

Guidelines for Restricting Interstate Highways for Major Weather Events



Pennsylvania Department of Transportation

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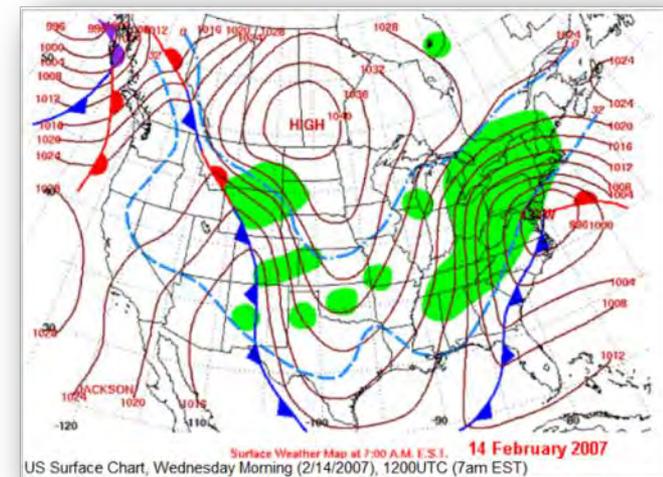
AGENDA

- **Valentine's Day Storm of 2007**
 - Problems
 - Improvements
 - Process Improvements
- **Benefits**
- **Results**
- **Decision Trees**
- **Engineering Studies to Determine Effectiveness**



Valentines Day Storm 2007

- Complex winter storm moved into PA on February 13, 2007, producing widespread snowfall and ice
 - ✓ Precipitation ranged from a few inches in the Southeast to 20" in the Northeast
 - ✓ Produced light snow in the Southwest in early morning
 - ✓ Snow spread north & east, and became heavy in the afternoon
 - ✓ Snow mixed with sleet in the evening, and turned to freezing rain over the Southeast

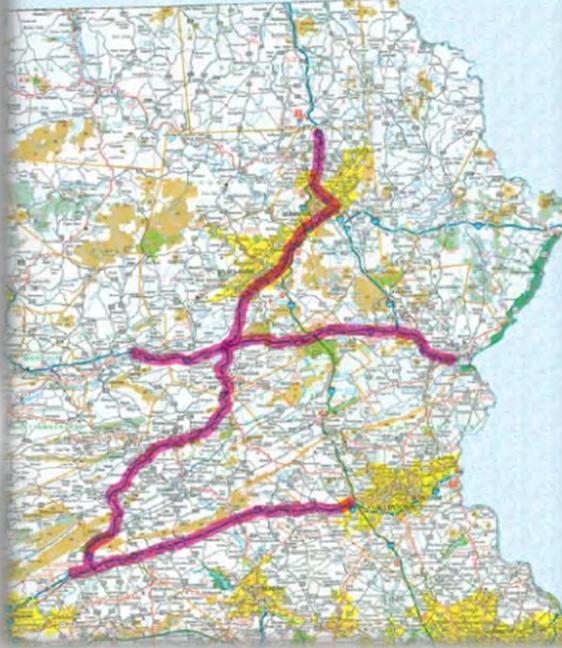


Aftermath

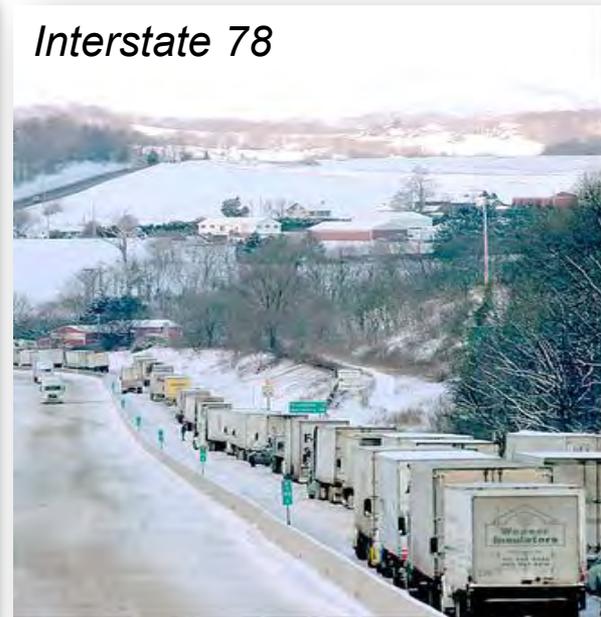
Interstate 80



**PA Interstates
Affected by Storm**



Interstate 78



Interstate 81



Standardized Road Condition Descriptions

- **Implemented to attain common understanding of Winter road conditions**
- **Represent the predominate condition of the road**
- **Improves Situational Awareness**
- **Conditions 1 – 6**
- **Triggers predetermined actions:**
 - Speed limit reduction
 - Truck restrictions
 - Road closures

Condition 1: Clear -

Dry/wet pavement surface is maintained at all times.

Condition 2: Wet with Freezing Conditions -

Wet pavement surface is the general condition with air temps near or below freezing.

Condition 3: Snow and/or Slush Covered -

Accumulations of loose snow or slush are regularly found on the pavement surface. Light to moderate snow cover may be present in some areas (up to 2" on secondary routes).

Condition 4: Snow Packed / Significant Snow Cover -

The pavement surface has continuous stretches of packed snow with or without loose snow on top of packed snow and ice. Significant snow accumulations present in some areas (2 – 5").

Condition 5: Icy -

The pavement surface is predominantly covered with ice and packed snow. There may be loose snow or sleet on top of the icy or packed snow surface.

Condition 6: Impassable -

The road is temporarily impassable to most or all vehicles. This may be the result of severe weather (low visibility, blowing snow, etc.) or road conditions [drifting, excessive unplowed snow (5+"), avalanche potential or actuality, glare ice, etc.]



Restrictions Imposed on Interstates

✓ **45 MPH Speed**

- Implemented as means to reduce crashes caused by vehicle speeds excessive for weather conditions
- First used during Winter of 2009-10

✓ **Vehicles**

- Implemented as means to reduce crashes caused by vehicle types not conducive for weather conditions
- First used during Winter of 2009-10
- Graduated on precipitation & wind speed
 - Twin trailers
 - Empty bottom trucks
 - Commercial vehicles
 - All vehicles

• **Both are implemented via:**

- ✓ Variable Message Boards & Hwy Advisory Radio
- ✓ Public radio & local news



Benefits

- **45 mph Speed Restriction**

- ✓ Fewer crashes
- ✓ Increases safety awareness
- ✓ Safer for emergency responders
- ✓ Makes snow removal more efficient & safer
- ✓ Reduces non-essential traffic

- **Truck Restrictions**

- ✓ All of above
- ✓ Promotes pre-trip planning
- ✓ Increases availability of shoulders



Decision Trees for Weather-Related Restrictions on Limited Access Highways

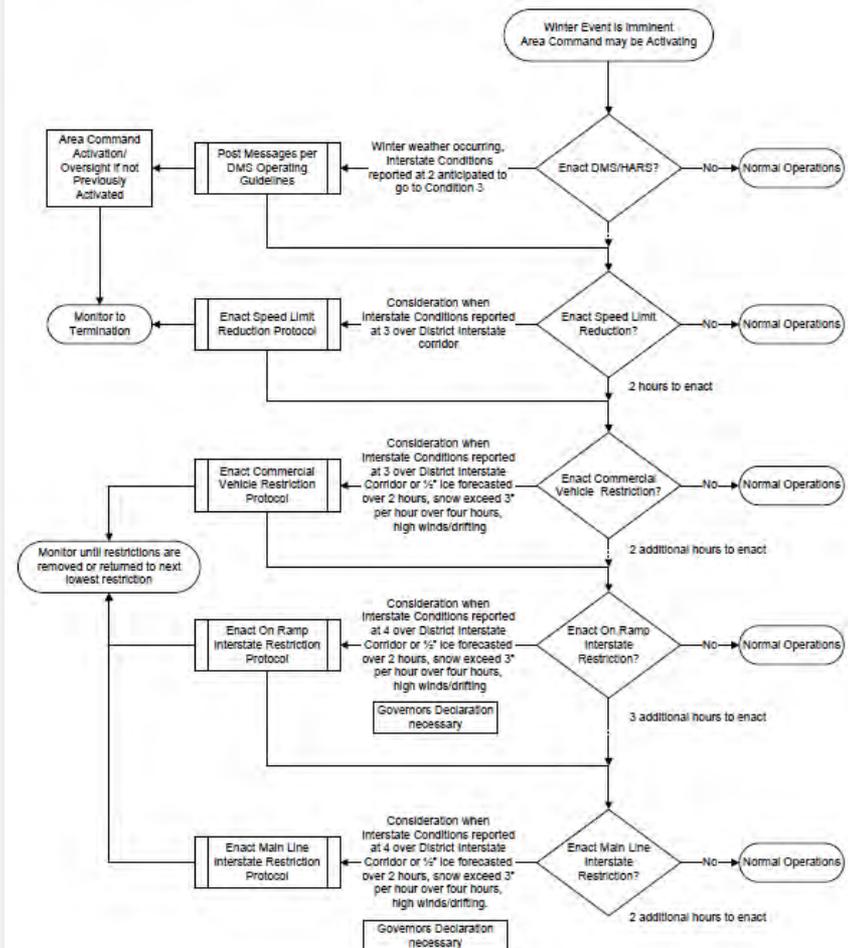
- ❖ **Weather Related Restrictions on Interstate/Limited Access Highways**
 - Provides an overview covering all restrictions
- ❖ **Winter Weather Pre-Emptive Restrictions**
 - Used by Area Command for State-wide decisions
- ❖ **Interstate/Limited Access Reduced Speed Limit Process**
- ❖ **Interstate Commercial Vehicle Restriction Protocol**
- ❖ **Response to Turnpike Commercial Vehicle Restriction Protocol**
- ❖ **Interstate On Ramp Restriction**
- ❖ **Interstate Mainline Restriction Protocol**



Weather Related Restrictions on Interstate & Limited Access Highways

- ☑ Overview covering all restrictions
- ☑ “Triggers” for the various restrictions
- ☑ Guides Area Command and District Incident Command Centers to the appropriate Protocol

Decision Tree for Weather Related Restrictions on Interstate/Limited Access Highways



Weather Related Restrictions on Interstate & Limited Access Highways

- ❄️ **When Winter weather is occurring and conditions are reported at **CONDITION 2** and anticipated to go to **CONDITION 3****

Condition 2: Wet with Freezing Conditions - Wet pavement surface is the general condition with air temperatures near or below freezing. There are occasional areas having snow or ice accumulations resulting from drifting, sheltering, cold spots, frozen melt-water, etc.



