

SDDOT/SDLTAP Gravel Road Experimental Project Update

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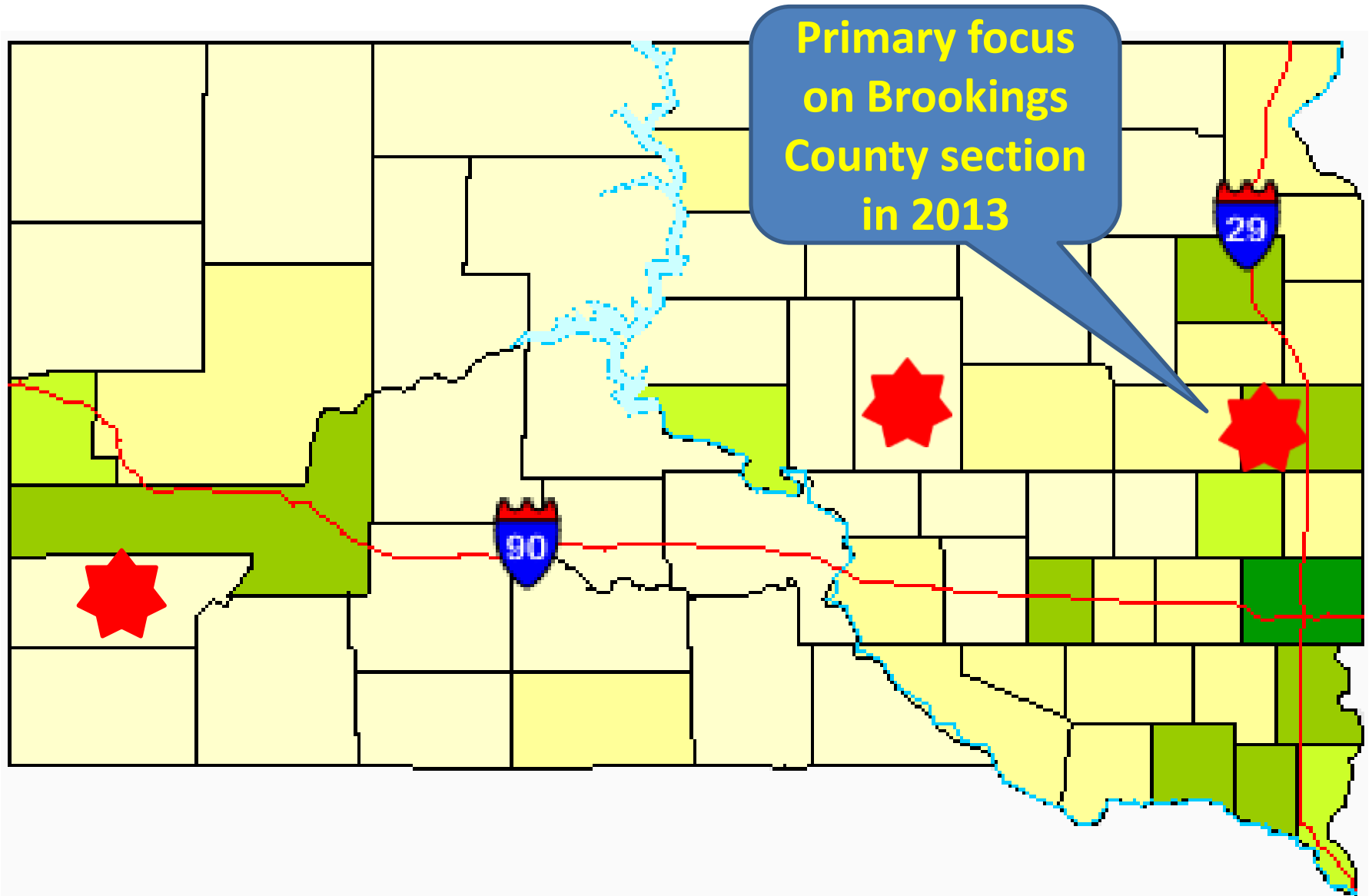
Reason for Project

