Indiana Case study

Unlocking the potential of granular material with older equipment

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LTAP LOCAL TECHNICAL ASSISTANCE PROGRAM

PURDUE UNIVERSITY SCHOOL OF CIVIL ENGINEERING

This Presentation was originally presented at the APWA 2014 North American Snow Conference
Additional presenters and major contributors

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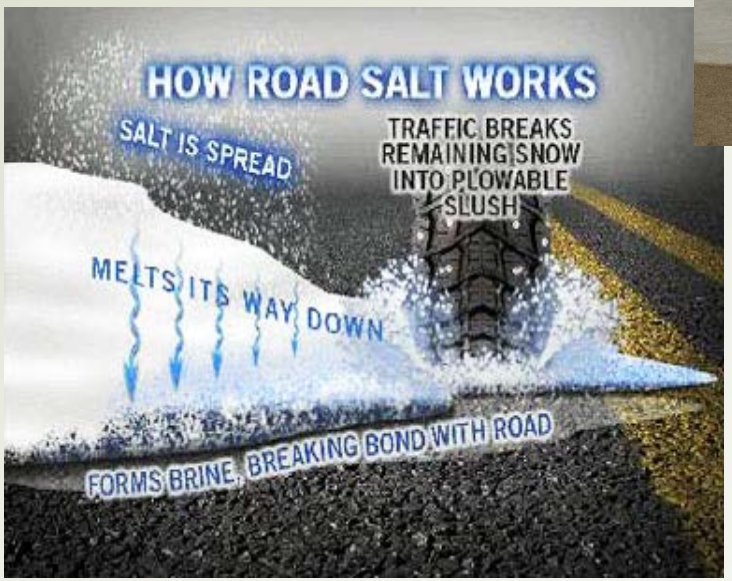
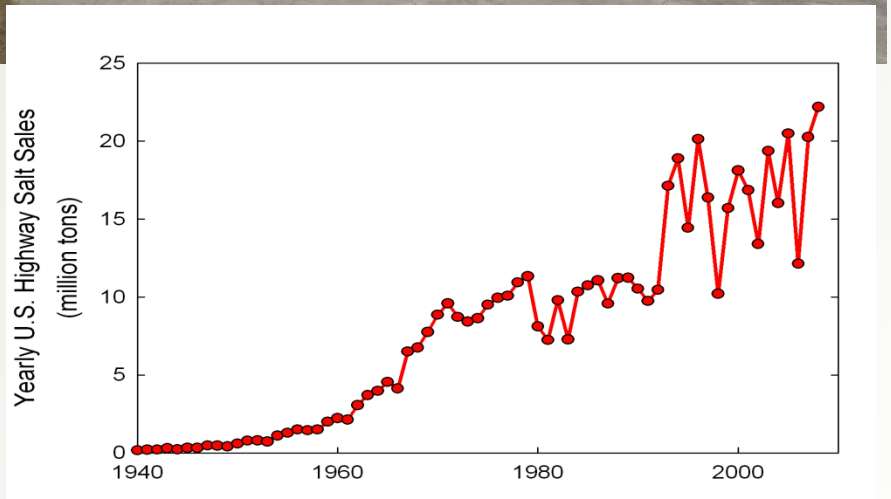
Road Solutions Inc.

Road Salt Management

"Waste Not – Want Not'





Improper Application

- Applying to much salt, beyond ***400lbs per lane mile.***
- Applying untreated salt when pavement temperatures are <10°.
- Did you know the pavement temperature?
- Applying too little salt, melt and refreeze. (salt/sand mix)

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Bounce and scatter

- Traveling too fast when spreading - above 25mph.
- Spinner set too high.
- Curb to curb mentality.
- Drivers need to see the spread pattern in their mirrors at night.

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Equipment Issues

- Salt carrying capacity, spillage.
- Salt does not need to be applied to the entire roadway, sand does.
- Salt should be applied toward the center of the road or top of the crown, traffic and other factors will carry it to the edges.
- Was the spinner assembly designed for sand application not salt?

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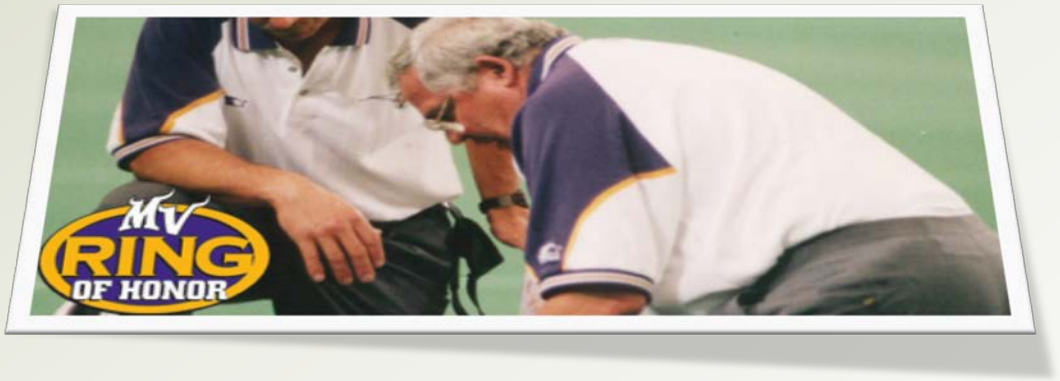
Lessons Learned

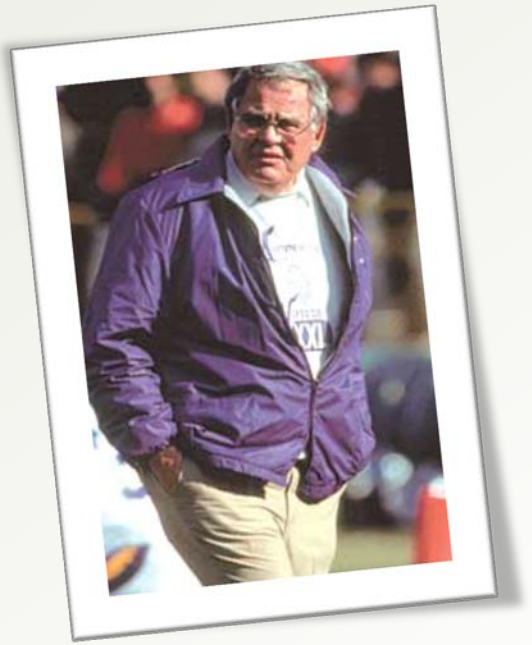
"The definition of insanity is doing the same thing year after year and expecting different results

Fred Zamberletti

Athletic Trainer Minnesota Vikings

(1961 – Present)





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The mission: Use salt to provide SAFE & DEPENDABLE Transportation During Winter

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But Not One Pound More!