This condition should be utilized during periods of precipitation when air and/or pavement temperatures are at 34 degrees and are expected to drop to freezing or below freezing during the course of the storm. This condition should also be used when wet or light snow cover conditions are expected to persist for two or more hours with freezing temperatures.

Condition 3: Snow and/or Slush Covered - Accumulations of loose snow or slush are regularly found on the pavement surface. Light to moderate snow cover may be present in some areas (up to 2 inches on secondary routes).



Some snow packed and/or icy conditions may be present but do not represent predominate road conditions on the interstates. Reduced travel speeds may be required due to slick road conditions. Secondary routes may have up to 2 inches of snow and/or slush accumulation.

- ☑️ Enact Dynamic Message Signs as per "DMS Operating Guidelines"
- ☑️ Districts enact immediately without Area Command activation/oversight



Weather Related Restrictions on Interstate & Limited Access Highways

❄️ When Interstate Conditions are reported at **CONDITION 3** over District Interstate Corridors...

Condition 3: Snow and/or Slush Covered - Accumulations of loose snow or slush are regularly found on the pavement surface. Light to moderate snow cover may be present in some areas (up to 2 inches on secondary routes).



Some snow packed and/or icy conditions may be present but do not represent predominate road conditions on the interstates. Reduced travel speeds may be required due to slick road conditions. Secondary routes may have up to 2 inches of snow and/or slush accumulation.



☑️ Consider enacting **“Speed Limit Reduction Protocol”**

- Area Command approves District request
- Can take 2 hrs. to enact
- Use 45 MPH
- Affected Districts place messages placed on all dynamic message signs & HARs
- Area Command and Districts monitor to termination, normally CONDITION 2

Weather Related Restrictions on Interstate & Limited Access Highways

❄️ **When conditions are reported at **CONDITION 3** over District Interstate Corridor, or:**

- 1. ½" ice forecasted over 2 hrs.,**
- 2. Snow to exceed 3" per hr. over 4 hrs.,**
- 3. High winds & drifting**



Consider enacting "Commercial Restriction Protocol"

- Area Command determines need
- Will take an ADDITIONAL 2 hrs. to enact
- Area Command & District ICCs monitor until restrictions are removed or returned to next lowest restriction as per Commercial Restriction Protocol

Weather Related Restrictions on Interstate & Limited Access Highways

❄️ **When conditions are reported at **CONDITION 4** over District Interstate Corridor, or:**

- 1. 1/2" ice forecasted over 2 hrs.,**
- 2. Snow to exceed 3" per hr. over 4 hrs.,**
- 3. High winds & drifting, AND**
- 4. Governor's Emergency Declaration**



Consider enacting "On Ramp Protocol"

- Area Command determines need
- Will take an ADDITIONAL 3 hrs. to enact
- Area Command & District ICCs monitor until restrictions are removed or returned to next lowest restriction as per Commercial Restriction Protocol

Weather Related Restrictions on Interstate & Limited Access Highways

❄️ **When conditions are reported at **CONDITION 4** over District Interstate Corridor, or:**

- 1. ½" ice forecasted over 2 hrs.,**
- 2. Snow to exceed 3" per hr. over 4 hrs.,**
- 3. High winds & drifting, AND**
- 4. Governor's Emergency Declaration**



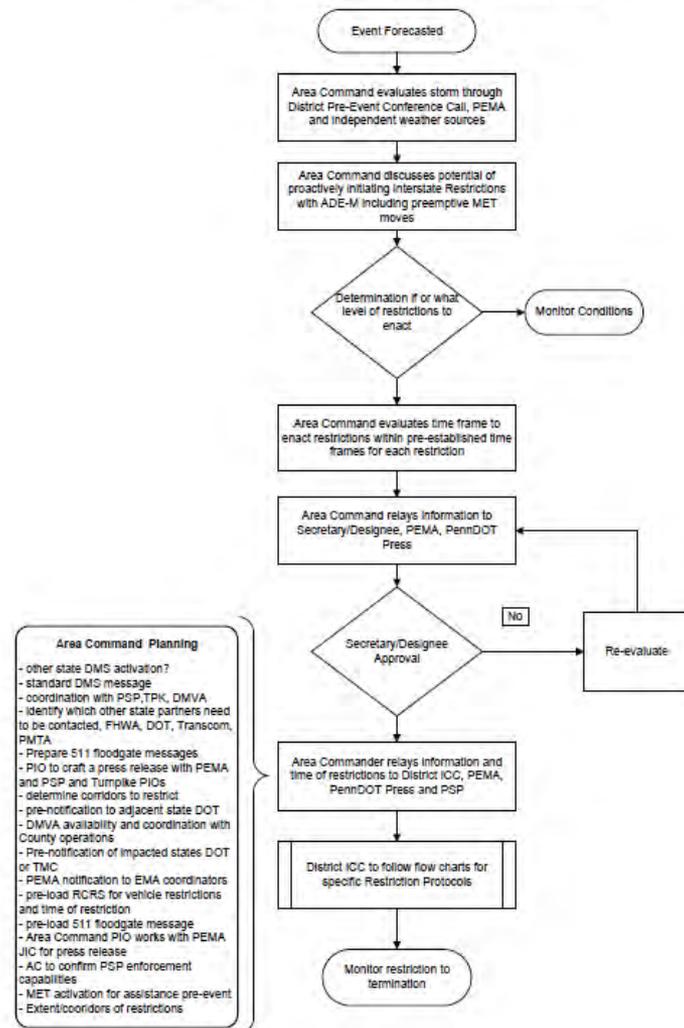
**Consider enacting
"Mainline Interstate Protocol"**

- Area Command determines need
- Will take an ADDITIONAL 2 hrs. to enact
- Area Command & District ICCs monitor until restrictions are removed or returned to next lowest restriction as per Commercial Restriction Protocol

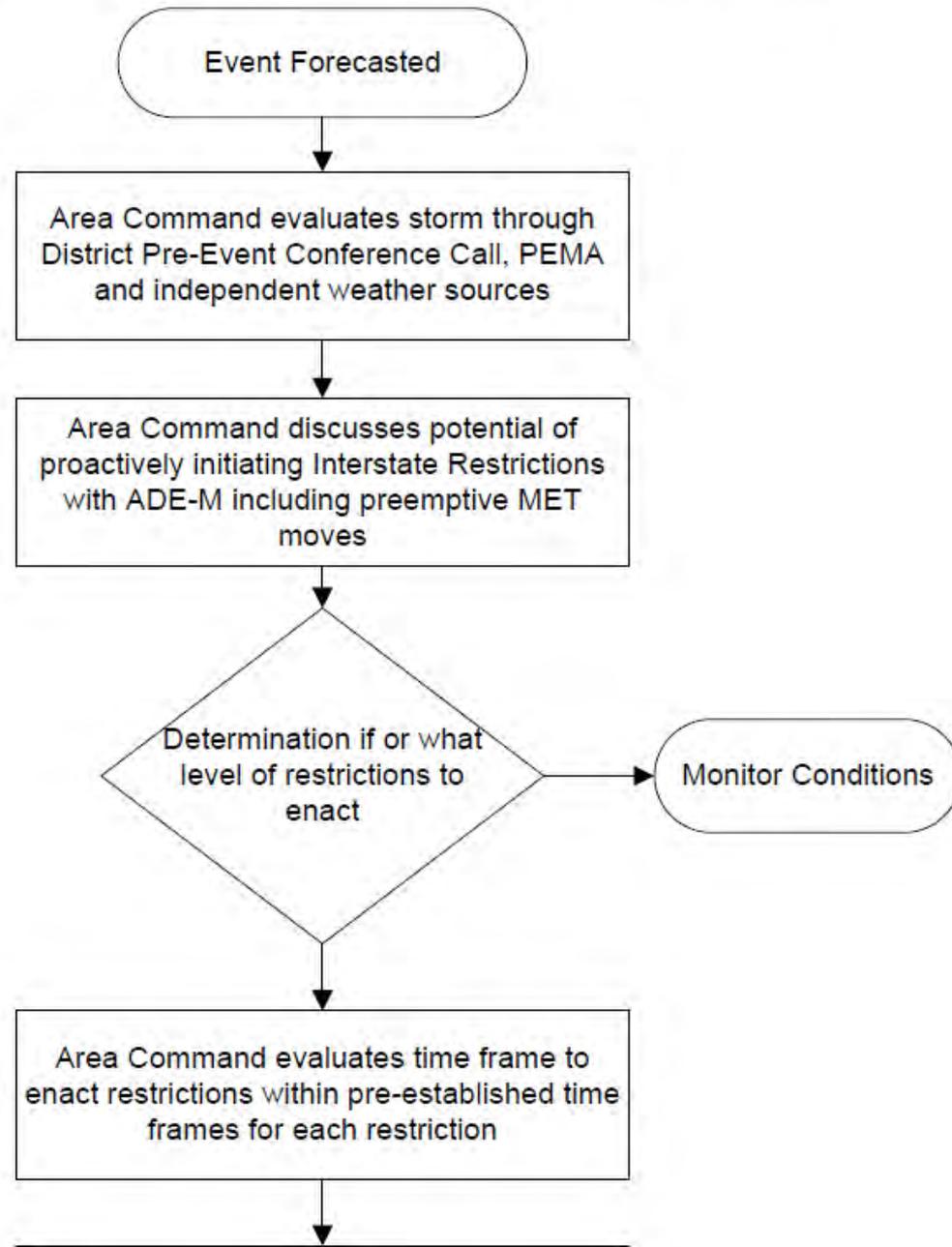
PennDOT Winter Weather Pre-Emptive Restrictions

