



RITA

U.S. Department of Transportation
Research and Innovative Technology Administration



Federal Highway Administration
Research & Innovative Technology Administration

project summary

Data Collection via CRS&SI Technology to Determine when to Impose SLR

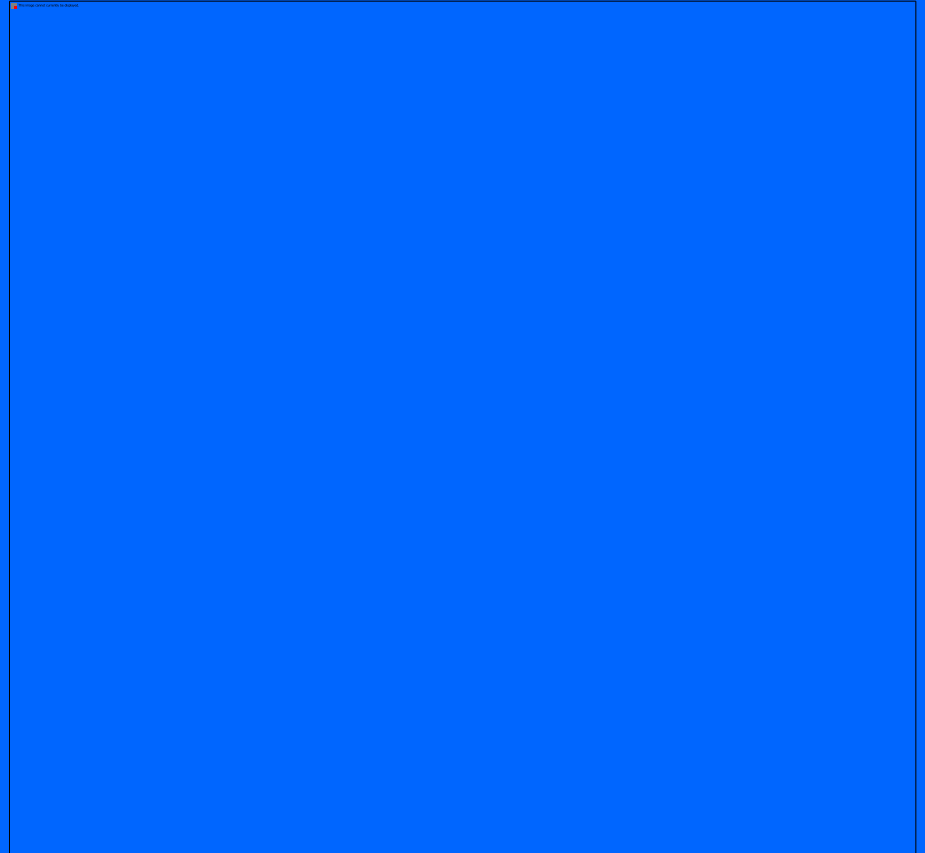
Road Weather Management Stakeholder Meeting

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Albuquerque, New Mexico
September 7-9, 2011



Introduction to the Problem

- ◆ Spring thaw processes weaken base layers and causes surface cracking on roads in cold regions.
- ◆ Spring Load Restrictions (SLRs) are applied in an effort to prevent excessive damage