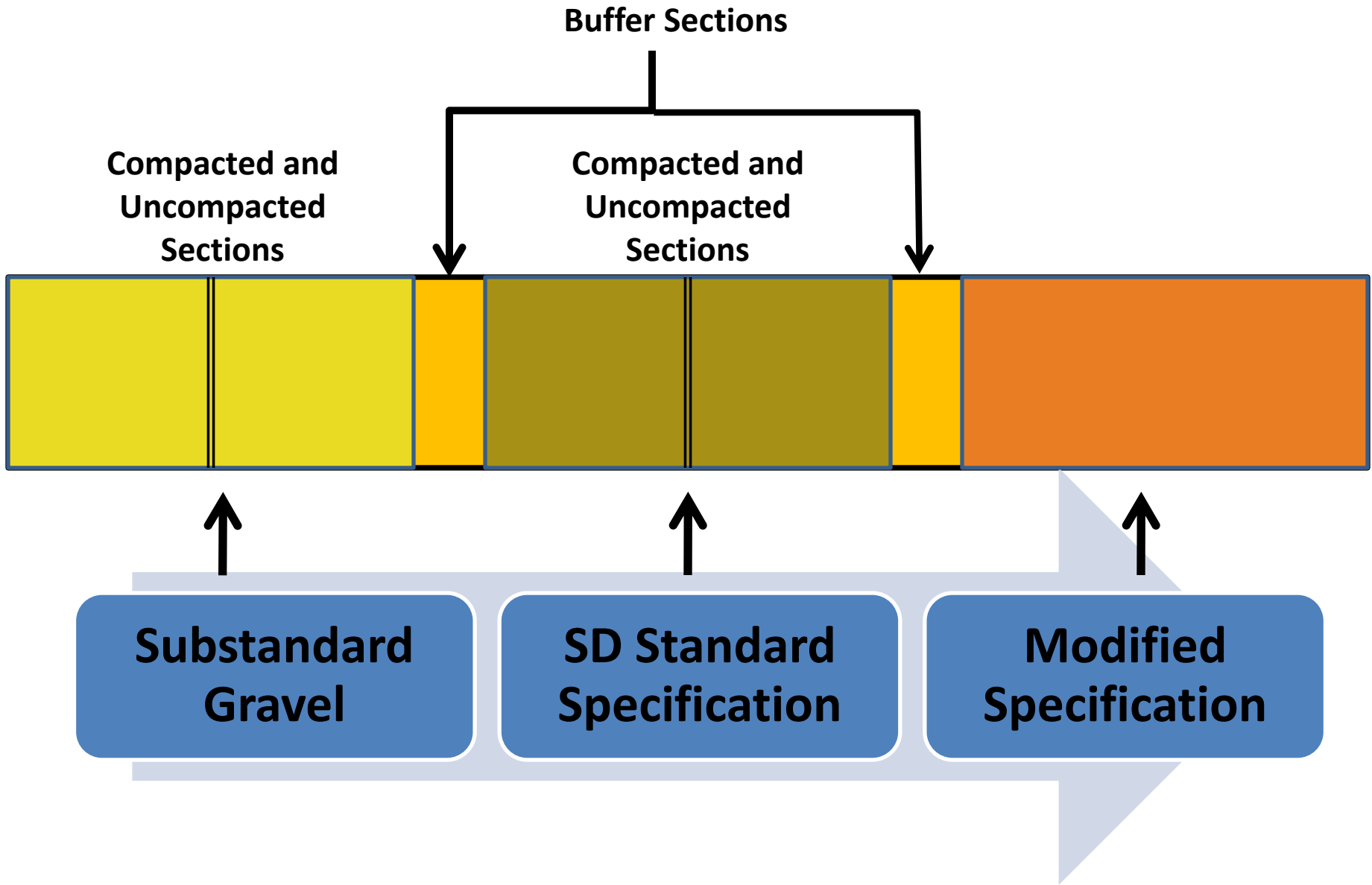
- **More than 75% of local roads in SD are unpaved – managing them is a challenge!**
- **Biggest complaints from public are: rough condition (generally from corrugation or “washboard” in surface) and too much loose aggregate on the surface makes it hard to control a vehicle.**
- **How critical is gravel quality to this and how does it affect total cost of maintenance?**

Focus of Test Project

- **Primary focus is on effect of gravel quality on life-cycle cost of gravel road maintenance**
- **Three types of gravel used in study:**
 1. **Substandard but commonly used – meets no spec except top size control – one inch minus.**
 2. **Barely meets SDDOT Gravel Surfacing Spec – percent passing #200 sieve is low and/or plasticity index (PI) at bottom of range at 4**
 3. **Modified SDDOT Spec – higher minimums of 10% passing #200 sieve and PI at 7.**

Three test sections were built:





Each section was built with three to four inches of new gravel after existing surface was prepared and shaped. Compaction/non compaction comparison as well.