- ✓ Provides processes for when an Event is forecasted
- ✓ Area Command evaluates storm by conducting a pre-event teleconference:
 - Districts
 - PEMA (PA Emergency Management Agency)
 - Independent weather sources
- ✓ Protocol includes a detailed Planning Checklist for Area Command
 - Used to evaluate conditions and determine notifications, activations, and other preparedness processes needing considered

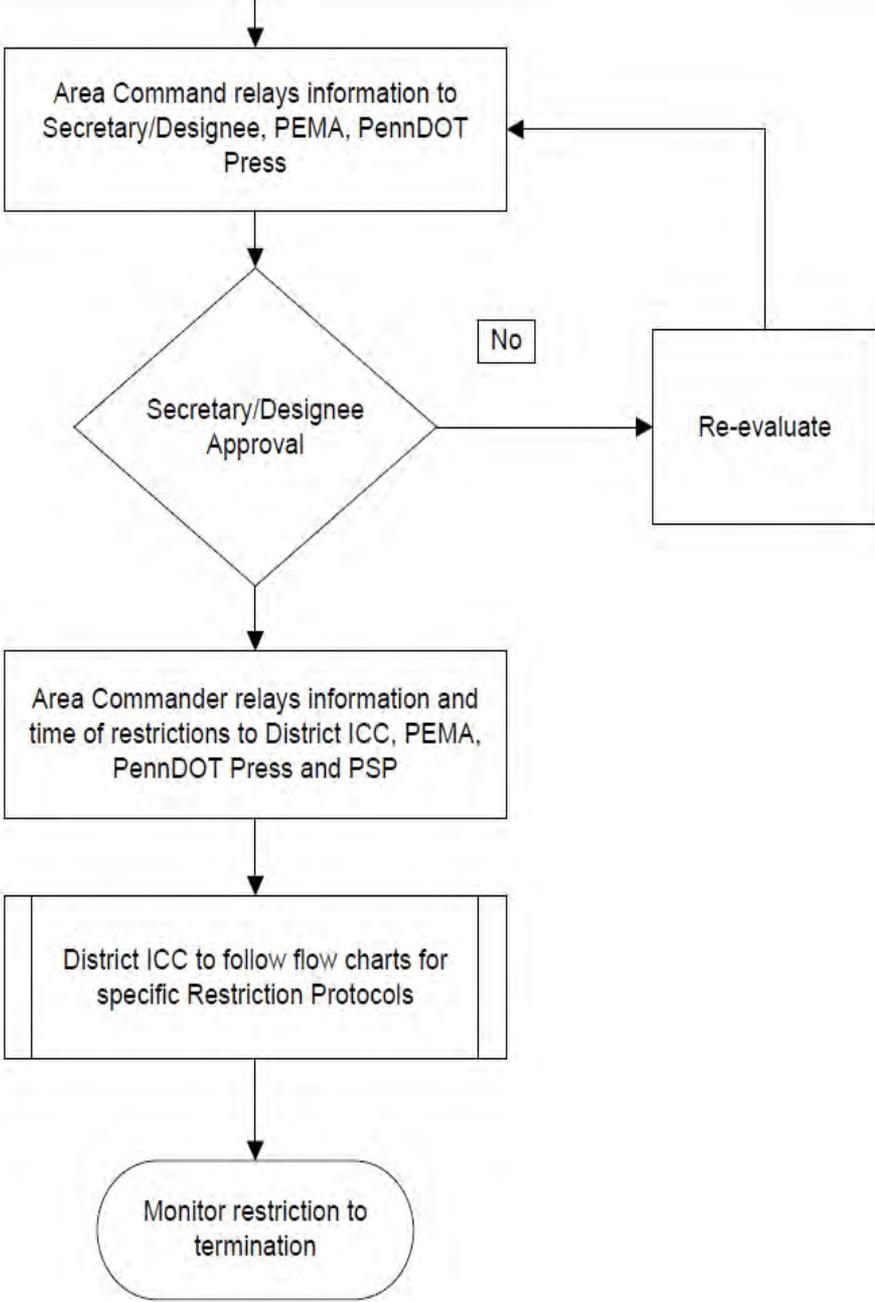
PennDOT Winter Weather Pre-Emptive Restrictions



PennDOT Winter Weather Pre-Emptive Restrictions

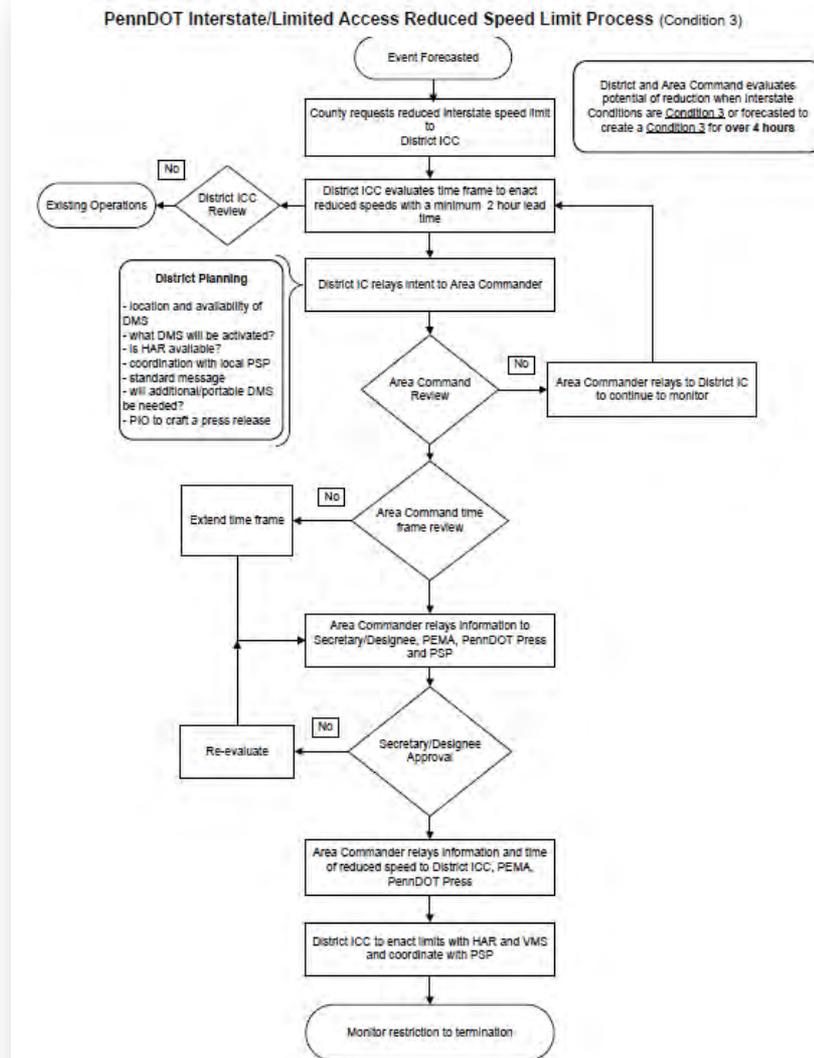


- Area Command Planning**
- other state DMS activation?
 - standard DMS message
 - coordination with PSP, TPK, DMVA
 - identify which other state partners need to be contacted, FHWA, DOT, Transcom, PMTA
 - Prepare 511 floodgate messages
 - PIO to craft a press release with PEMA and PSP and Turnpike PIOs
 - determine corridors to restrict
 - pre-notification to adjacent state DOT
 - DMVA availability and coordination with County operations
 - Pre-notification of impacted states DOT or TMC
 - PEMA notification to EMA coordinators
 - pre-load RCRS for vehicle restrictions and time of restriction
 - pre-load 511 floodgate message
 - Area Command PIO works with PEMA JIC for press release
 - AC to confirm PSP enforcement capabilities
 - MET activation for assistance pre-event
 - Extent/cooridors of restrictions