Road Salt Management

The Assessment of Current Methods.

- *Inventory and Assessment of all deicing equipment.*
- *Calibration of all deicing equipment.*
- *Identifying proper application rates.*
- *Minimizing the "bounce and scatter" effect.*
- *Accounting of amounts, locations and performance of deicers used.*

The Mix of Fixes.

- *Calibration of all deicing equipment.*
- *Calibration of spreading patterns.*
- *Improving deicing equipment – ground speed controls.*
- *Adding Liquid anti-icing and Pre-wetting to the toolbox*
- *Improved deicing chemicals*
- *Training of management and staff on methods to manage chloride usage.*

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Deicing Equipment

1950's – 1980's

- *Chain driven off the rear wheel.*
- *Dropped material directly behind vehicle.*
- *Material dispensed relative to the speed of the vehicle.*

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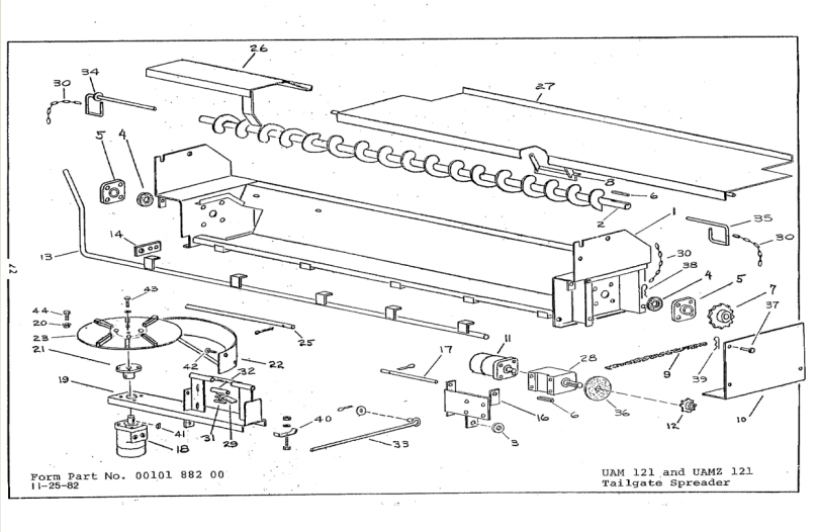
Deicing Equipment

1980's

- ***Advent of hydraulic driven, hydraulic controlled spreader units.***
- ***Allowed operators to dispense more material.***
- ***Speed of truck no longer a factor.***



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Deicing Equipment

1980's – 1990's

- *The hydraulic components used allowed for maximum application rates.*
- *Combined with the introduction of the auger application rates of 6500+ lbs per lane mile can be achieved.*

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Deicing Equipment

Late 1990's - Today

- *Introduction of load sensing hydraulic systems and electronic spreader controls.*
- *Ground speed sensors allowed for consistent application rates.*
- *Can set min / max application rates.*
- *Can store salt usage data.*

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Calibration

Calibration has been around for a very long time, used by the farming industry for it's funnel spreaders to determine fertilizer rates.

Requires no special tools.

- *Bucket or tarp.*
- *Bathroom scale.*
- *Masking tape.*
- *Tape Measure.*
- *Calculator*
- *Salt calibration chart*

(LTAP & Salt Institute)

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Calibration

There are several benefits to performing annual salt spreader calibration.

- ***Financial benefit of reduced salt usage, accurate budgeting and ordering.***
- ***Allows for older units with high salt usage to be identified and either repaired or replaced.***
- ***Can be used as a performance measure for truck hydraulic systems and electronic controls.***
- ***Measurement of chlorides used within an area or snow route.***
- ***Provides a baseline for determining cost of service and level of service.***

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Calibration Of Newer Equipment

Calibration should be performed annually on both tailgate and v-box type spreaders.

Calibration should be performed annually on all open loop or closed loop electronically controlled systems to set valve NO/NC positions.
(This may have to be performed when vehicle encounters power failure or CPU is reset).

Smaller pick-up size electronic powered units should be annually calibrated and can be set by adding a resistor or potentiometer to power circuit.

Liquid deicer applicators should also be calibrated according to mfg instructions.

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Calibration Chart

Agency: **The Perfect Truck in a Perfect World (3:1 Salt and Sand)**

Location:

Truck Number: 00

Spreader Number:

Date:

By:

Hopper Gate Opening (Inches): 2

				Pounds Discharged Per Mile								
	A	B	C	Minutes to Travel One Mile								
Control Setting	Shaft RPM (Loaded)	Discharge Per Revolution (Pounds)*	Discharge Rate (lb/min)	5 mph x 12.00	10 mph x 6.00	15 mph x 4.00	20 mph x 3.00	25 mph x 2.40	30 mph x 2.00	35 mph x 1.71	40 mph x 1.50	45 mph x 1.33
1	1	58	58	696	348	232	174	139	116	99	87	77
2	3	58	174	2088	1044	696	522	418	348	298	261	231
3	5	58	261	3132	1566	1044	783	626	522	446	392	347
4	6	58	319	3828	1914	1276	957	766	638	545	479	424
5	6	58	348	4176	2088	1392	1044	835	696	595	522	463
6	7	58	406	4872	2436	1624	1218	974	812	694	609	540
7	8	58	464	5568	2784	1856	1392	1114	928	793	696	617
8	9	58	522	6264	3132	2088	1566	1253	1044	893	783	694
9	10	58	551	6612	3306	2204	1653	1322	1102	942	827	733
10	11	58	609	7308	3654	2436	1827	1462	1218	1041	914	810

** This weight remains constant*

3:1 Salt to Sand Ratio

1200lbs per lane mile application rate

Calibration Chart

Agency: **The Real Truck in the Real World (3:1 Salt and Sand) Tippecanoe County Indiana**

Location:

Truck Number: 33

Spreader Number:

Date:

By:

Hopper Gate Opening (Inches): 1.5

				Pounds Discharged Per Mile								
	A	B	C	Minutes to Travel One Mile								
Control Setting	Shaft RPM (Loaded)	Discharge Per Revolution (Pounds)*	Discharge Rate (lb/min)	5 mph x 12.00	10 mph x 6.00	15 mph x 4.00	20 mph x 3.00	25 mph x 2.40	30 mph x 2.00	35 mph x 1.71	40 mph x 1.50	45 mph x 1.33
1	11	18	189	2268	1134	756	567	454	378	323	284	251
2	12	18	216	2592	1296	864	648	518	432	369	324	287
3	14	18	243	2916	1458	972	729	583	486	416	365	323
4	14	18	252	3024	1512	1008	756	605	504	431	378	335
5	15	18	270	3240	1620	1080	810	648	540	462	405	359
6	16	18	279	3348	1674	1116	837	670	558	477	419	371
7	16	18	288	3456	1728	1152	864	691	576	492	432	383
8	16	18	288	3456	1728	1152	864	691	576	492	432	383
9	17	18	297	3564	1782	1188	891	713	594	508	446	395
10	17	18	306	3672	1836	1224	918	734	612	523	459	407