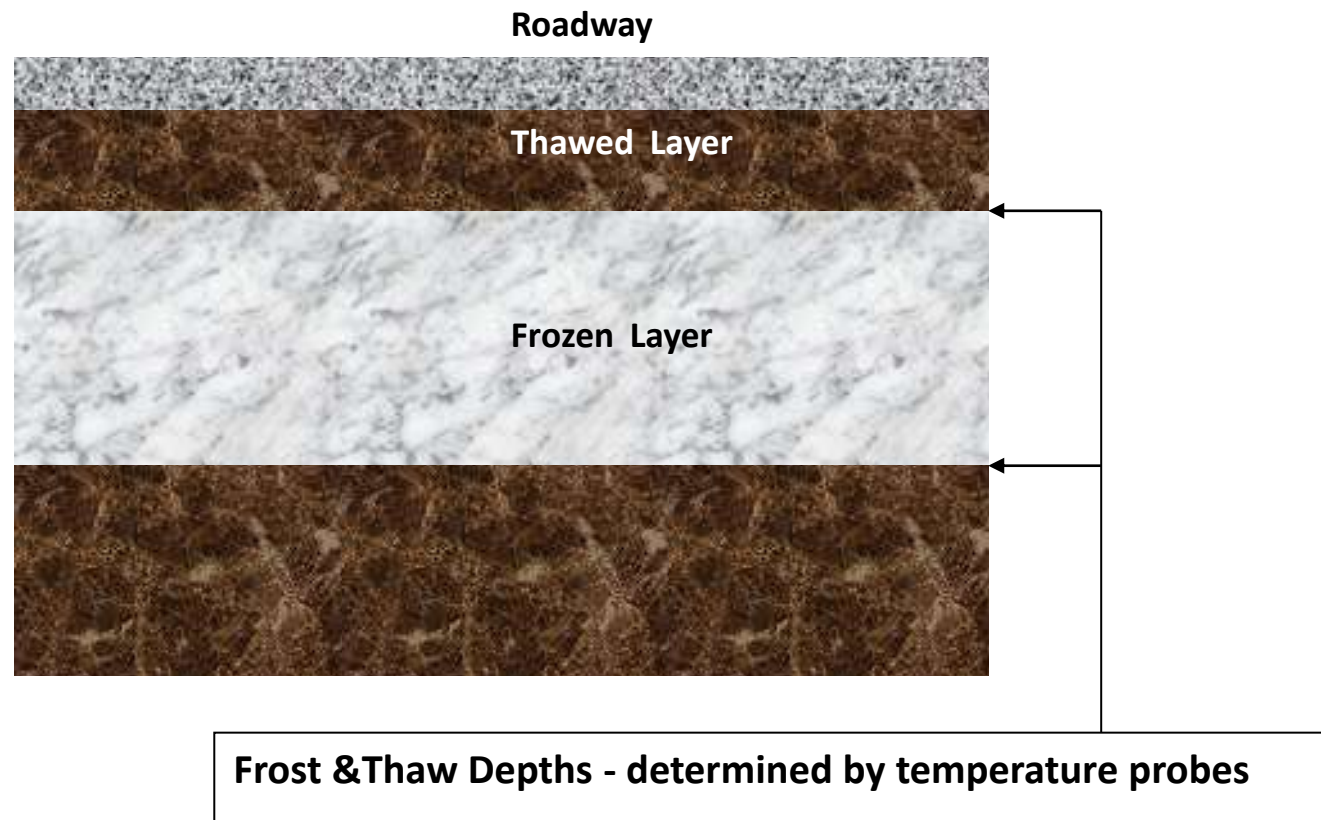


Current Approaches: Posting SLRs

- Predetermined SLR start dates and time limits that stay constant from year to year.
- Inspection/observation methods where field workers go out and observe changes in the roadways during the early spring.
- Quantitative approaches based upon:
 1. Pavement Deflection Data (FWD)
 2. Frost/Thaw Depths (Subsurface Temperature Data)
 3. Predictive models using various climactic data



SLRI's Determination of the Frost-Thaw Depths



By collecting temperatures at different depths beneath the surface, the SLRI tool will interpolate the depths at which the earth changes between being frozen and thawed.