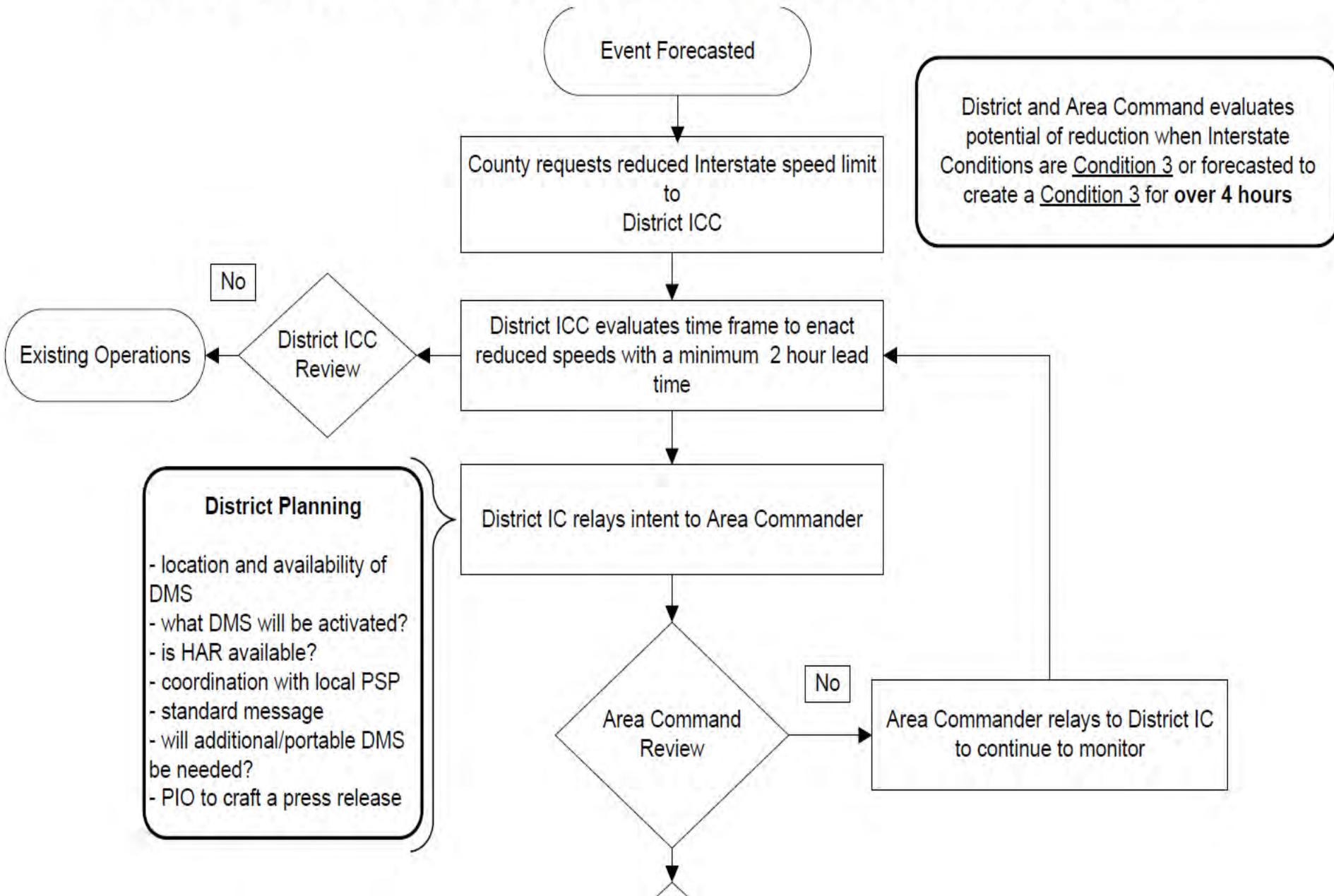


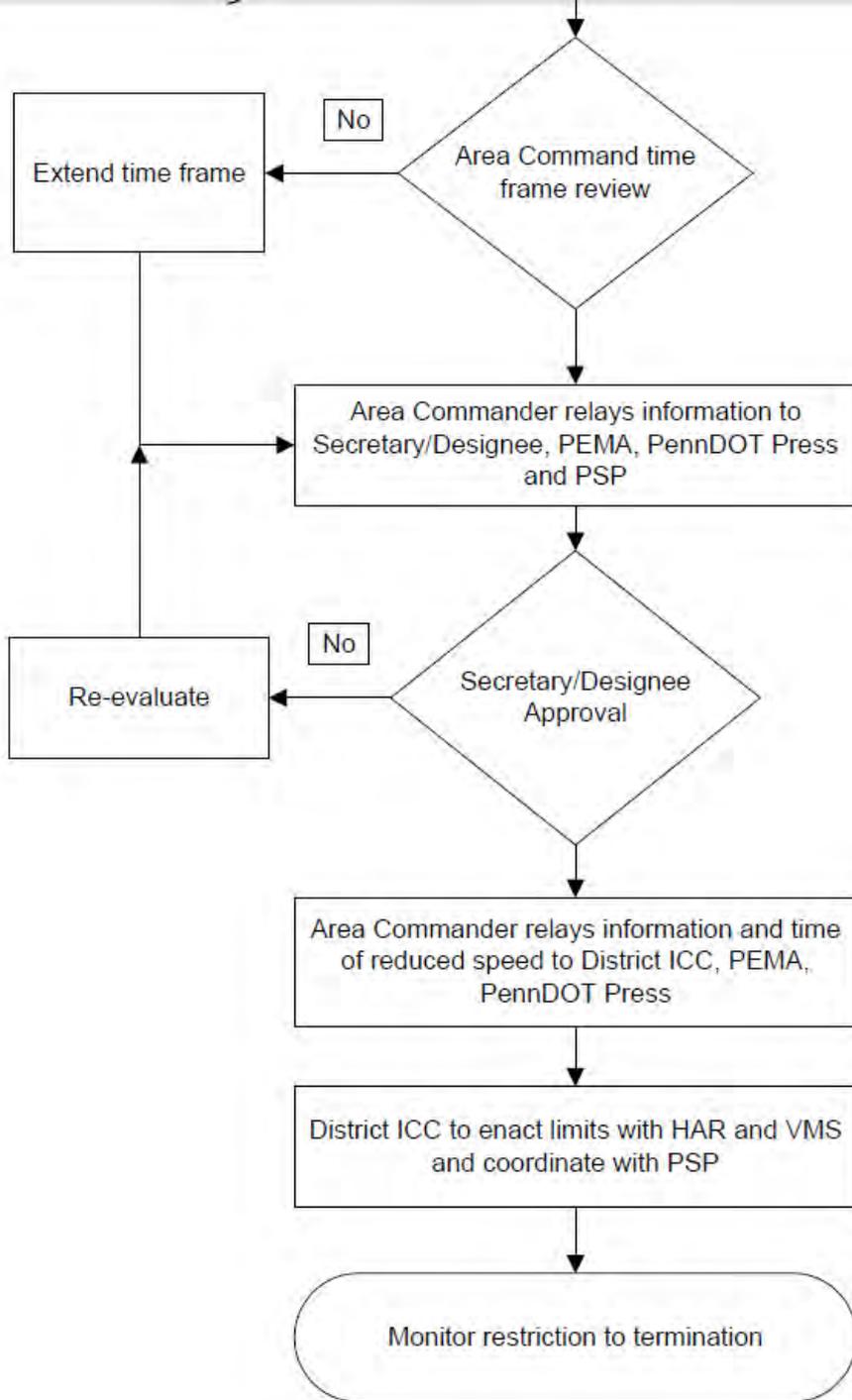
Interstate/Limited Access Reduced Speed Limit Process

- Used when County requests reduced Interstate Speed Limit to District ICC
- Protocol provides a checklist for District ICC
- Area Command reviews request and makes proper notifications
 - Internal...Secretary of Transportation, District ICC
 - External...PA State Police, PEMA
- District ICC will enact 45 MPH Speed Limit
 - Only after approval from Area Command
 - By way of available Dynamic Message Signs, Highway Advisory Radio, and Media