One of the biggest challenges was finding gravel that meets the modified SDDOT Specification: “Shall have minimum plasticity index (PI) of seven”. (Even higher minimum was considered in project planning)

One way to meet modified spec – blend different material from separate sources



This was done on one section in Brookings Co and one section in Custer Co



Is this the future? More blending or “manufacturing” to get high quality gravel – processing from a natural clay source here:



Road mixing natural clay to get a high quality surface gravel





Please
note this
area

Some sections showed contrast in performance quickly due to gravel quality

Custer County Test Sections



Brookings County Test Sections



Substandard Section

Only one month after construction



Modified Section



Substandard gravel loosens in 31 days. Loose aggregate (or float) is 1 ¼ to 1 ½ inches between the wheel paths.

Modified material has only 1/4 to 3/8 inch of loose aggregate (float) between the wheel paths in the same 31 days.



Current Status of Project

- **SDLTAP has accumulated photo documentation on all sections over the past two years.**
- **Measurement and documentation has been done on these distress types in 2012 & 2013:**
 1. **Accumulation of loose aggregate (float)**
 2. **Changes in top width from time of construction**
 3. **Presence of corrugation (washboard) on surface**
 4. **Change in roadway crown**

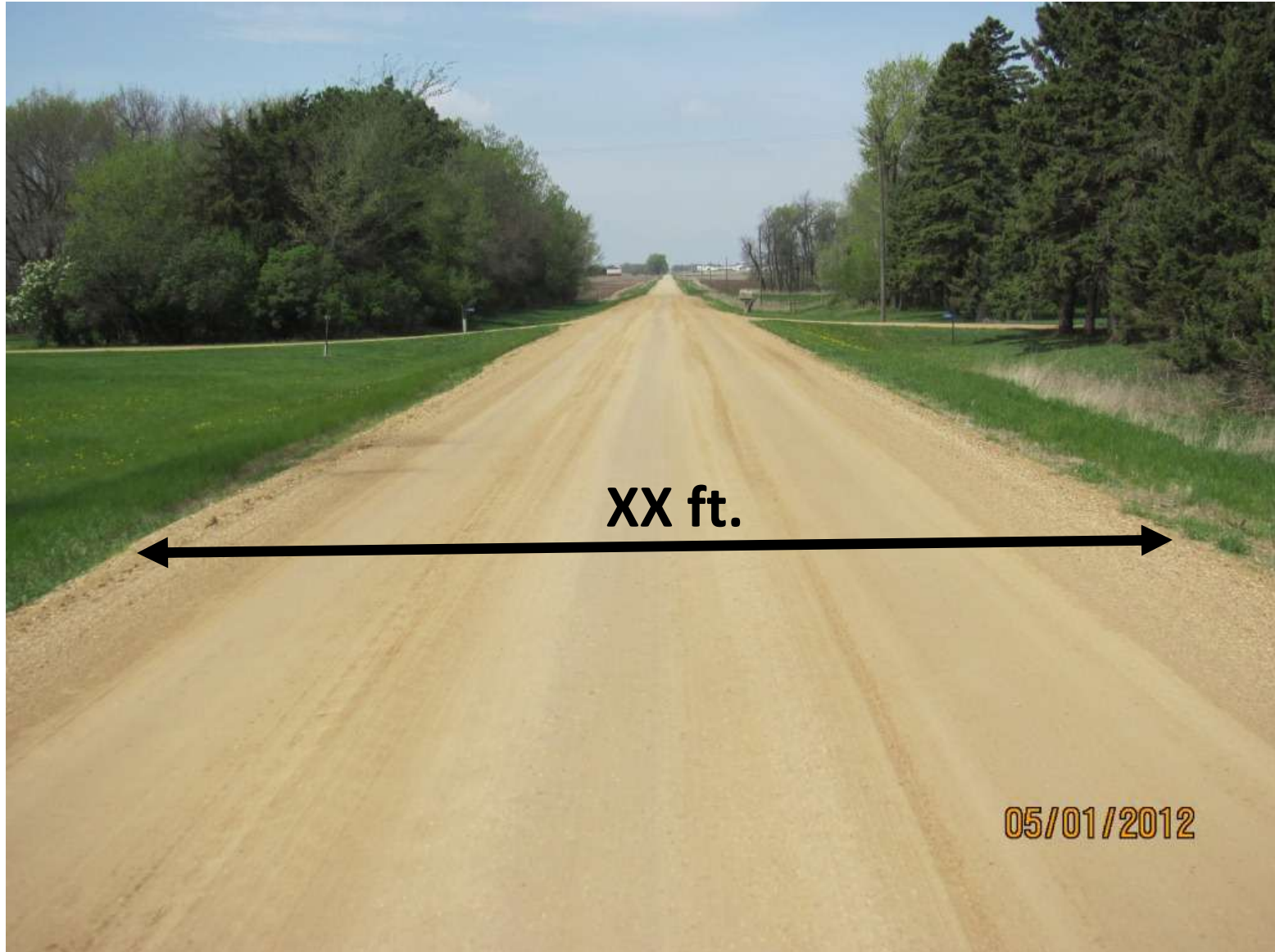
The float test (loose aggregate)