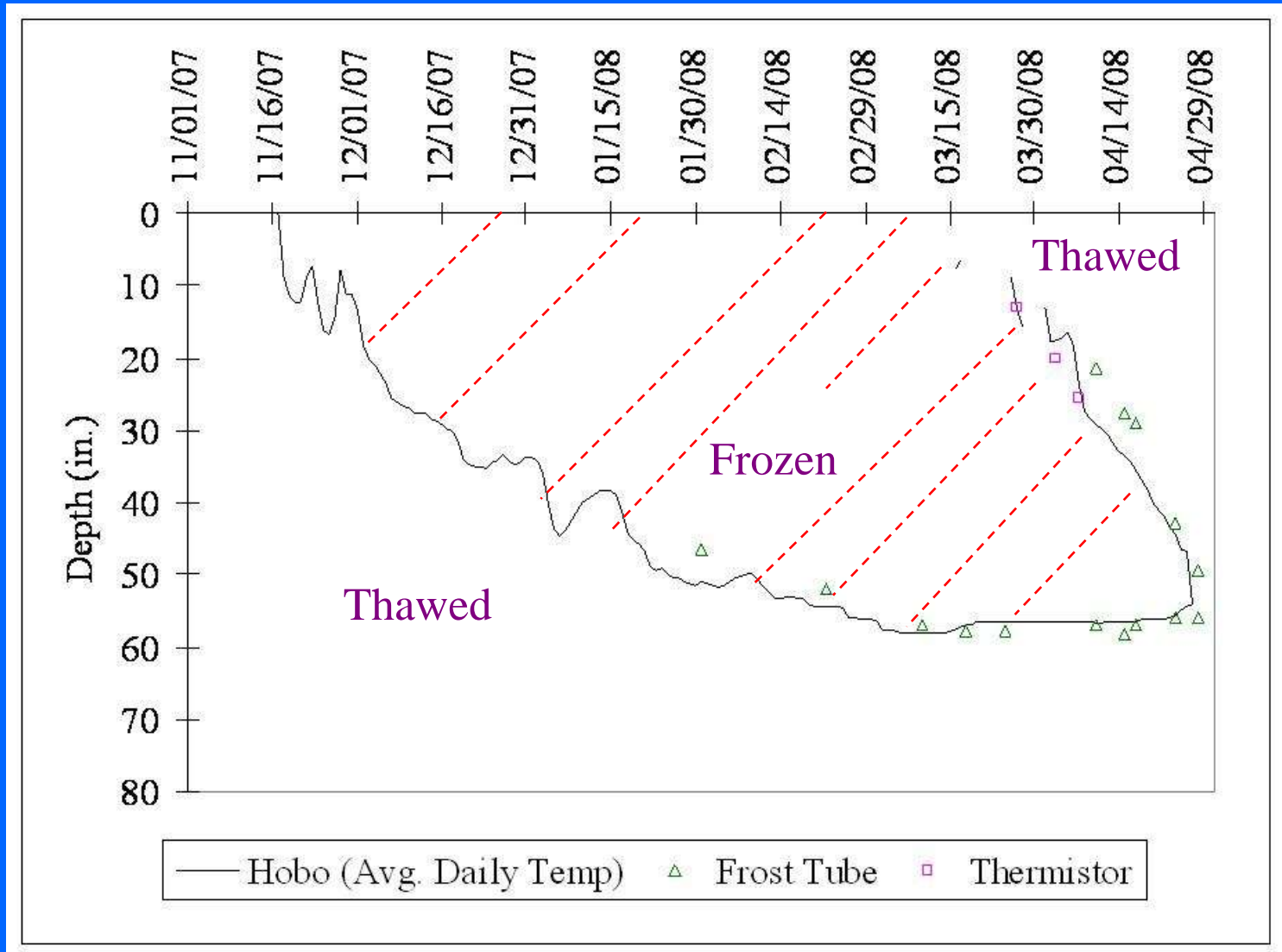




Current Procedures: Data Reduction

Date	Hobo Depth below Pavement Surface (in.)									Thaw	Frost
	4.5	10.5	16.5	22.5	28.5	34.5	40.5	52.5	76.5	Depth (in.)	Depth (in.)
12/01/08	33.9	34.1	36.1	39.3	44.6	47.4	46.0	49.6	52.6		
12/02/08	33.0	33.7	34.9	36.5	38.8	41.0	43.2	47.1	50.5		
12/03/08	32.6	33.9	35.1	36.6	38.6	40.7	42.9	46.7	50.1		
12/04/08	32.2	33.5	34.9	36.5	38.5	40.5	42.6	46.3	49.7		
12/05/08	31.9	33.3	34.7	36.2	38.3	40.3	42.3	45.9	49.3		4.75
12/06/08	30.6	32.7	34.3	36.0	38.1	40.1	42.1	45.6	48.9		8.54
12/07/08	30.9	32.3	33.9	35.7	37.8	39.8	41.8	45.4	48.6		9.27
12/08/08	25.2	30.7	33.3	35.3	37.5	39.5	41.5	45.0	48.3		11.94
12/09/08	20.6	25.4	30.7	34.1	36.8	39.1	41.2	44.8	48.0		18.78
12/10/08	28.7	28.7	30.5	33.3	36.0	38.4	40.7	44.4	47.7		19.81
12/11/08	30.9	30.8	31.5	33.4	35.7	38.0	40.2	44.1	47.4		18.03
12/12/08	31.2	31.1	31.9	33.5	35.6	37.7	39.9	43.7	47.1		16.81
12/13/08	26.8	29.9	32.0	33.6	35.6	37.6	39.6	43.4	46.8		16.50
12/14/08	23.0	26.0	30.0	33.1	35.3	37.4	39.4	43.1	46.5		19.66
03/01/09	29.1	29.3	29.6	29.8	30.2	30.7	31.4	33.8	36.1		43.59
03/02/09	28.4	29.0	29.6	29.8	30.2	30.8	31.4	33.8	36.0		43.50
