tools
- Test > Audit > Re-test

Development

- Snow fence
- Highway
- Step 1
  - Perpendicular lines
  - 30° angle lines
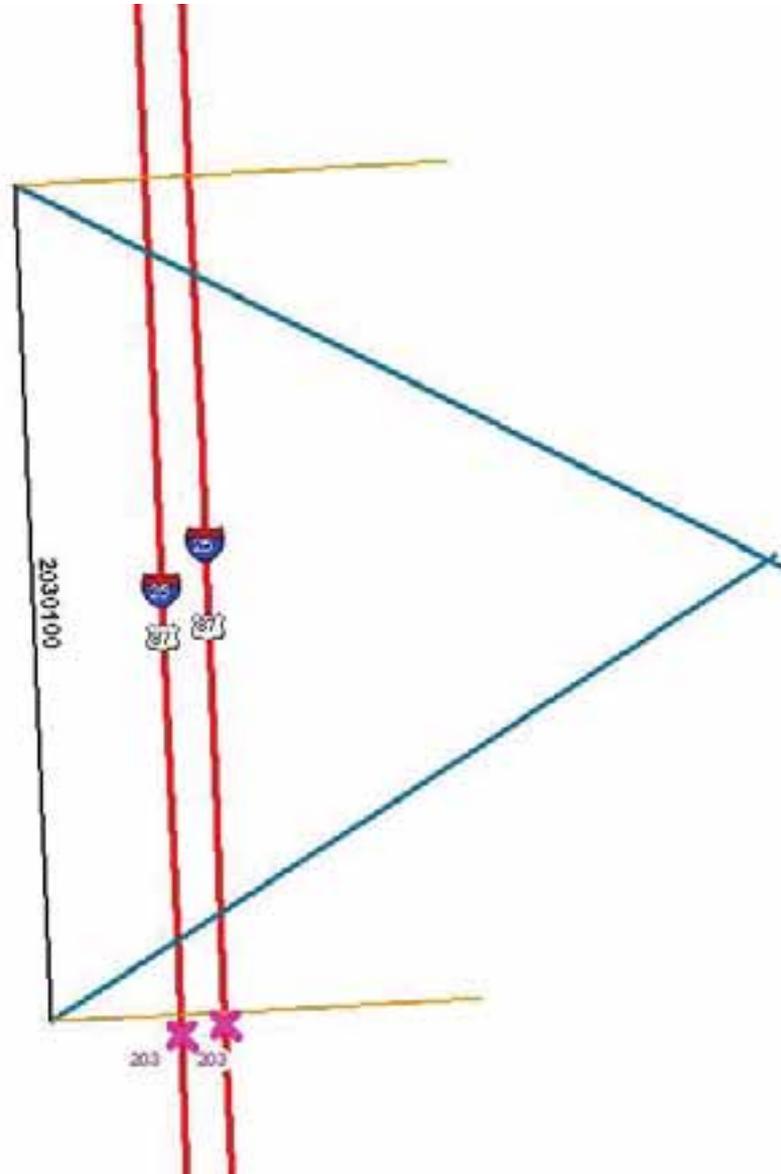
Development

- Snow fence
- Highway
- Step 1
  - Perpendicular lines
  - 30° angle lines
- Step 2
  - 35H offset
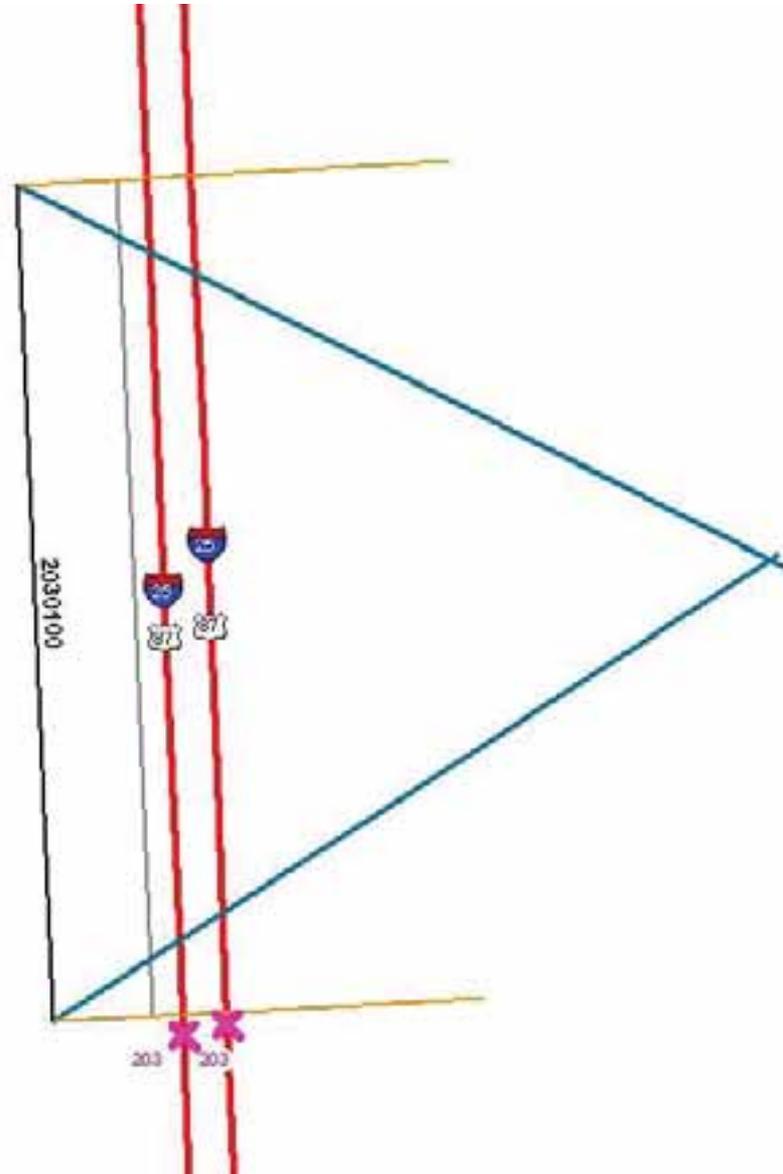
Development

