

Modeling Snowdrift Accumulation to Determine Snow Fence Performance in Wyoming

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Introductions

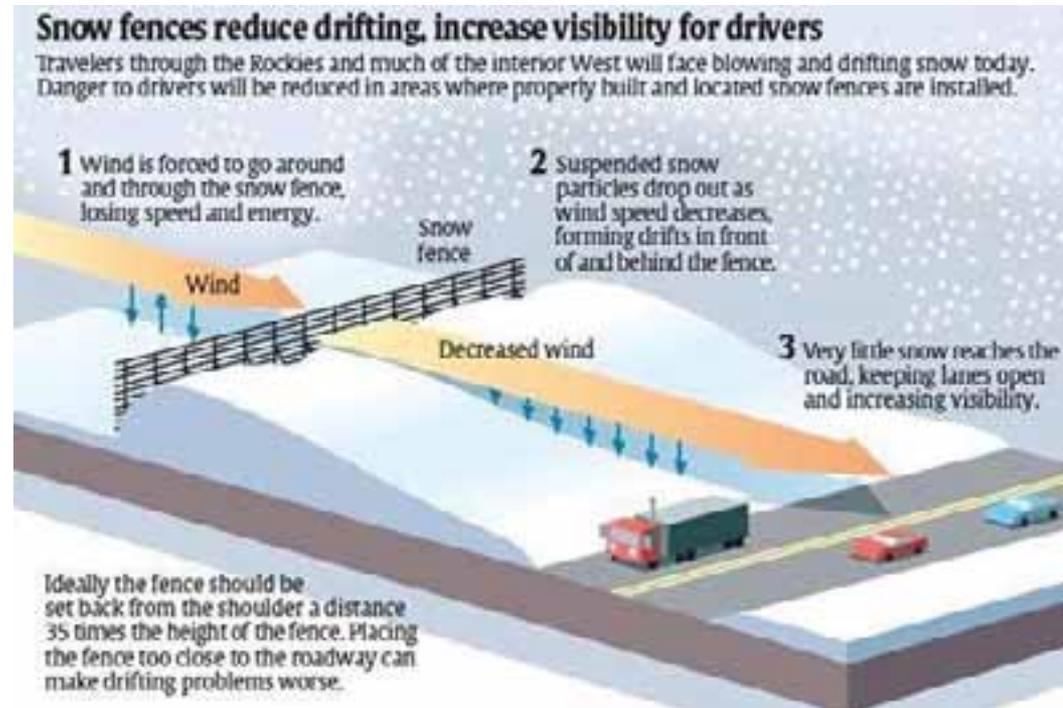
- Chad Flynn
 - GIS Analyst, Project Manager
- Jim Vanderweide
 - IT Program Manager