03/03/09	24.1	25.9	27.8	29.3	30.1	30.8	31.4	33.8	36.0		43.47
03/04/09	22.6	24.1	26.0	28.0	29.5	30.5	31.3	33.8	36.0		43.72
03/05/09	24.2	24.8	26.0	27.5	29.0	30.3	31.2	33.8	36.0		44.17
03/06/09	29.9	28.8	28.4	28.4	29.2	30.2	31.2	33.6	36.0		44.42
03/07/09	30.7	29.8	29.4	29.2	29.7	30.4	31.2	33.6	35.9		44.44
03/08/09	32.0	30.7	30.0	29.7	29.9	30.3	30.8	33.4	35.7	4.50	45.82
03/09/09	32.0	31.3	30.6	30.0	30.1	30.5	30.9	33.6	35.8	4.50	45.35
03/10/09	32.5	31.4	30.9	30.3	30.4	30.7	31.2	33.6	35.8	7.35	44.53
03/11/09	32.5	31.6	31.0	30.6	30.6	30.8	31.2	33.6	35.8	7.88	44.44
03/12/09	32.6	31.6	31.2	30.7	30.7	30.9	31.2	33.6	35.7	8.07	44.44
03/13/09	32.3	31.6	31.2	30.8	30.8	31.0	31.2	33.6	35.6	7.27	44.51
03/14/09	33.5	31.7	31.4	30.8	30.8	31.0	31.2	33.5	35.6	9.39	44.60
03/15/09	36.1	32.1	31.4	31.0	31.0	31.0	31.4	33.4	35.6	11.68	44.12
03/16/09	38.0	34.3	31.5	31.0	31.0	31.1	31.4	33.4	35.6	15.46	44.02
03/17/09	39.8	36.2	32.2	31.1	31.0	31.2	31.4	33.4	35.6	17.75	44.02
03/18/09	37.2	35.7	33.7	31.4	31.2	31.3	31.4	32.9	34.9	21.00	44.94
03/19/09	39.8	36.5	34.4	32.9	31.6	31.5	31.4	32.2	34.1	26.63	48.98
03/20/09	38.4	36.2	34.3	32.6	31.6	31.3	31.3	32.8	34.7	26.15	45.87