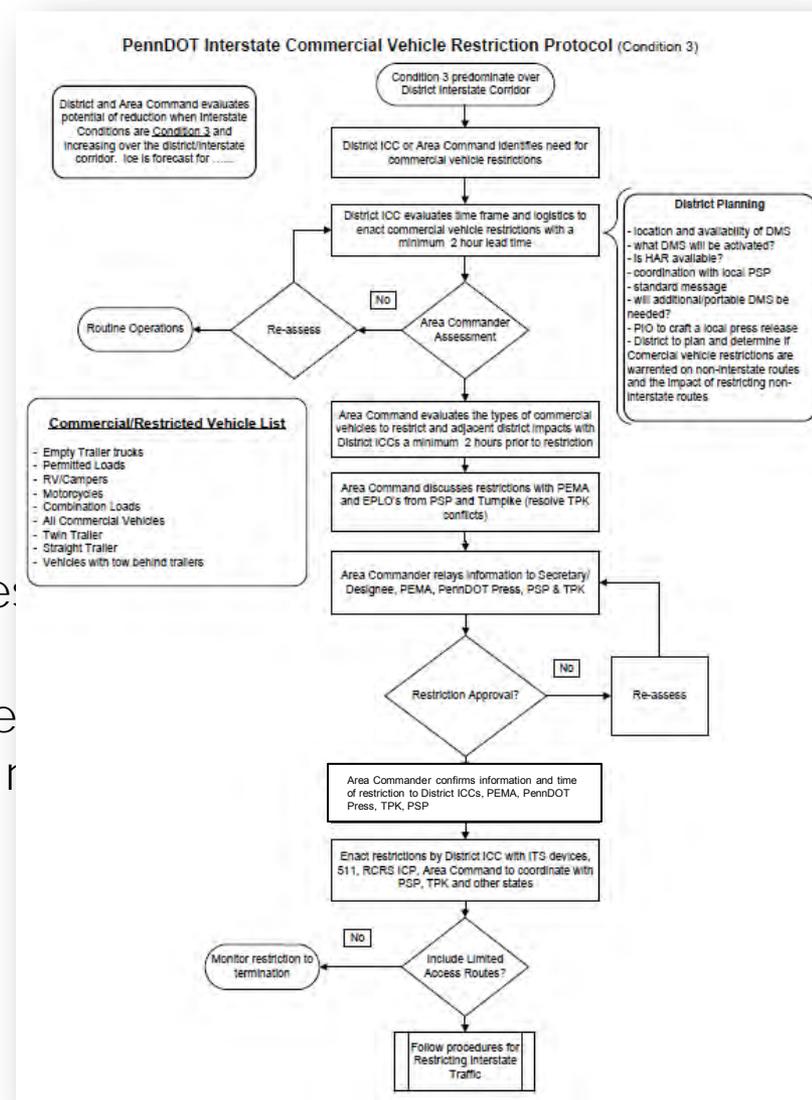
PennDOT Interstate/Limited Access Reduced Speed Limit Process (Condition 3)





Interstate Commercial Vehicle Restriction Protocol

- CONDITION 3 over District Interstate Corridor
- Area Command evaluates:
 - Type of vehicles to restrict
 - Adjacent District impacts
 - Coordinates with PA State Police, PA Turnpike, Adjacent Districts
- Districts enact restrictions via:
 - Informing motorists via ITS devices, 511PA, and media
 - Other Internal Situational Awareness processes (Road Condition Reporting System, email, etc.)



PennDOT Interstate Commercial Vehicle Restriction Protocol (Condition 3)

District and Area Command evaluates potential of reduction when Interstate Conditions are Condition 3 and increasing over the district/interstate corridor. Ice is forecast for

Condition 3 predominate over District Interstate Corridor

District ICC or Area Command identifies need for commercial vehicle restrictions

District ICC evaluates time frame and logistics to enact commercial vehicle restrictions with a minimum 2 hour lead time

District Planning

- location and availability of DMS
- what DMS will be activated?
- is HAR available?
- coordination with local PSP
- standard message
- will additional/portable DMS be needed?
- PIO to craft a local press release
- District to plan and determine if Commercial vehicle restrictions are warranted on non-interstate routes and the impact of restricting non-interstate routes

No

Area Commander Assessment

Re-assess

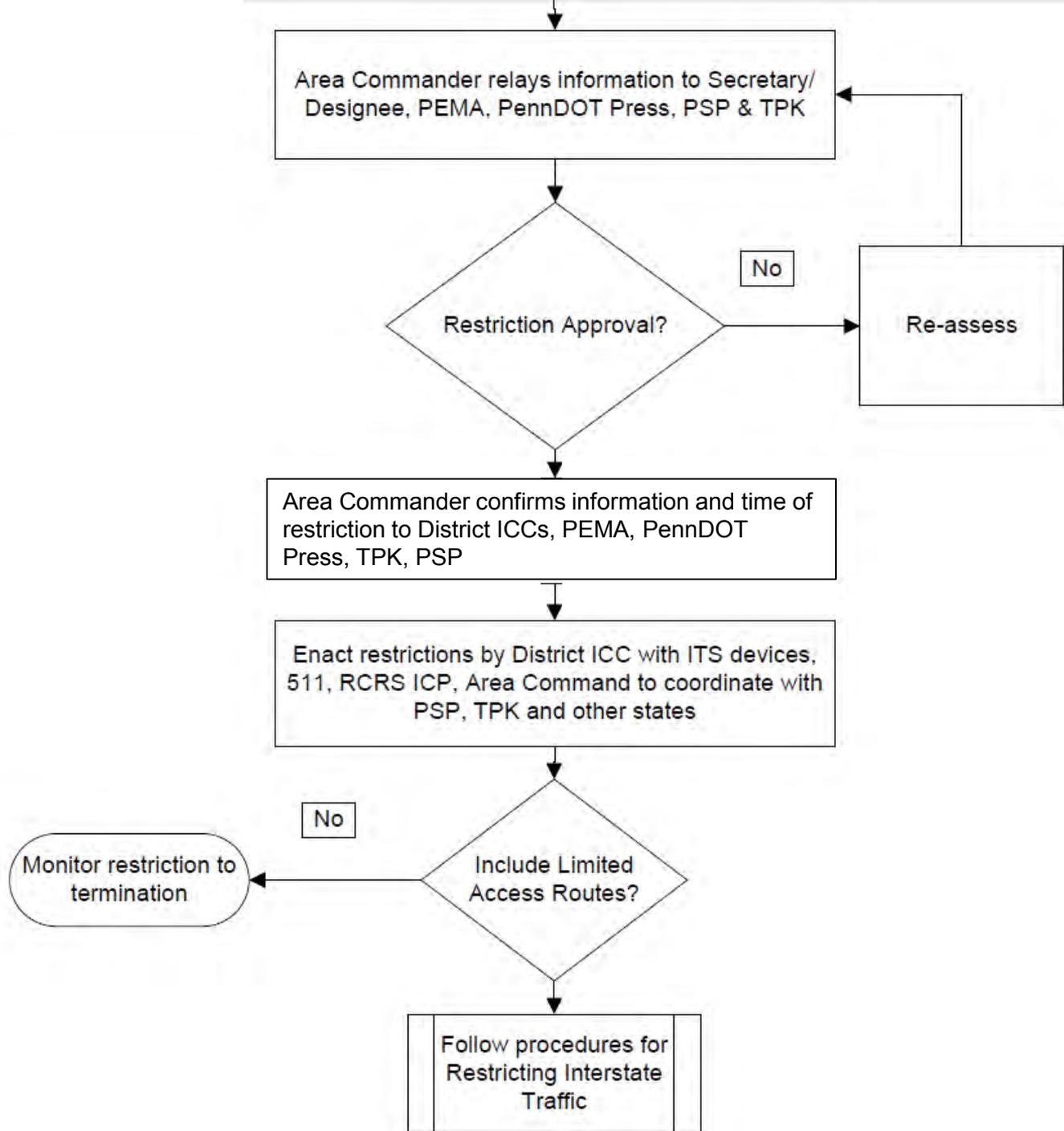
Routine Operations

Commercial/Restricted Vehicle List

- Empty Trailer trucks
- Permitted Loads
- RV/Campers
- Motorcycles
- Combination Loads
- All Commercial Vehicles
- Twin Trailer
- Straight Trailer
- Vehicles with tow behind trailers

Area Command evaluates the types of commercial vehicles to restrict and adjacent district impacts with District ICCs a minimum 2 hours prior to restriction

Area Command discusses restrictions with PEMA and EPLO's from PSP and Turnpike (resolve TPK conflicts)



Interstate Commercial Vehicle Restriction Protocol

- Area Command will consider enacting Restricting Vehicles by Type
 - Graduated based on precipitation & wind speed

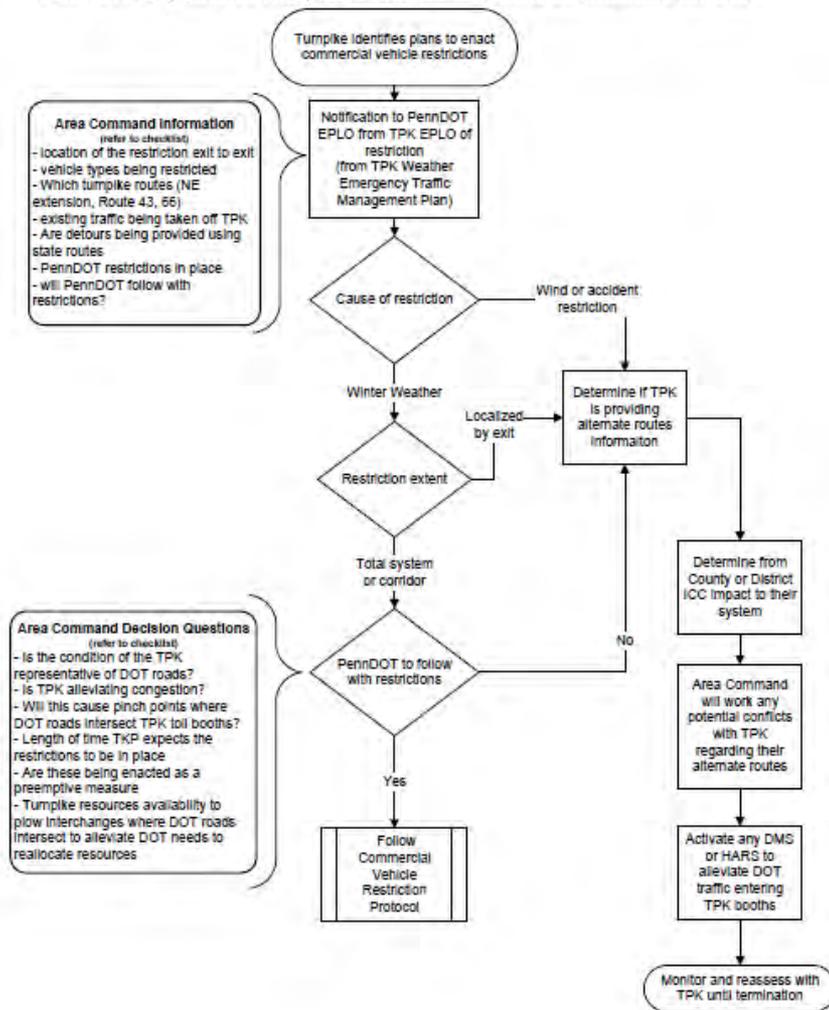
- Empty Trailer trucks
- Permitted Loads
- RVs/Campers
- Motorcycles
- Combination Loads
- All Commercial Vehicles
- Twin Trailers
- Straight Trailers
- Vehicles with Tow Behind Trailers