** This weight remains constant*

3:1 Salt to Sand Ratio

1200lbs per lane mile application rate

Calibration Chart

Agency: Tippecanoe County

Location:

Truck Number: 17

Spreader Number:

Date:

By:

Hopper Gate Opening (Inches):

				Pounds Discharged Per Mile								
	A	B	C	Minutes to Travel One Mile								
Control Setting	Shaft RPM (Loaded)	Discharge Per Revolution (Pounds)*	Discharge Rate (lb/min)	5 mph x 12.00	10 mph x 6.00	15 mph x 4.00	20 mph x 3.00	25 mph x 2.40	30 mph x 2.00	35 mph x 1.71	40 mph x 1.50	45 mph x 1.33
1	3	19	57	684	342	228	171	137	114	97	86	76
2	17	19	323	3876	1938	1292	969	775	646	552	485	430
3	44	19	836	10032	5016	3344	2508	2006	1672	1430	1254	1112
4	73	19	1387	16644	8322	5548	4161	3329	2774	2372	2081	1845
5	98	19	1862	22344	11172	7448	5586	4469	3724	3184	2793	2476
6			0	0	0	0	0	0	0	0	0	0
7			0	0	0	0	0	0	0	0	0	0
8			0	0	0	0	0	0	0	0	0	0
9			0	0	0	0	0	0	0	0	0	0
10			0	0	0	0	0	0	0	0	0	0

** This weight remains constant*

Application Rates

How Much is Enough

(300# - 400# per lane mile for straight salt is a good starting point).

Application Rates

- *These will vary depending on the temperature and volume of precipitation.*
- *Type of pavements.*
- *Truck Speed*

Level of Service:

- *Traffic volumes and peak traffic times should be considered.*
- *Intersections, curves, subdivisions will have varying rates.*
- *Urban roads vs. Rural road.*

Severity of Winter:

Northern Indiana can expect more freeze / thaw cycles and can have a higher average snowfall total.

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Deicing Application Rate Guidelines

24' of pavement (typcial two-lane road)

These rates are not fixed values, but rather the middle of a range to be selected and adjusted by an agency according to its local conditions and experience.

			Pounds per two-lane mile			
Pavement Temp. (°F) and Trend (↑↓)	Weather Condition	Maintenance Actions	Salt Prewetted / Pretreated with Salt Brine	Salt Prewetted / Pretreated with Other Blends	Dry Salt*	Winter Sand (abrasives)
> 30° ↑	Snow	Plow, treat intersections only	80	70	100*	Not recommended
	Freezing Rain	Apply Chemical	80 - 160	70 - 140	100 - 200*	Not recommended
30° ↓	Snow	Plow and apply chemical	80 - 160	70 - 140	100 - 200*	Not recommended
	Freezing Rain	Apply Chemical	150 - 200	130 - 180	180 - 240*	Not recommended
25° - 30° ↑	Snow	Plow and apply chemical	120 - 160	100 - 140	150 - 200*	Not recommended
	Freezing Rain	Apply Chemical	150 - 200	130 - 180	180 - 240*	Not recommended
25° - 30° ↓	Snow	Plow and apply chemical	120 - 160	100 - 140	150 - 200*	Not recommended
	Freezing Rain	Apply Chemical	160 - 240	140 - 210	200 - 300*	400
20° - 25° ↑	Snow or Freezing Rain	Plow and apply chemical	160 - 240	140 - 210	200 - 300*	400
20° - 25° ↓	Snow	Plow and apply chemical	200 - 280	175 - 250	250 - 350*	Not recommended
	Freezing Rain	Apply Chemical	240 - 320	210 - 280	300 - 400*	400
15° - 20° ↑	Snow	Plow and apply chemical	200 - 280	175 - 250	250 - 350*	Not recommended
	Freezing Rain	Apply Chemical	240 - 320	210 - 280	300 - 400*	400
15° - 20° ↓	Snow or Freezing Rain	Plow and apply chemical	240 - 320	210 - 280	300 - 400*	500 for freezing rain
0° - 15° ↑↓	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	300 - 400	Not recommended	500 - 750 spot treatment as needed
< 0°	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	400 - 600**	Not recommended	500 - 750 spot treatment as needed

* Dry salt is not recommended. It is likely to blow off the road before it melts ice.

** A blend of 6 - 8 gal/ton $MgCl_2$ or $CaCl_2$ added to NaCl can melt ice as low as -10°.

Spinner Calibration

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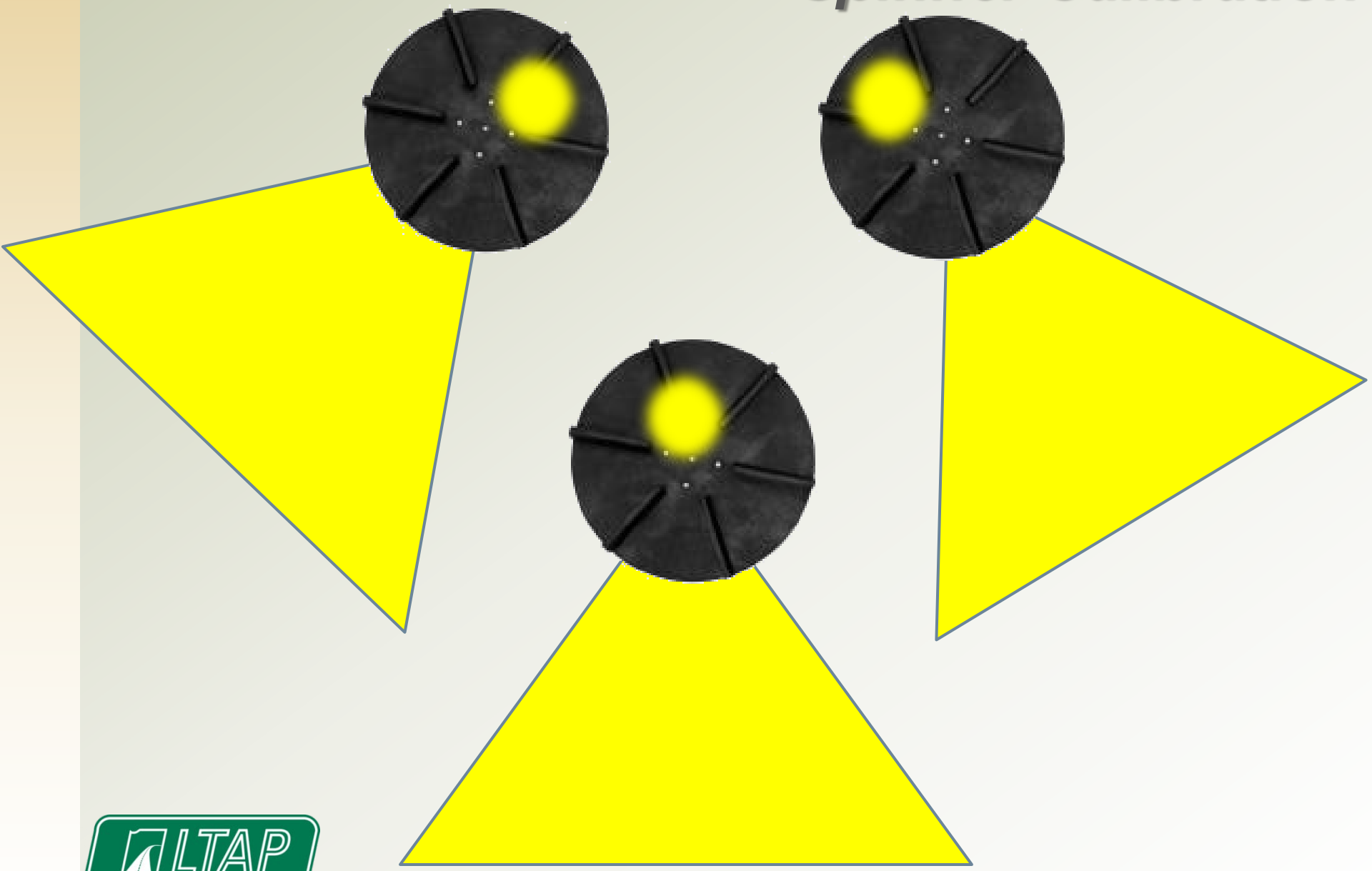
Spinner Calibration