- 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



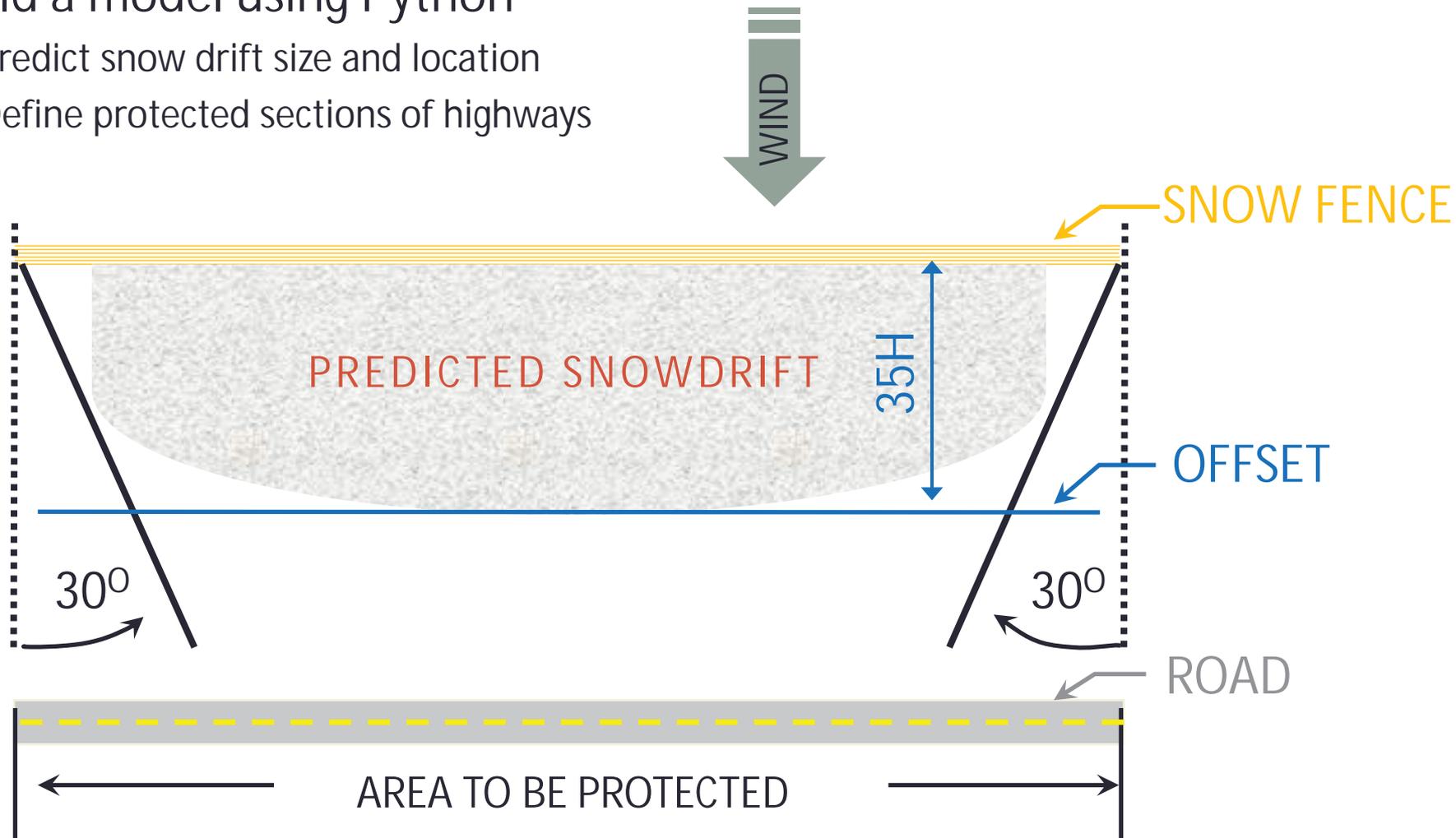
GPS Field Inventory

- 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



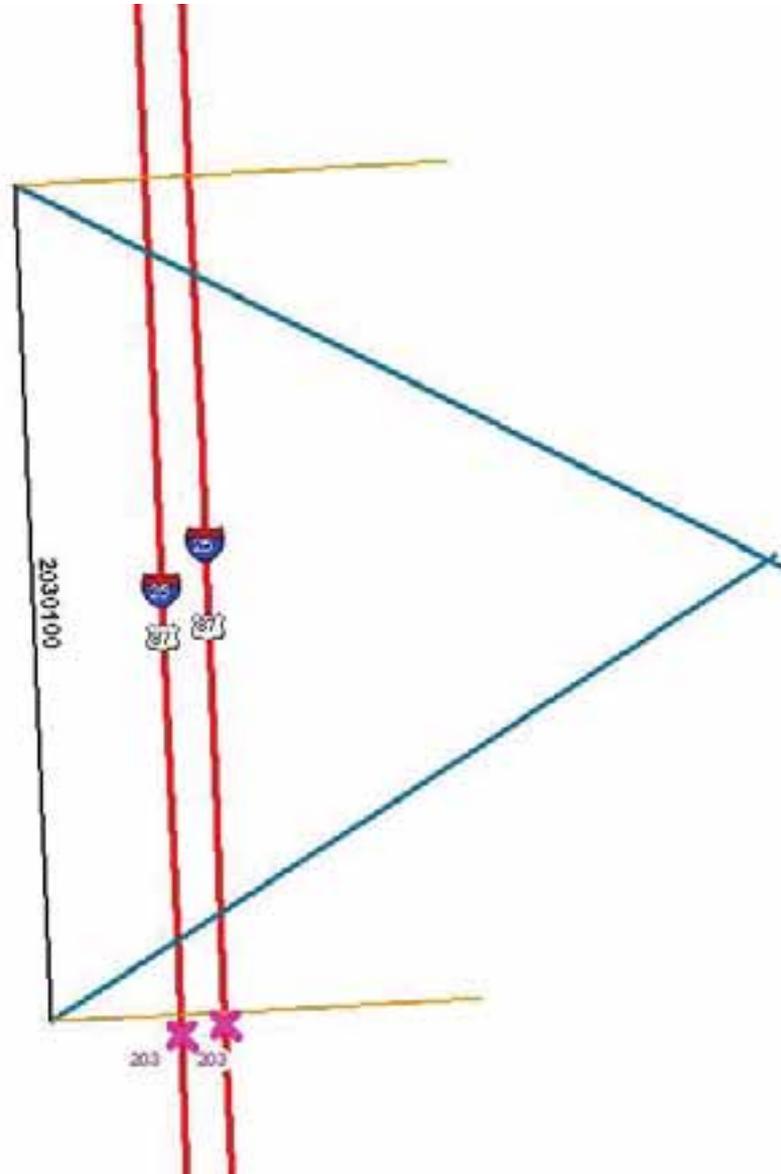
Development

- 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



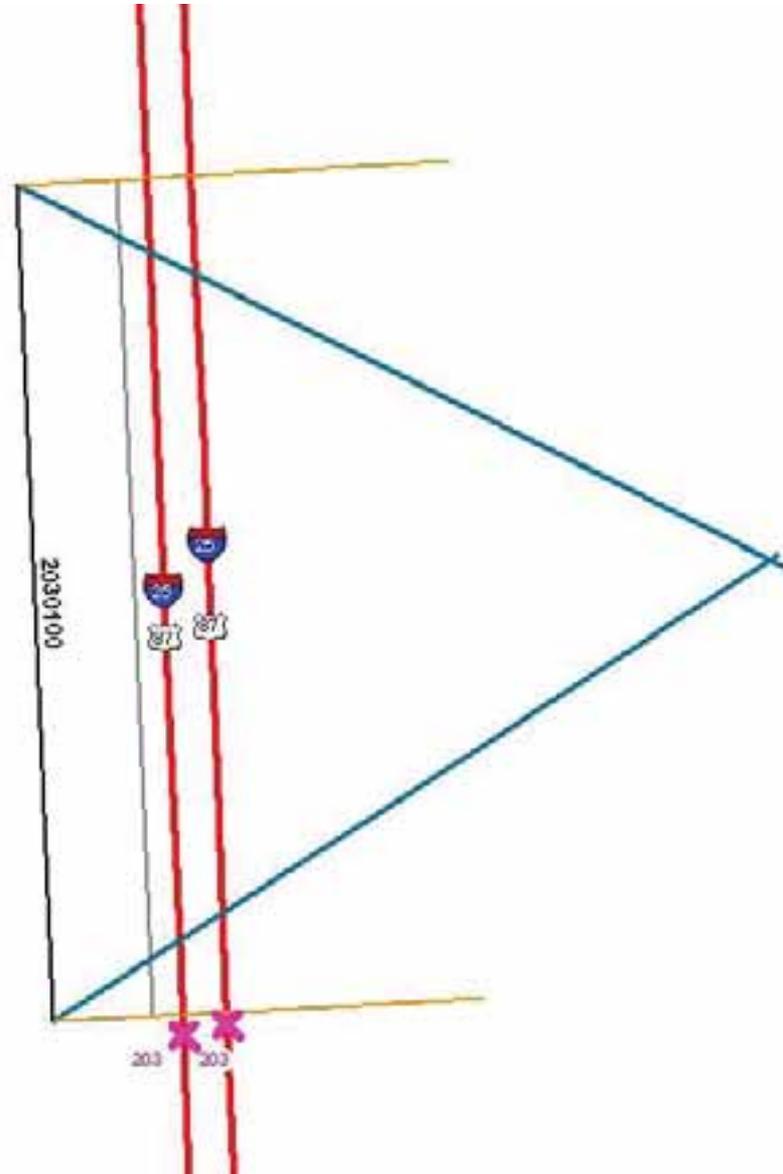
Development

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



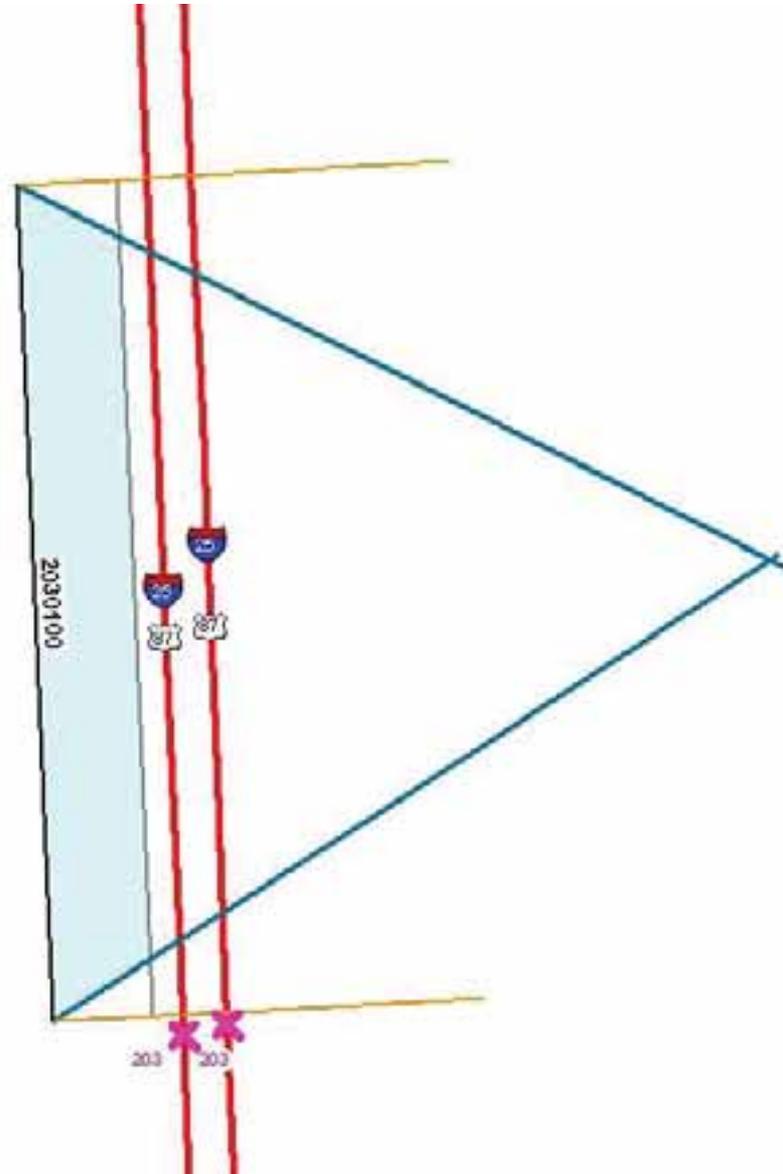
Development

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



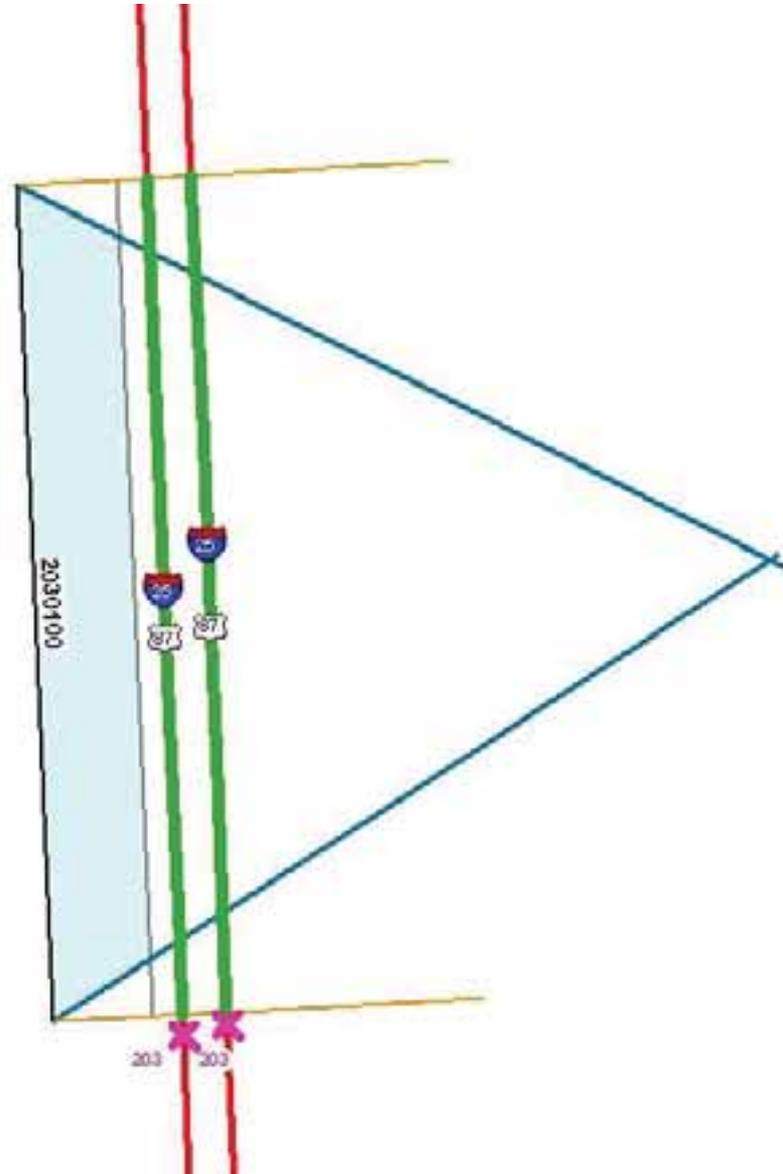
Development

- Snow fence
- Highway
- Step 1
 - Perpendicular lines
 - 30° angle lines