Results: Frost-Thaw Profile



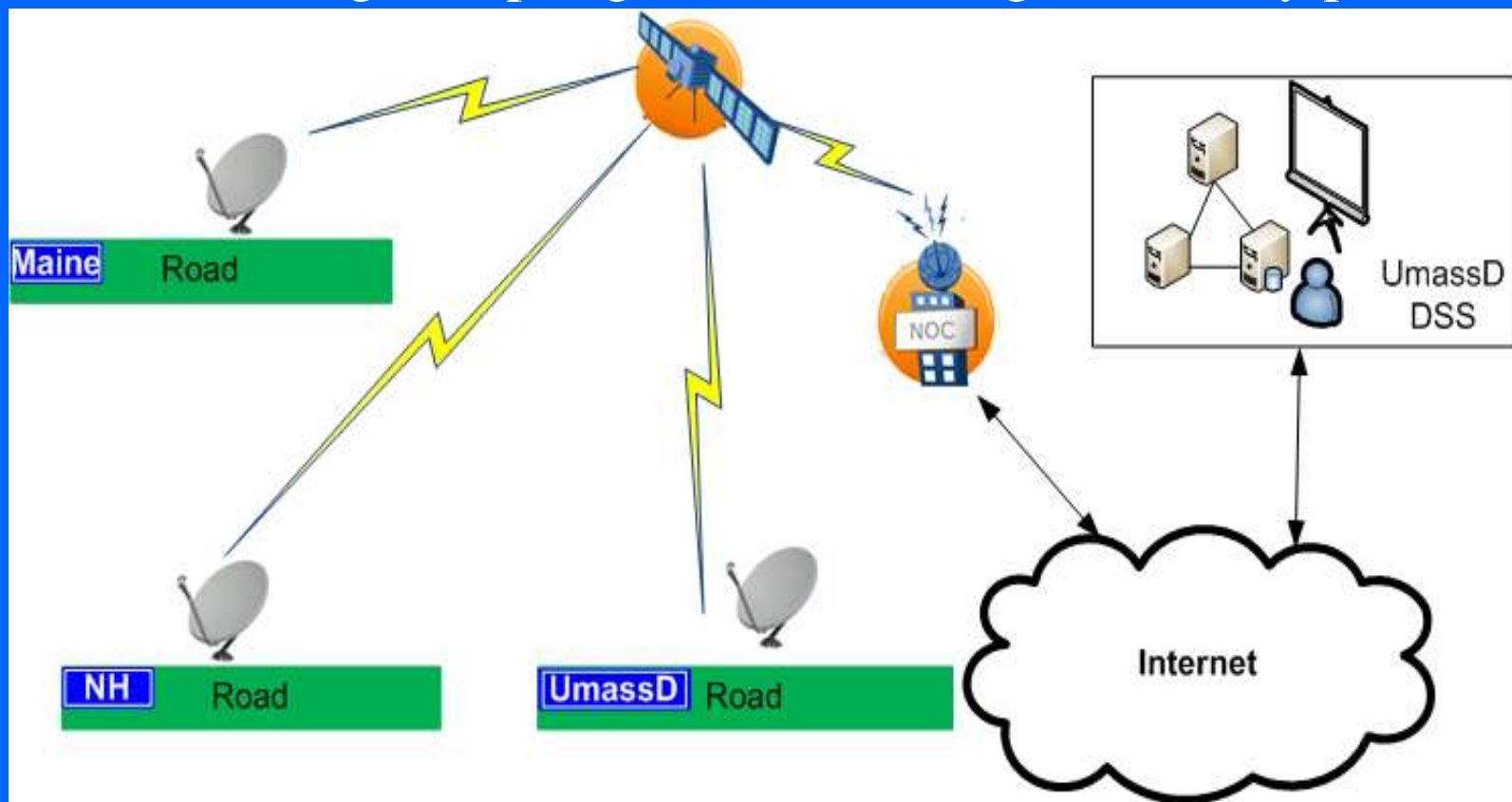
Current Problems:

Frost/Thaw Monitoring

- ◆ Manual downloading of data in the field is often challenging
- ◆ Difficult to obtain subsurface temperature data in real time
- ◆ Current data processing methods are not automated and are very cumbersome

Overall Project Objective:

Apply commercial remote sensing and spatial information (CRS&SI) technology to monitor the condition of roadways in real time during the spring thaw and strength recovery period.



Key Features of Demonstration Project

- ◆ System will modify current data collection procedures from onsite manual downloading to real time data transfer via satellite
- ◆ Decision Support System (DSS) which will automate data reduction and produce graphical displays of frost-thaw penetration
- ◆ Database and search engine to retrieve archived data as well as current data
- ◆ An integrated predictive model to assist decision makers in applying SLRs

Deliverables

- **Deliverables:**
Three CRS-SI Technology equipped Test Sites
- **Deliverables:**
Working DSS-SLR website and all Components
- **Deliverables:**
Preliminary Testing of the Predictive Model