Specific restrictions based on conditions & operational needs

Response to Turnpike Commercial Vehicle Restriction Protocol

- Used when the PA Turnpike enacts commercial vehicle restrictions
- Protocol includes:
 - Decision questions for Area Command
 - Checklist for Area Command
 - Notifications needing made
 - Consideration for affected PennDOT Districts to follow Commercial Vehicle Restriction Protocol
 - Area Command is to work through potential conflicts with PA Turnpike regarding their alternate routes
 - Utilize nearby DMSs & HARs

PennDOT response to Turnpike Commercial Vehicle Restriction Protocol



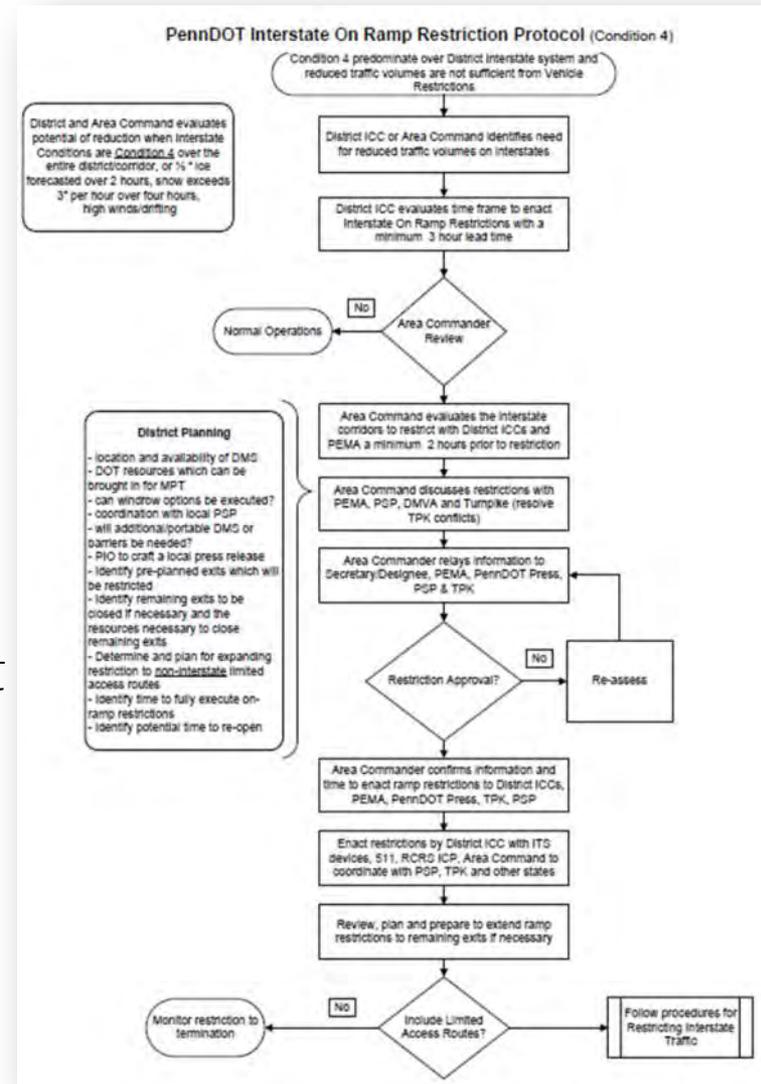
Interstate On-Ramp Restriction Protocol

- Considered when CONDITION 4 is reported over the entire District corridor

OR

- 1/" ice forecasted over 2 hrs.
- Snow exceeds 3" per hr.
- High winds/drifts
- Reduced traffic volumes are not sufficient from Commercial Vehicle Restrictions

- Protocol includes detailed District Planning needs



PennDOT Interstate On Ramp Restriction Protocol (Condition 4)

District and Area Command evaluates potential of reduction when Interstate Conditions are Condition 4 over the entire district/corridor, or ½ " ice forecasted over 2 hours, snow exceeds 3" per hour over four hours, high winds/driftng

Condition 4 predominate over District Interstate system and reduced traffic volumes are not sufficient from Vehicle Restrictions

District ICC or Area Command identifies need for reduced traffic volumes on interstates

District ICC evaluates time frame to enact Interstate On Ramp Restrictions with a minimum 3 hour lead time

Area Commander Review

No

Normal Operations

- District Planning**
- location and availability of DMS
 - DOT resources which can be brought in for MPT
 - can window options be executed?
 - coordination with local PSP
 - will additional/portable DMS or barriers be needed?
 - PIO to craft a local press release
 - Identify pre-planned exits which will be restricted
 - Identify remaining exits to be closed if necessary and the resources necessary to close remaining exits
 - Determine and plan for expanding restriction to non-interstate limited access routes
 - Identify time to fully execute on-ramp restrictions
 - Identify potential time to re-open

Area Command evaluates the interstate corridors to restrict with District ICCs and PEMA a minimum 2 hours prior to restriction

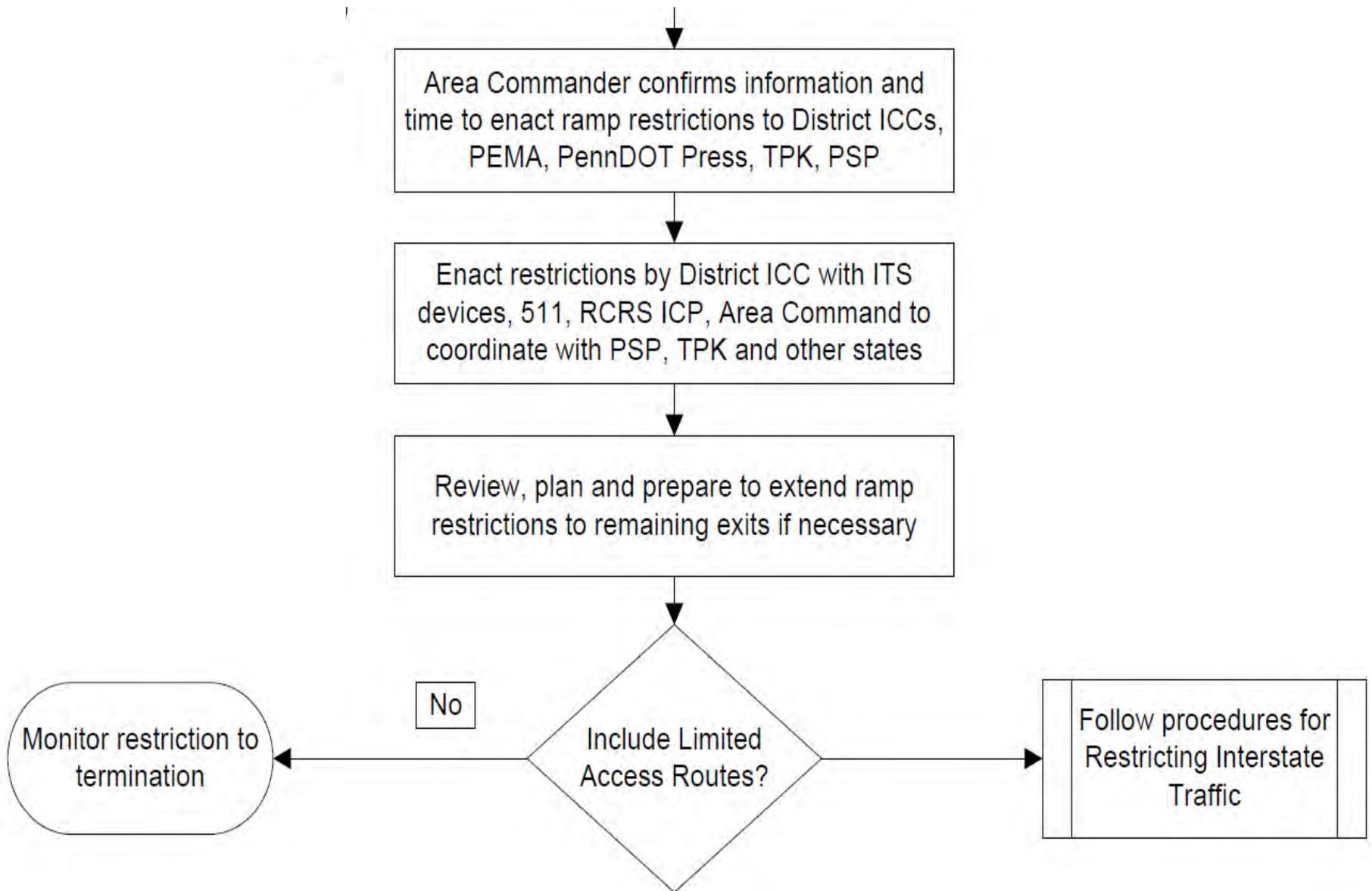
Area Command discusses restrictions with PEMA, PSP, DMVA and Turnpike (resolve TPK conflicts)

Area Commander relays information to Secretary/Designee, PEMA, PennDOT Press, PSP & TPK

Restriction Approval?