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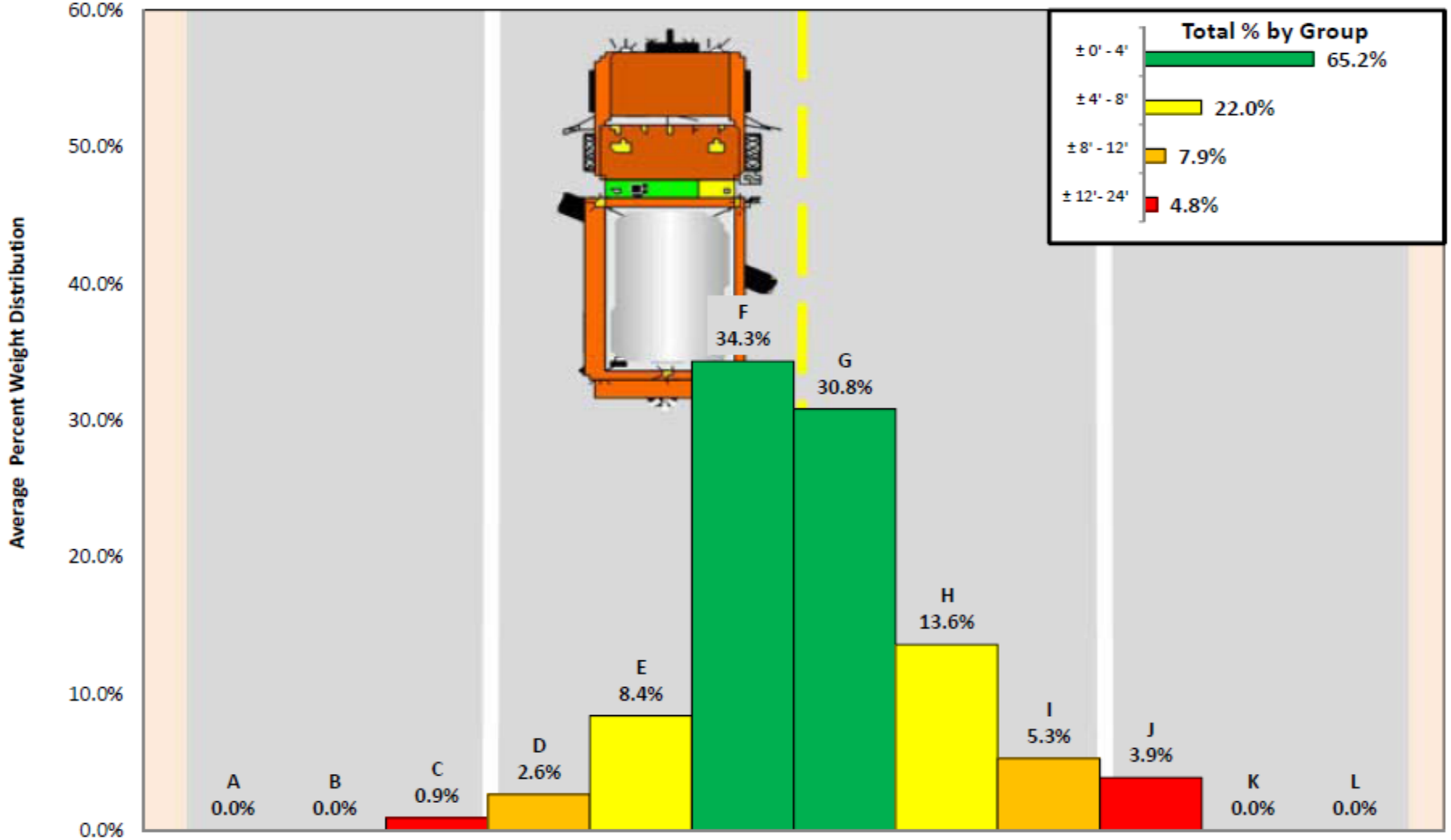
Bounce and Scatter Collection Graphs