Posting SLRs based upon Predictive Models

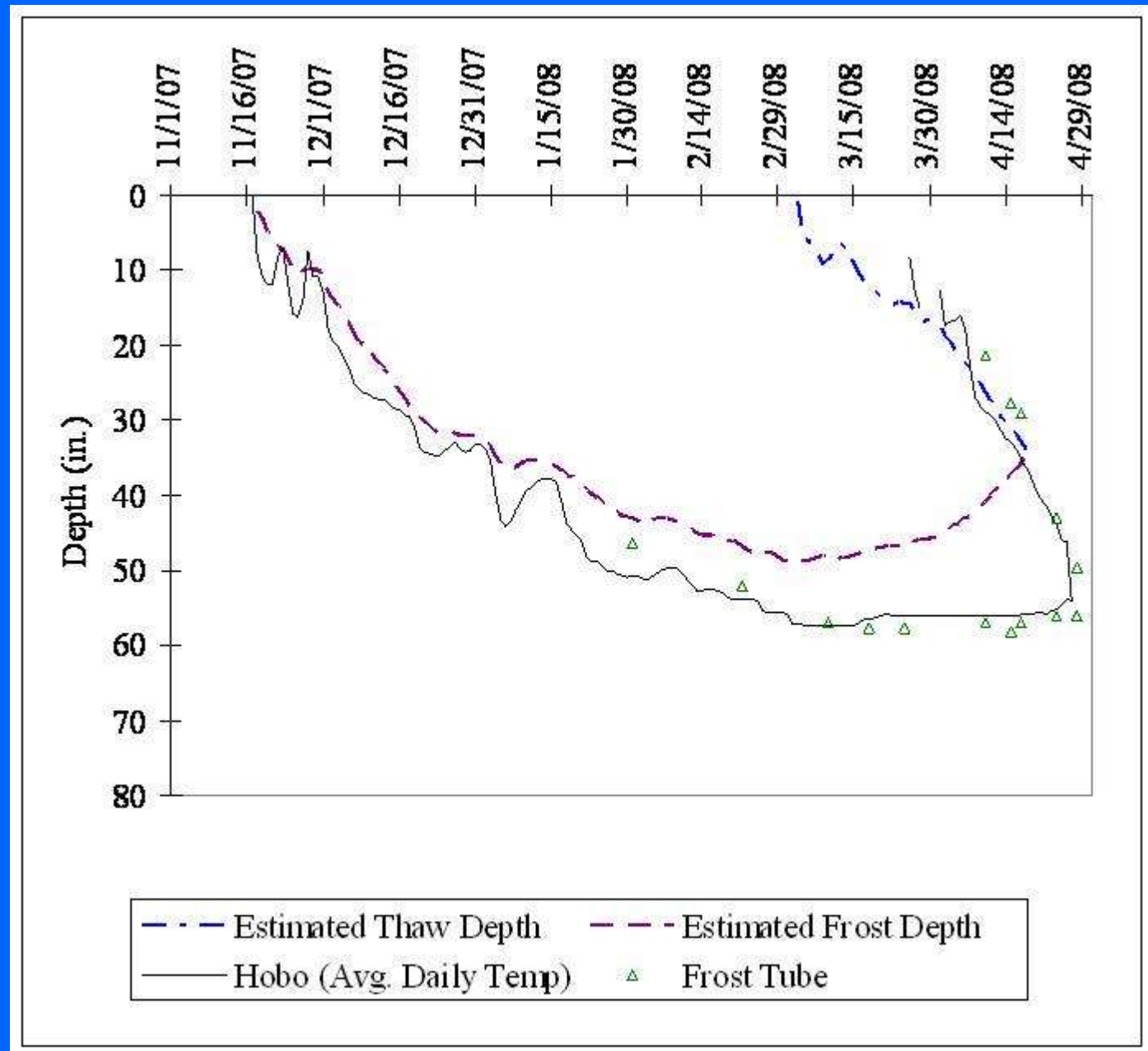
Why consider predictive models?

- ◆ State DOTs do not have funds to instrument and monitor all of their roadways for frost/thaw depths
- ◆ FWD Testing & analysis is even more costly & time consuming
- ◆ Difficult to obtain and analyze subsurface temperature and/or FWD data in real time
- ◆ Truckers must be notified of SLR 3 to 5 days ahead of actual posting