No

Re-assess



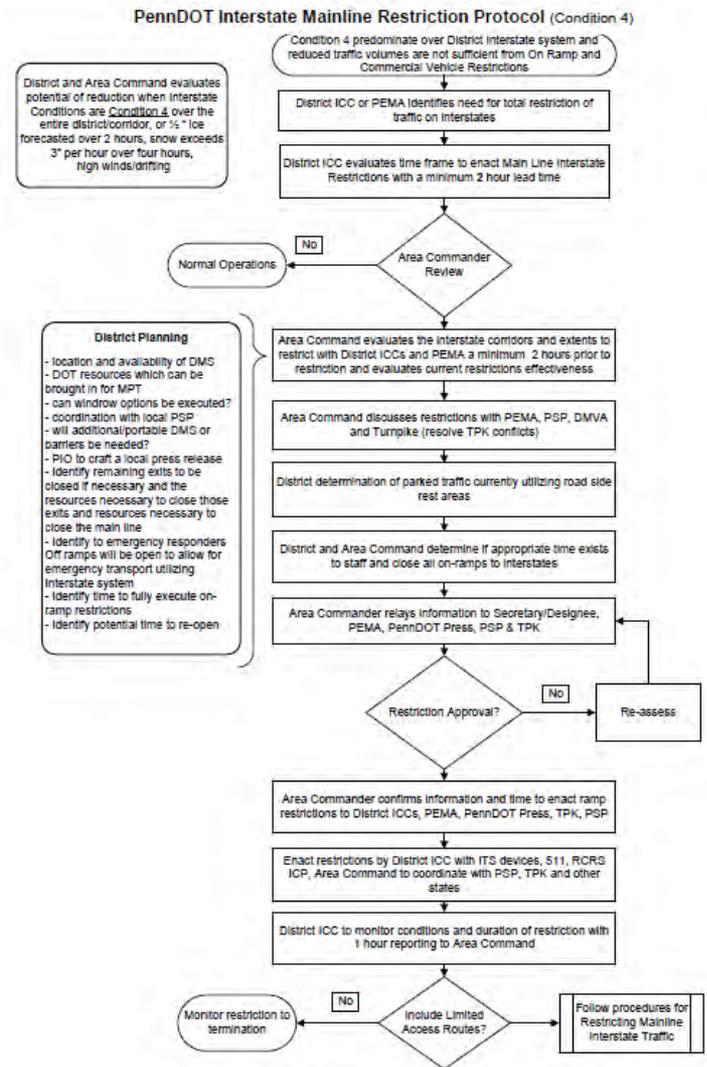
Interstate Mainline Restriction Protocol

- Considered when CONDITION 4 is reported over the entire District corridor

OR

- 1/” ice forecasted over 2 hrs.
- Snow exceeds 3” per hr.
- High winds/driftng
- Reduced traffic volumes are not sufficient from On Ramp and Commercial Vehicle Restrictions

- Protocol includes detailed District Planning needs



PennDOT Interstate Mainline Restriction Protocol (Condition 4)

District and Area Command evaluates potential of reduction when Interstate Conditions are Condition 4 over the entire district/corridor, or ½" ice forecasted over 2 hours, snow exceeds 3" per hour over four hours, high winds/drifts

Condition 4 predominate over District Interstate system and reduced traffic volumes are not sufficient from On Ramp and Commercial Vehicle Restrictions

District ICC or PEMA identifies need for total restriction of traffic on interstates

District ICC evaluates time frame to enact Main Line Interstate Restrictions with a minimum 2 hour lead time

Area Commander Review

No

Normal Operations

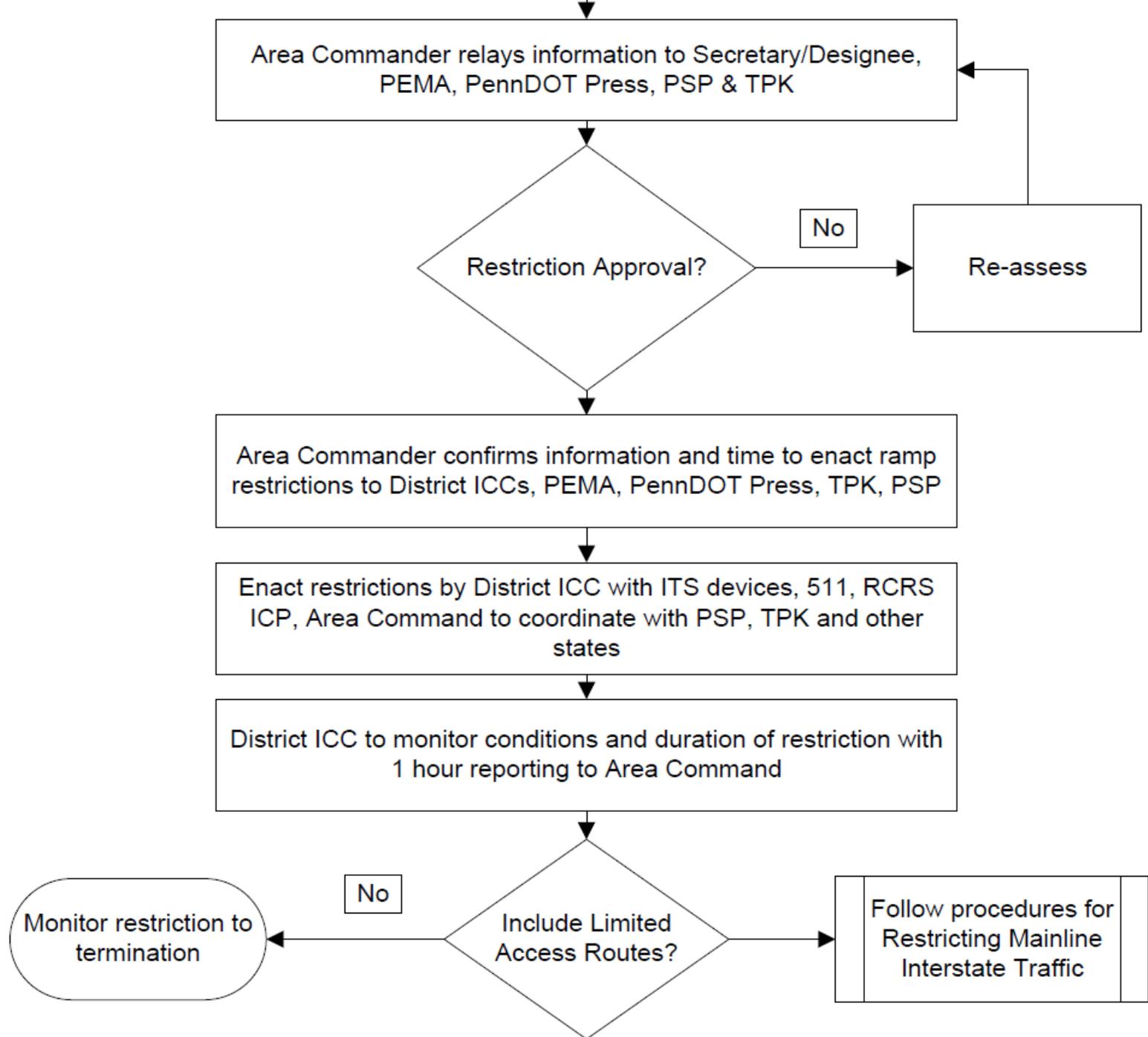
- District Planning**
- location and availability of DMS
 - DOT resources which can be brought in for MPT
 - can windrow options be executed?
 - coordination with local PSP
 - will additional/portable DMS or barriers be needed?
 - PIO to craft a local press release
 - Identify remaining exits to be closed if necessary and the resources necessary to close those exits and resources necessary to close the main line
 - Identify to emergency responders Off ramps will be open to allow for emergency transport utilizing Interstate system
 - Identify time to fully execute on-ramp restrictions
 - Identify potential time to re-open

Area Command evaluates the interstate corridors and extents to restrict with District ICCs and PEMA a minimum 2 hours prior to restriction and evaluates current restrictions effectiveness

Area Command discusses restrictions with PEMA, PSP, DMVA and Turnpike (resolve TPK conflicts)

District determination of parked traffic currently utilizing road side rest areas

District and Area Command determine if appropriate time exists to staff and close all on-ramps to interstates



Engineering Study Used for Basis of Restrictions – *45 MPH Speed*

Were pre-emptive 45mph restrictions effective in reducing crashes?