- Step 2
 - 35H offset
- Step 3
 - Snowdrift polygon



Development

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



Development

- Drift Calculations: Step 1

The screenshot displays the ArcMap interface with a workflow diagram for 'Snow Drift Line Work #1'. The workflow consists of five input nodes (blue ovals) pointing to a central red box labeled 'WYDOT Script 1', which then points to a final green oval labeled 'Network'. The input nodes are:

- Ferrous_Model_jf1 1/2012
- Drain
- contourline.shd
- PCDL_Altitude.shd

A console window titled 'Snow Drift Line Work #1' is open, showing the execution of the script. The console output includes:

```
Running WYDOT Script 1...
C:\ESRI_2011\Projects\Drift_Model1
\Scripts\Files\WCS_Altitude.gx1
Start Time: Wed Feb 15 07:31:52
2012
Running script WYDOTScript1...
```

The background map shows a network of roads overlaid on a terrain map. The right-hand side of the interface shows the 'Toolbox' with various tool categories, including 'Network Analyst Tools'.

Development

- Drift Calculations: Step 2

The screenshot displays a GIS software interface with a workflow diagram and a command window. The workflow diagram, titled 'Snow Drift Offset #2', shows four blue oval nodes on the left: 'MCL_Whisk.gx', 'SnowDriftWork Table', 'MCL_Model_21.gx', and 'Forecast_Model_2012012'. Arrows from these nodes point to a central red rectangular node labeled 'WYDOT SP Offset Lines'. A command window titled 'Snow Drift Offset #2' is open over the diagram, showing the following text:

```
Run  
Executing WYDOT SP Offset Lines...  
[ ] Show the dialog when completed successfully  
\\Drift_Model\1\Support\FLines  
\\009_b\lwork.gx  
Start Time: Wed Feb 12 07:42:08  
2013  
Running script WYDOT02...
```

The background shows a map with a grid and various lines. The interface includes a 'Layers' panel on the left, a 'Toolbox' on the right, and a menu bar at the top.