Untreated, 25 mph, Conveyor

Average Salt Displacement

A B C D E F G H I J K L

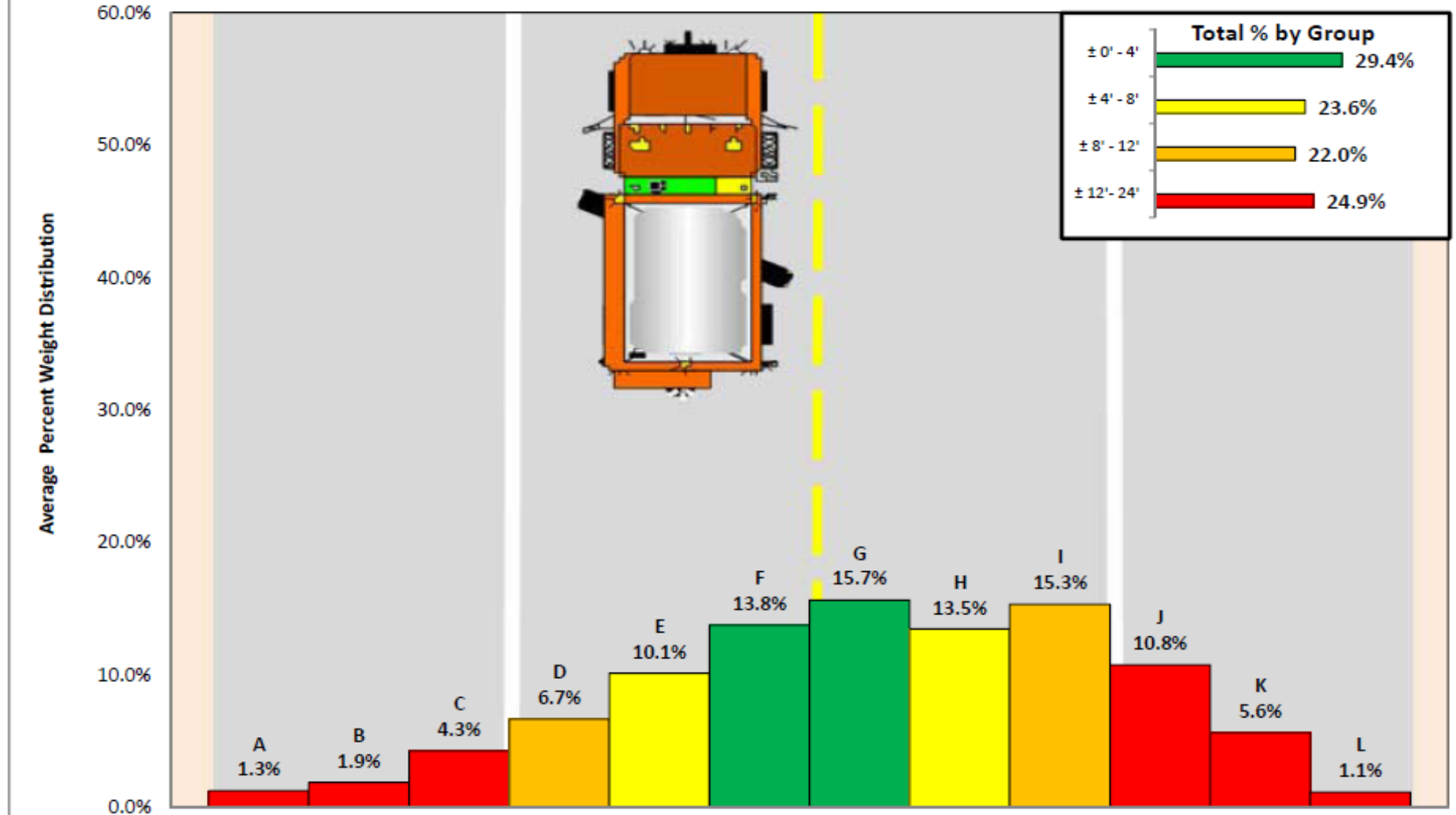
Note: Each letter represents a 4' width by 100' length portion of the collection grid.

MDOT Michigan Department of Transportation

Operations Field Services Division

Southwest Region
June 2012

Bounce and Scatter Collection Graphs



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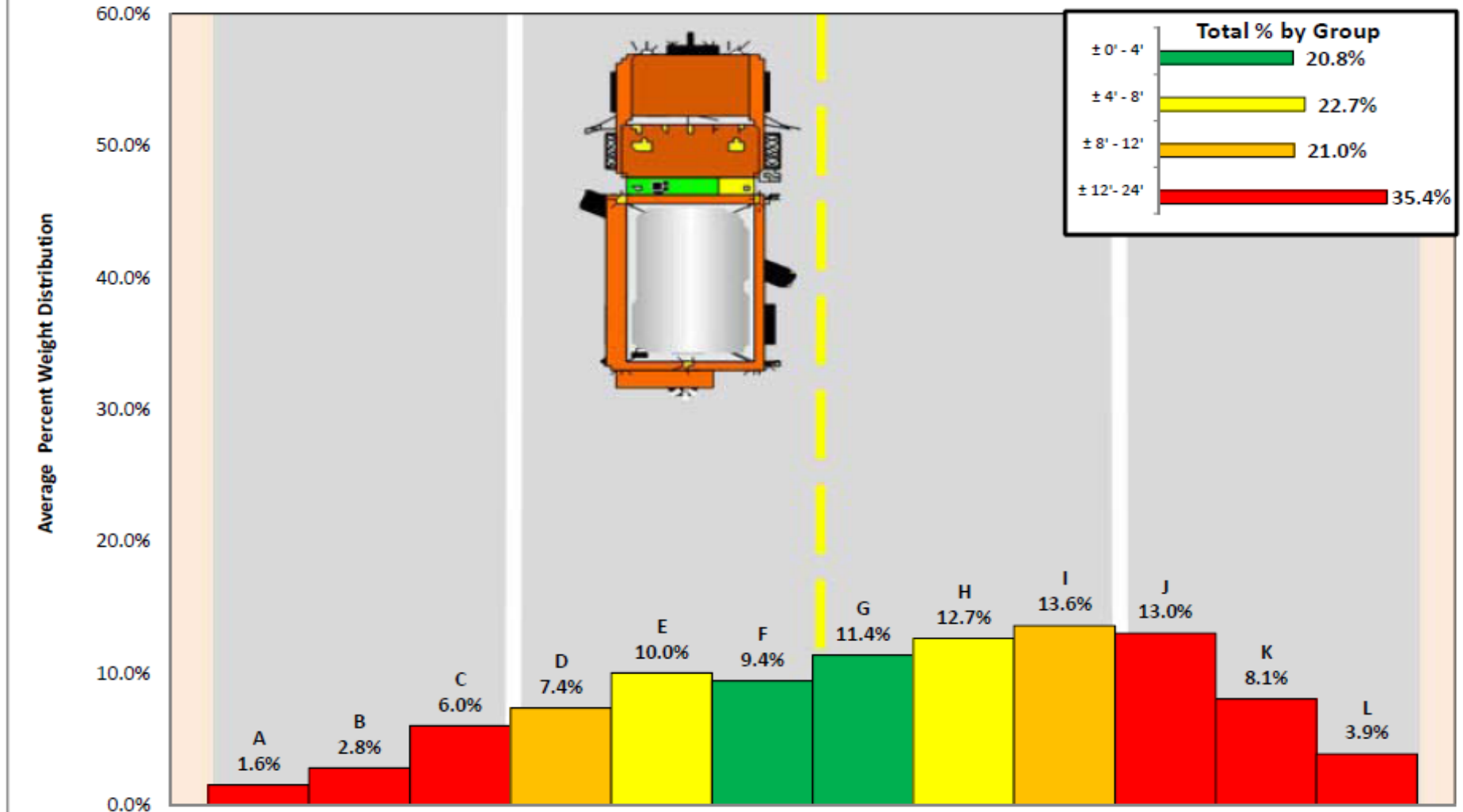
Bounce and Scatter Collection Graphs



Untreated, 45 mph, Conveyor

Average Salt Displacement

A B C D E F G H I J K L

Note: Each letter represents a 4' width by 100' length portion of the collection grid.