- Snow fence
- Highway
- Step 1
  - Perpendicular lines
  - 30^{0} angle lines
- Step 2
  - 35H offset
- Step 3
  - Snowdrift polygon
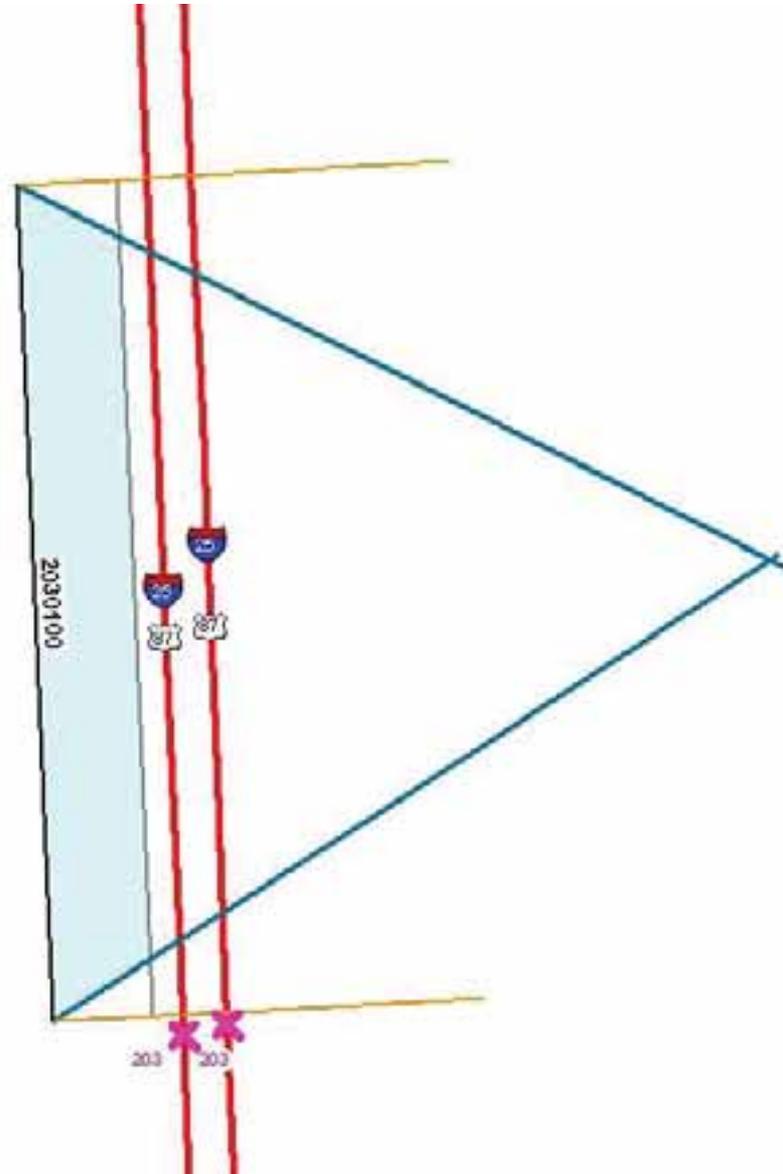
Development

- Snow fence
- Highway
- Step 1
  - Perpendicular lines
  - 30^0 angle lines
- Step 2
  - 35H offset
- Step 3
  - Snowdrift polygon
- Protected roadway