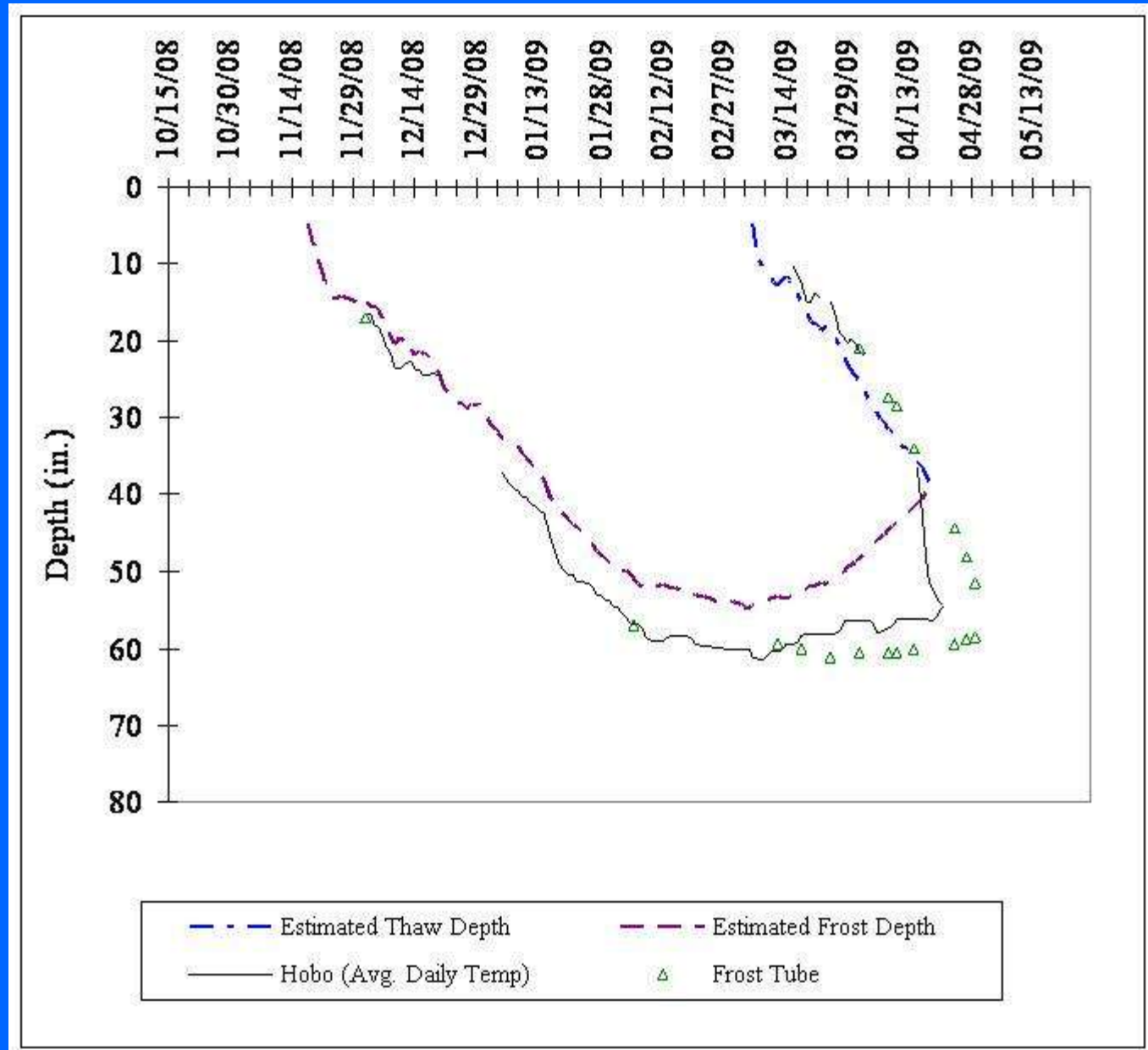
Two predictive models/approaches under consideration:

1. Freeze/Thaw Index approach(es): Based upon measured air temperatures only
2. Enhanced Integrated Climactic Model (EICM): Considers air temperature, solar radiation, wind speed, precipitation and other factors

Preliminary
Results of
Freeze/Thaw
Index Model at
NH Site K-3
(2007-2008)



Preliminary
Results of
Freeze/Thaw
Index Model at
NH Site K-3
(2008-2009)



Project's Immediate Benefits

1. Eliminate manual downloading of temperature data in the field
2. Obtain the temperature data real time
3. Automate the drafting of the Frost – Thaw Plots using the SLRI tool and the real temperature data
4. Test one of the newly emerging Predictive Model's output by comparing it to the SLRI output
5. Perform all of the above on a user friendly website or DSS-SLR

Thank you

project summary

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