MDOT Michigan Department of Transportation

Operations Field Services Division

Southwest Region
June 2012

Case Study - Tippecanoe County

Project Goals:

- ***To reduce or eliminate sand from the mix of deicers.***
- ***To reduce winter weather related crashes.***
- ***To identify and implement cost saving measures related to materials, personnel and equipment.***

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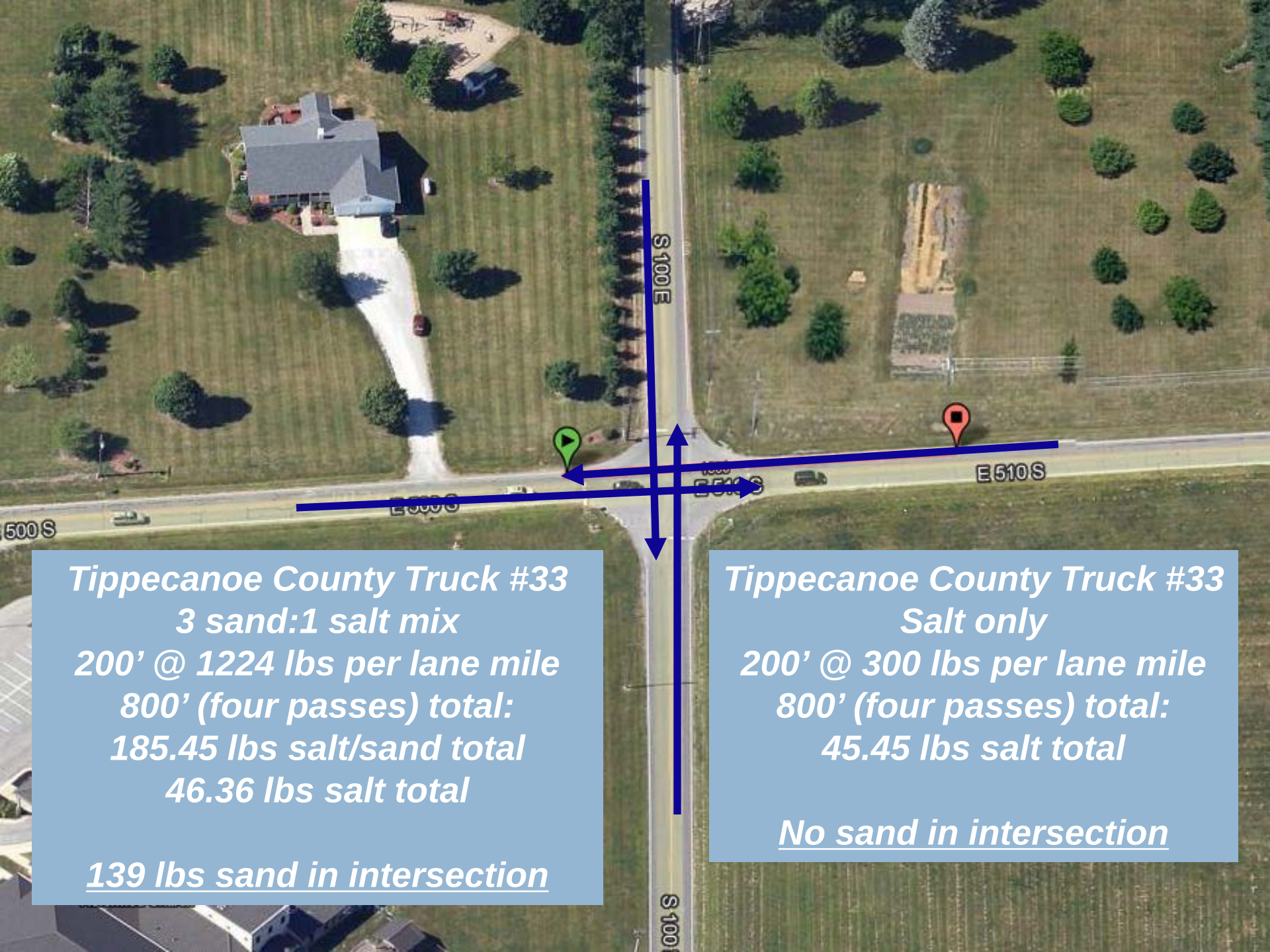
Case Study - Tippecanoe County

Mix of Fixes:

- ✓Calibration of all plow equipment.
  Mechanical Staff
- ✓Training of drivers and maintenance staff.
  LTAP
- ✓Training of administrative staff.
  APWA
- ✓Implement good accounting practices to measure results.
  Office Staff
- ✓Meet with vendors and winter materials suppliers for
  - Salt
  - Sand
  - Beet juice