Development

- Drift Calculations: Step 3

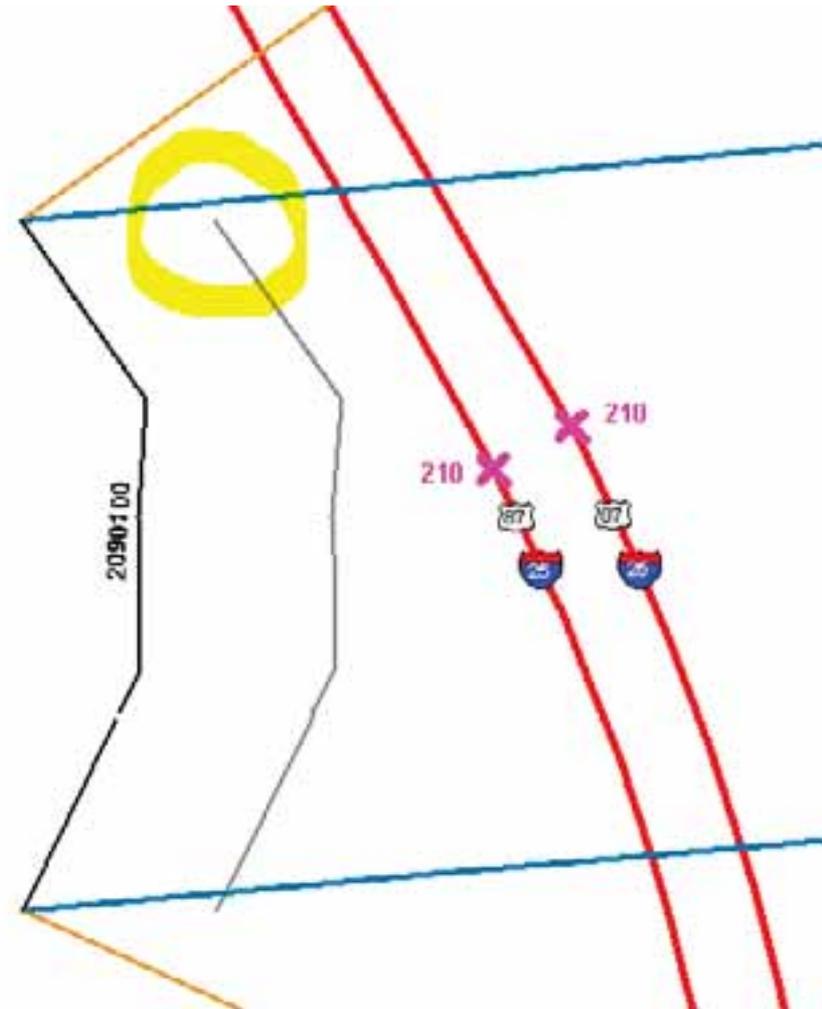
The screenshot displays the ArcMap interface with a workflow diagram titled "Snow Drift Polygon Calculation #3". The diagram shows a central red box labeled "WYDOT SF Snow Drift Polygon Calculation" with arrows pointing to it from several blue boxes: "SnowDrift", "SnowDriftOffset", "SnowDriftLineWork", "SnowDriftPolygonCalculation", "SnowDriftPolygonCalculation", "SnowDriftPolygonCalculation", "SnowDriftPolygonCalculation", and "SnowDriftPolygonCalculation".

A "Run" dialog box is open, showing the command: "Executing WYDOT SF Snow Drift Polygon Calculation." Below the command, there is a checkbox for "Clear the dialog when completed successfully" and a text area containing the following text:

```
\\1213-003-002\020\2012_2013\Projects >
\Drift_Model\Data\scriptTemplate.dwf
Start Time: Fri Feb 15 11:11:07
2013
Running script WYDOTSF...
```


Testing

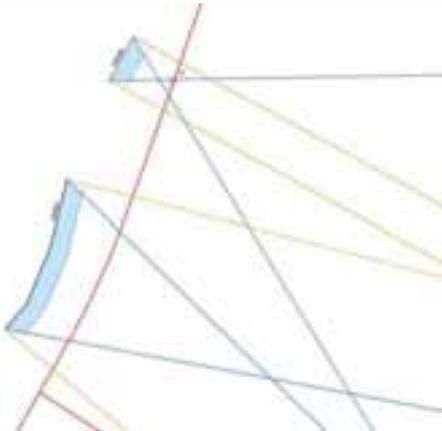
- Audit
 - Attribute join: snow drift ID
 - ID of snowdrift is assigned as snow fence ID during the modeling process
 - Spatial join: snow fence to snow drift
 - Identify areas where polygon fails to draw
- Initial success rate of ~ 55%
- Current snow fence coverage success ~ 88%
- ArcGIS 10.1 upgrade: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



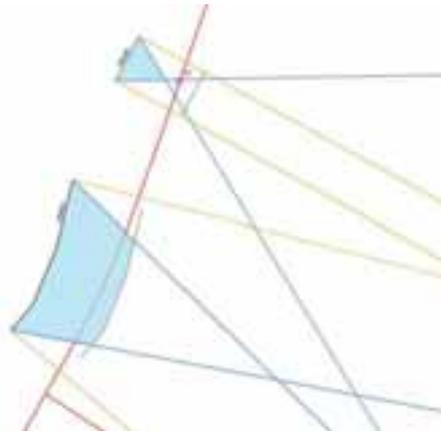
Deployment - Desktop

- 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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