Development

- Drift Calculations: Step 1

Development

- Drift Calculations: Step 2

Development

- Drift Calculations: Step 3

Development

- Roadway Protection Calculation

Testing

- Audit
  - Attribute join: snow drift ID
    - ID of snowdrift is assigned as snow fence ID during the modeling process
  - Spatial join: snow fence to snow drift
  - Identify areas where polygon fails to draw
- Initial success rate of ~ 55%
- Current snow fence coverage success ~ 88%
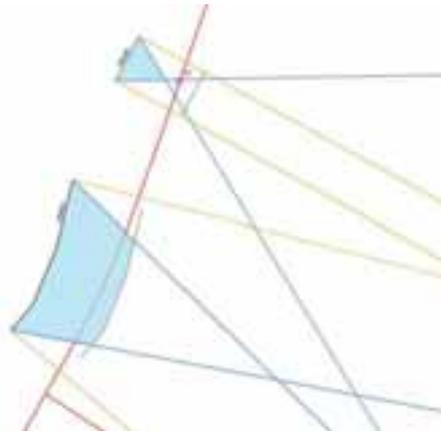- ArcGIS 10.1 upgrade: Retest for success
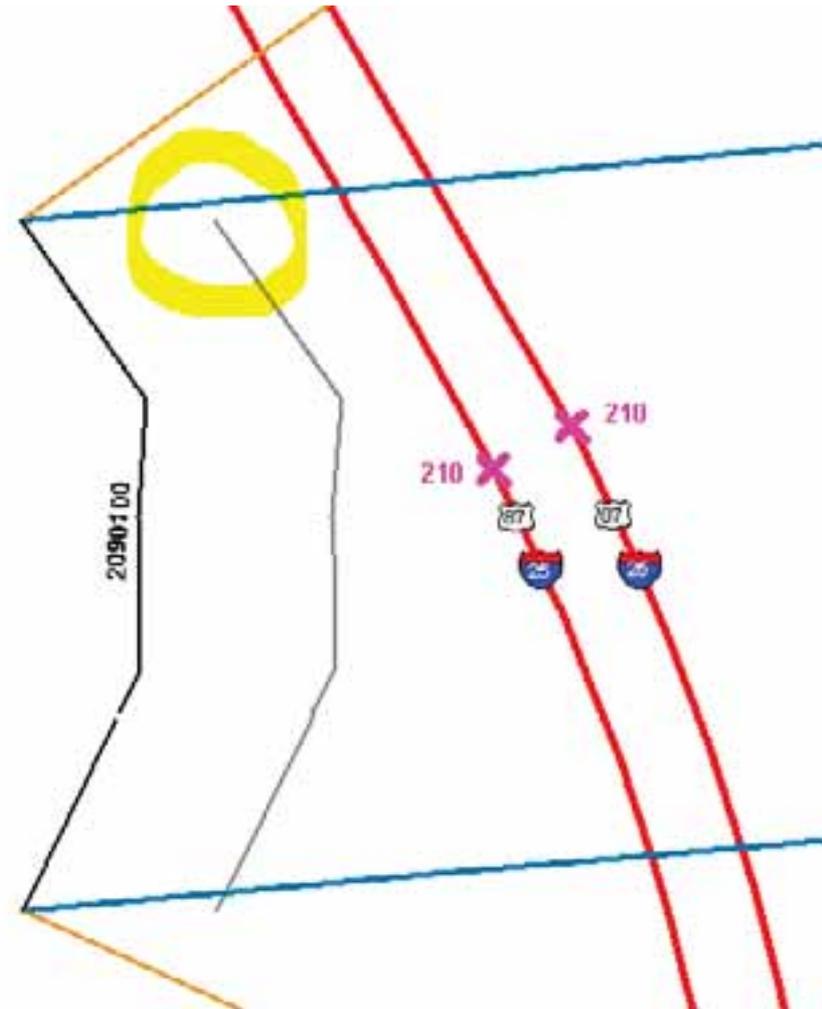
Deployment - Desktop

- Deploy custom toolbox containing scripts and models
  - Planning tool
  - Client can digitally build a new fence, run model and assess protection
- Photos of fences are hyperlinked in ArcGIS
  - Maintenance scheduling tool

Fence height = 5'
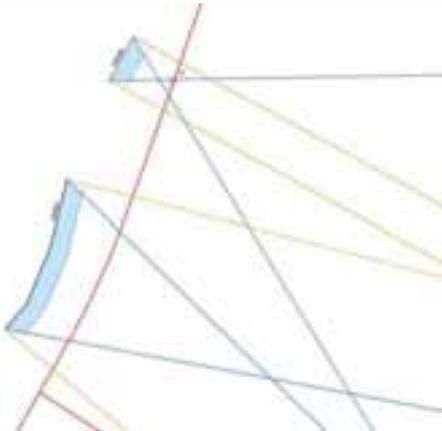
Fence height = 10'

Fence sections need repair

Future Plans

- Refine model
  - Acquire and incorporate actual prevailing wind coverage data
  - Areas of bad geometry
    - Fix snow fence line work – Edit data
  - Goal of 95% success
- Updating and rerunning model as maintenance occurs
- Adding sophistications
  - Model storm data when they occur
    - Typically abnormal wind direction
  - Overlay crash data

Future Plans

- Data and model served up through ArcGIS Server visualization platform
  - Silverlight GIS Direct module

Questions?

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