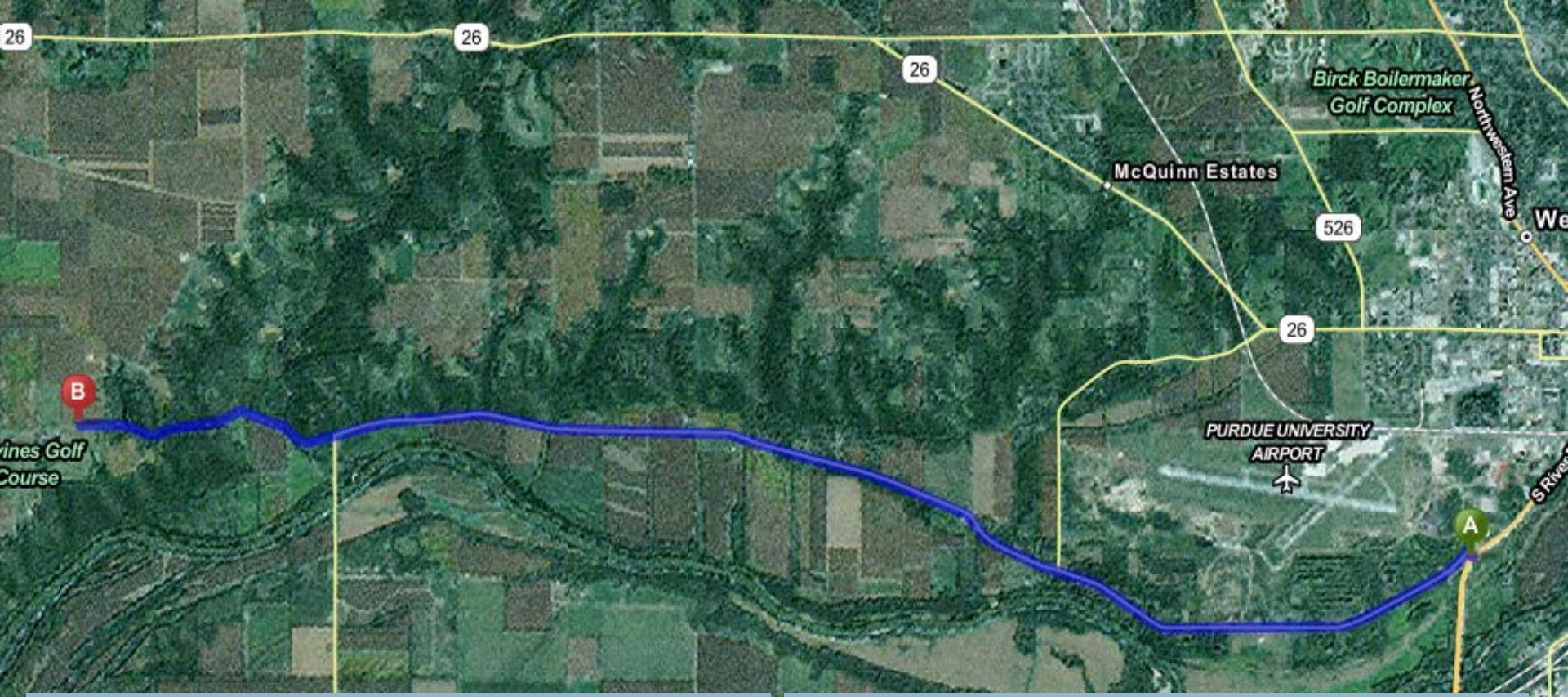


Tippecanoe County Truck #33
3 sand:1 salt mix
200’ @ 1224 lbs per lane mile
800’ (four passes) total:
185.45 lbs salt/sand total
46.36 lbs salt total

<u>139 lbs sand in intersection</u>

Tippecanoe County Truck #33
Salt only
200’ @ 300 lbs per lane mile
800’ (four passes) total:
45.45 lbs salt total

<u>No sand in intersection</u>



Tippecanoe County Truck #33
3 Sand: 1 Salt Mix
8 miles @ 1224 lbs per lane mile
= 9,792 lbs salt/sand mix per lane
= 19,584 lbs salt/sand total
= 6,528 lbs salt total

<u>The single axle truck is empty!</u>

Tippecanoe County Truck #33
Salt Only Mix
8 miles @ 300 lbs per lane mile
= 2,400 lbs salt per lane mile
= 4,800 lbs salt total

<u>The single axle truck is 3/4 full!</u>

Environmental Impact

- *Reduction or elimination of sand or slag on roadway or drainage structures.*
- *Calibration and accurate recordkeeping can identified faulty equipment and chloride "hot spots".*
- *Plan to add newer equipment and methods that will provide more accurate management of chloride usage.*
- *Reduced volume of spring sweepings for transport and disposal.*
- *Fewer Fines reduces sweeping dust.*

	Ice Sand (Tons)
2009	9,865.26
2010	7,388.00
2011	5,850.65
2012	1,801.48
2013	916.45

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Financial Impact

- *Reduced or eliminated cost of sand/slag.*
- *Trucks stay on route longer, more productive.*
- *Reduce sweeping cost.*
- *Fuel savings.*
- *Equipment Wear.*
- *Identified wasteful equipment.*
- *Accurate accounting of chloride usage by route, area or township.*

Ice Sand Cost	
2009	$59,192
2010	$44,328
2011	$35,104
2012	$10,809
2013	$5,499

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Financial Impact

	Ice Control Sand (tons)
2009	9,865.26
2010	7,388.00
2011	5,850.65
2012	1,801.48
2013	916.45

	Salt Totals (Tons)
2009	2,009.61
2010	1,897.27
2011	1,439.71
2012	2,003.49
2013	

	Total Winter OT Hours (Dec – Mar)
2009	4,131.10
2010	4,321.34
2011	2,830.70
2012	1,820.75
2013	896.25
	14,000.14

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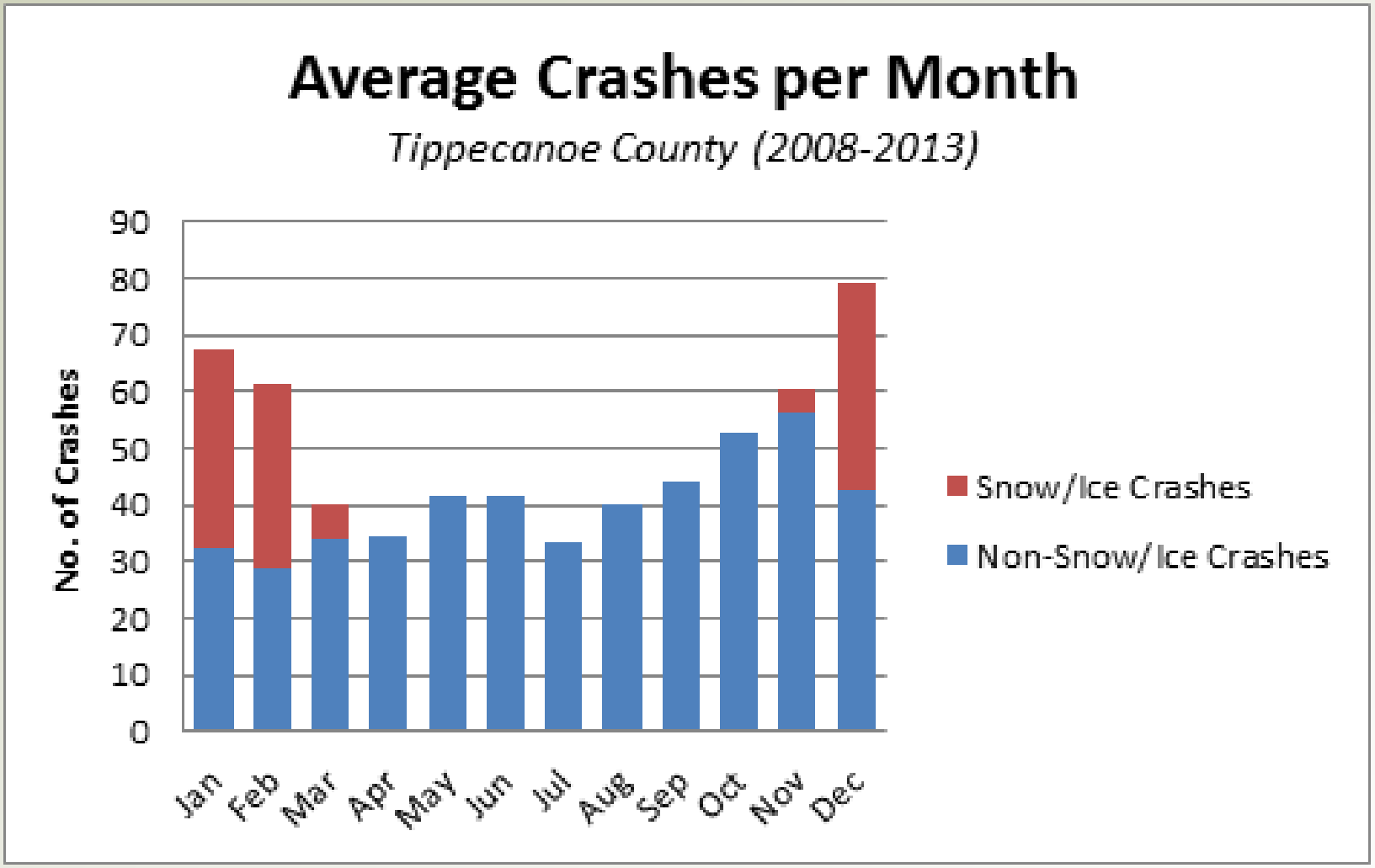
Level of Service (L.O.S.)