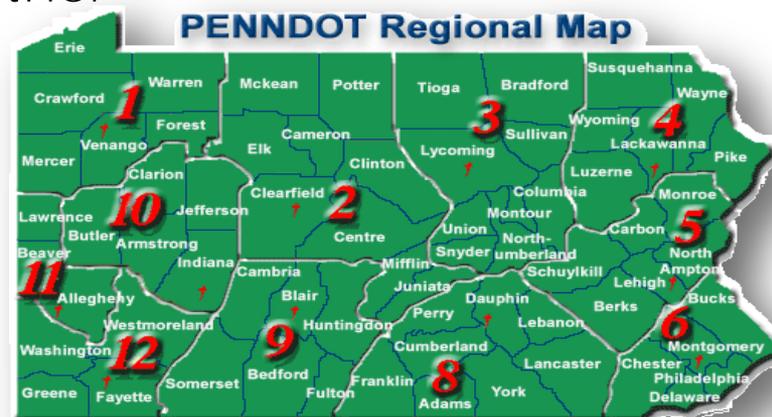
- **Compiled dates implemented 45 MPH restriction:**

When?: 14 dates during Dec. 2009 to Feb. 2011

Where?: 17 Interstate/District Combinations (*Single Interstate traversing a single PennDOT District*)

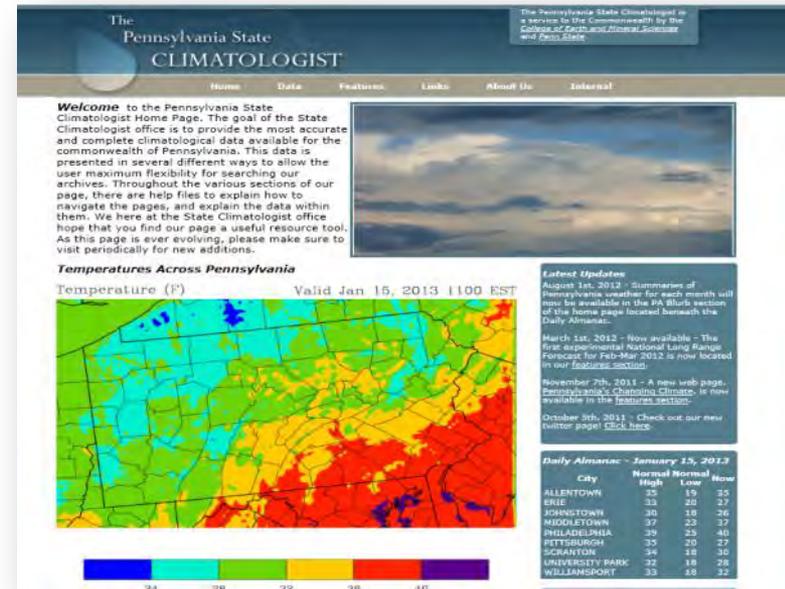
- ✓ Focuses on Districts 4, 5, 8
- ✓ Highly-traveled Interstates
- ✓ Varying degree of winter weather

- **Retrieved crash data for each date of 45 MPH restriction**



Engineering Study Used for Basis of Restrictions – *45 MPH Speed*

- **Compiled list of storms 2"+ within study areas**
 - 36 dates
- **Obtained snowfall data obtained from The [Pennsylvania State Climatologist](#) website for the same time period**
 - County by County data
- **Considered two scenarios** (due to limited increments of available data)
 - ❄ 4+" of snowfall
 - ❄ 2" to 4" of snowfall



Engineering Study Used for Basis of Restrictions – *45 MPH Speed*

- **Used Before/After crash analysis of the overall number of crashes in the study region**
 - *Did not consider time of events, nor restrictions*

- Before Data: 1/1/07 to 6/30/09
 - ✓ Total of 9069 crashes
 - ✓ Average of 3627.6/yr.
- After Data: 7/1/09 to 6/30/11
 - ✓ Total of 7189 crashes
 - ✓ Average of 2875.6/ yr.

❖ **Overall reduction = 20.7%**

		4+'' Snow PRIOR		2-4'' and 4+'' PRIOR		Speed Restriction		4+'' to Speed Restriction Change	2-4'' and 4+'' to Speed Restriction Change	
		Events	Average Crashes	Events	Average Crashes	Events	Average Crashes			
By District	4-0	I-80	7	1.71	21	0.90	5	0.80	-53.33%	-11.58%
		I-81	12	6.75	30	4.63	6	2.67	-60.49%	-42.45%
		I-84	11	2.82	27	1.96	6	1.50	-46.77%	-23.58%
		I-380	7	0.14	26	0.38	3	0.67	366.67%	73.33%
		I-476	9	1.00	27	1.04	2	0.50	-50.00%	-51.79%
	5-0	I-78	8	3.50	15	3.47	8	1.88	-46.43%	-45.91%
		I-80	7	4.57	15	2.73	6	1.83	-59.90%	-32.93%
		I-81	4	4.50	11	3.64	7	0.29	-93.65%	-92.14%
		I-176	5	0	12	0.33	0	0	No Speed Restriction Data	
		I-380	9	0.67	16	0.81	4	0.75	12.50%	-7.69%
	8-0	I-76	5	0.20	12	0.25	0	0	-100.00%	-100.00%
		I-476	8	5.75	16	4.69	2	2.00	-65.22%	-57.33%
I-78		1	1.00	9	0.33	8	0.38	-62.50%	12.50%	
I-81		2	7.50	11	5.27	7	1.86	-75.24%	-64.78%	
I-83		2	7.50	11	3.91	5	1.80	-76.00%	-53.95%	
By Interstate	4-0, 5-0, and 8-0	I-283	1	0	9	0.33	4	0	0.00%	-100.00%
		I-76	3	5.67	11	4.27	0	0	-100.00%	-100.00%
		I-78	9	3.22	24	2.29	16	1.13	-65.99%	-50.91%
		I-80	14	3.14	36	1.67	11	1.36	-66.81%	-18.18%
		I-81	18	6.33	52	4.56	20	1.55	-75.53%	-65.99%
	4-0, 5-0, and 8-0	I-83	2	7.50	11	3.91	5	1.80	-76.00%	-53.95%
		I-84	11	2.82	27	1.96	6	1.50	-46.77%	-23.58%
		I-176	5	0	12	0.33	0	0	No Speed Restriction Data	
		I-283	1	0	9	0.33	5	0	0.00%	-100.00%
		I-380	16	0.44	42	0.55	7	0.71	63.27%	30.43%
ALL	I-76	8	2.25	23	2.17	0	0	-100.00%	-100.00%	
	I-476	17	3.24	43	2.40	4	1.25	-61.36%	-47.82%	
ALL	ALL	101	3.10	279	2.26	74	1.24	-59.88%	-45.03%	

Engineering Study Used for Basis of Restrictions – *45 MPH Speed*

- **Average number of crashes per event compared between the 45 MPH speed restriction scenarios and the “before data” snowfall scenarios**
 - Comparison was done at the Interstate/District combination level, and each interstate as a whole
- **Percentage reductions were calculated**
 - *Fatalities & major injuries in both data sets were few and randomly distributed...Therefore not considered*

❖ **Overall, the reduction in crashes during the 45 MPH speed restriction was:**

- ✓ **59.9% in 4+” of snowfall**
- ✓ **45.0% in 2” to 4” of snowfall**



Engineering Study Used for Basis of Restrictions – *Trucks*

- **Crash data confirmed the following:**

- ❖ The number of crashes increased as the inclement weather increased
- ❖ The number of crashes decreased when the speed limit restriction was implemented
- ❖ The number of crashes decreased slightly more when trucks were restricted
- ❖ Data on Interstates during closures still showed crashes because the restriction may have been reactionary



Engineering Study Used for Basis of Restrictions – *Trucks*

Were Truck restrictions during Winter along Interstates effective in reducing crashes?

- Gathered days that PEMA activated (indicates snow/ice)
- Gathered days where implemented 45 MPH speed
- Gathered days where truck restrictions were implemented
- Determined number of crashes on each Interstate per day throughout year
- Compared this to the number of truck crashes that occurred during PEMA activations
 - *Did not analyze crashes on alternate routes*

Inter-state	Number of Truck Crashes / Day During Winter 2009-10				
	Closure	Truck	45mph	PEMA Activation	Avg. Number
Avg.	12.0	6.67	6.86	10.22	4.57
I-78	2.33	0.67	0.57	0.78	0.37
I-99	0.67	0	0.43	0.44	0.09
I-95	1.00	0	1.00	0.33	0.32
I-81	2.00	1.00	0.71	1.44	0.89
I-80	4.33	3.67	1.57	3.44	1.14

Engineering Study Used for Basis of Restrictions – *Trucks*

- **Crash data confirmed:**

- ✓ Number of crashes increased as the inclement weather increased
- ✓ Number of crashes decreased when the speed limit restriction was implemented
- ✓ Number of crashes decreased slightly more when trucks were restricted
- ✓ Data on Interstates during closures still showed crashes because the restriction may have been reactionary



Guidelines for Restricting Interstate Highways for Major Weather Events

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