631 snow/ice crashes (from 1/1/08-5/31/13), which account for 20% of the total crashes in Tippecanoe County.

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Level of Service (L.O.S.)

- *Not spreading less salt – just less waste*
- *Roads are treated quicker.*
- *Routes have a better response time.*
- *Less bonding of ice to pavement.*
- *In most cases, more chloride per application.*
- *Curves, intersections and hills are serviced faster, and are clearer longer.*
- *Less bonding in subs, able to reach bare pavement quicker.*
- *Less damage to equipment.*
- *Fewer breakdowns.*

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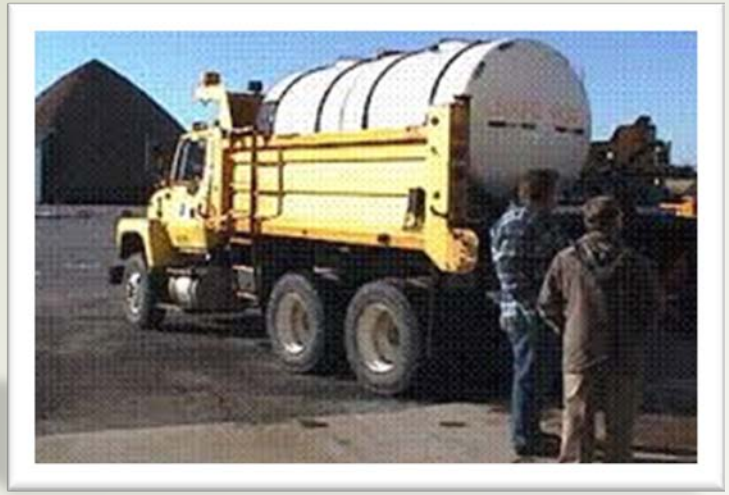
Telling Our Story

Development Timeline

- **Spring 2010** Agency trip to APWA North American Snow Conference Omaha, NE
- **Fall 2010** Began Ice Bite™ pile treatment trial program with 1500 tons (3:1 sand/salt)
- **Fall 2010** Began annual calibration training for crew with LTAP and Road Solutions
- **2011-2014** Continued training and expanded pile treatment to entire salt/sand mix inventory of 3:1 sand/salt
- **Fall 2013** Add brine production and distribution
- **2013-2014** Ice Bite S™ blend anti icing trail period

Development Timeline

- **2015 and beyond**
  - Modify equipment to eliminate sand – performance of deicing chemicals improves
  - Further expand anti icing program
  - Further develop deicing/anti-icing materials



Telling Our Story

Conclusions

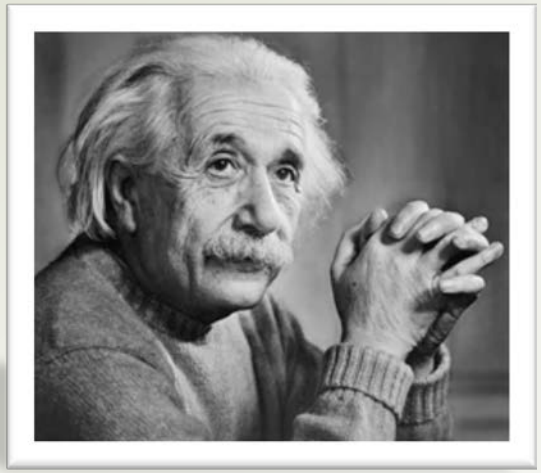
- *Older equipment is holding back gains in salt efficiency.*
- *Calibration of salt spreading equipment is a low cost, easy to use solution.*
- *Spinner calibration and adjustment will reduce loss of material to “bounce and scatter” and reduce waste.*
- *Adding a liquid anti-icing and pre-wetting component to your program is important.*
- *We are NOT reducing salt – We ARE reducing waste!*

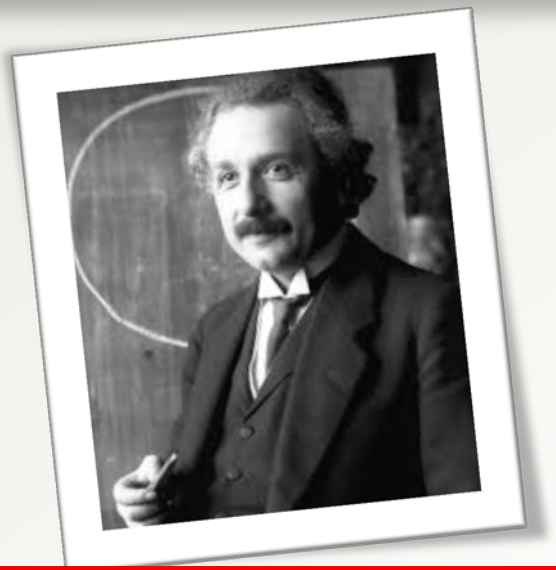
Lessons Learned

Wise old saying:

A person who never made a mistake never tried anything new

Albert Einstein





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- MDOT Salt Bounce and Scatter Study. Nov 2012
- Old Farmer’s Almanac 2015
- APWA North American Snow Conference

Questions ?