Simply remove loose aggregate from a 10 inch cross section, weigh it and convert that to a one-mile section



Change in top-width is measured on traveled way – hinge point to hinge point





Corrugation (washboard):
Hard to quantify in extent,
fairly easy to measure severity



Crown:
measured with a
laser level

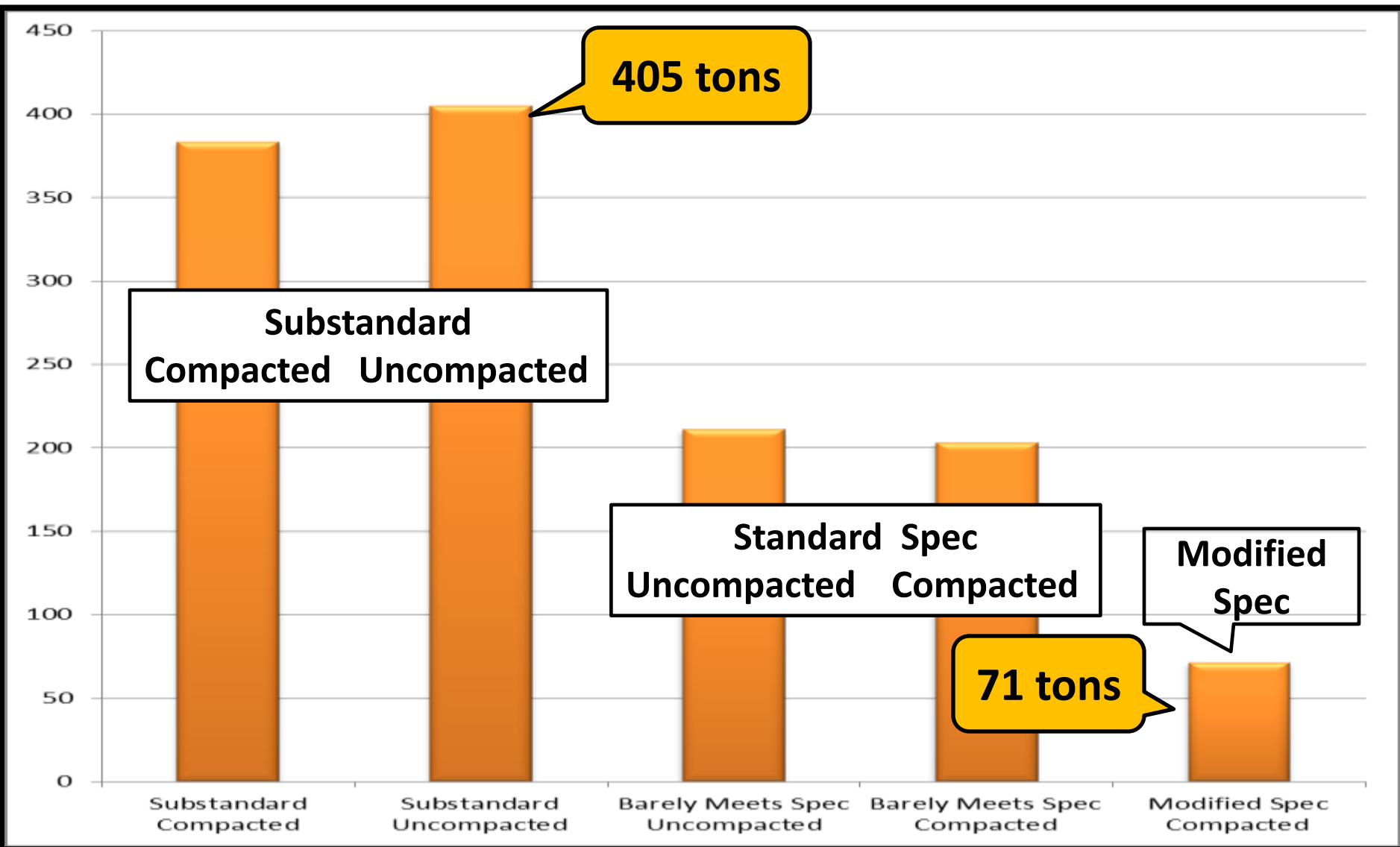


Difference in 2012 & 2013 maintenance seasons:

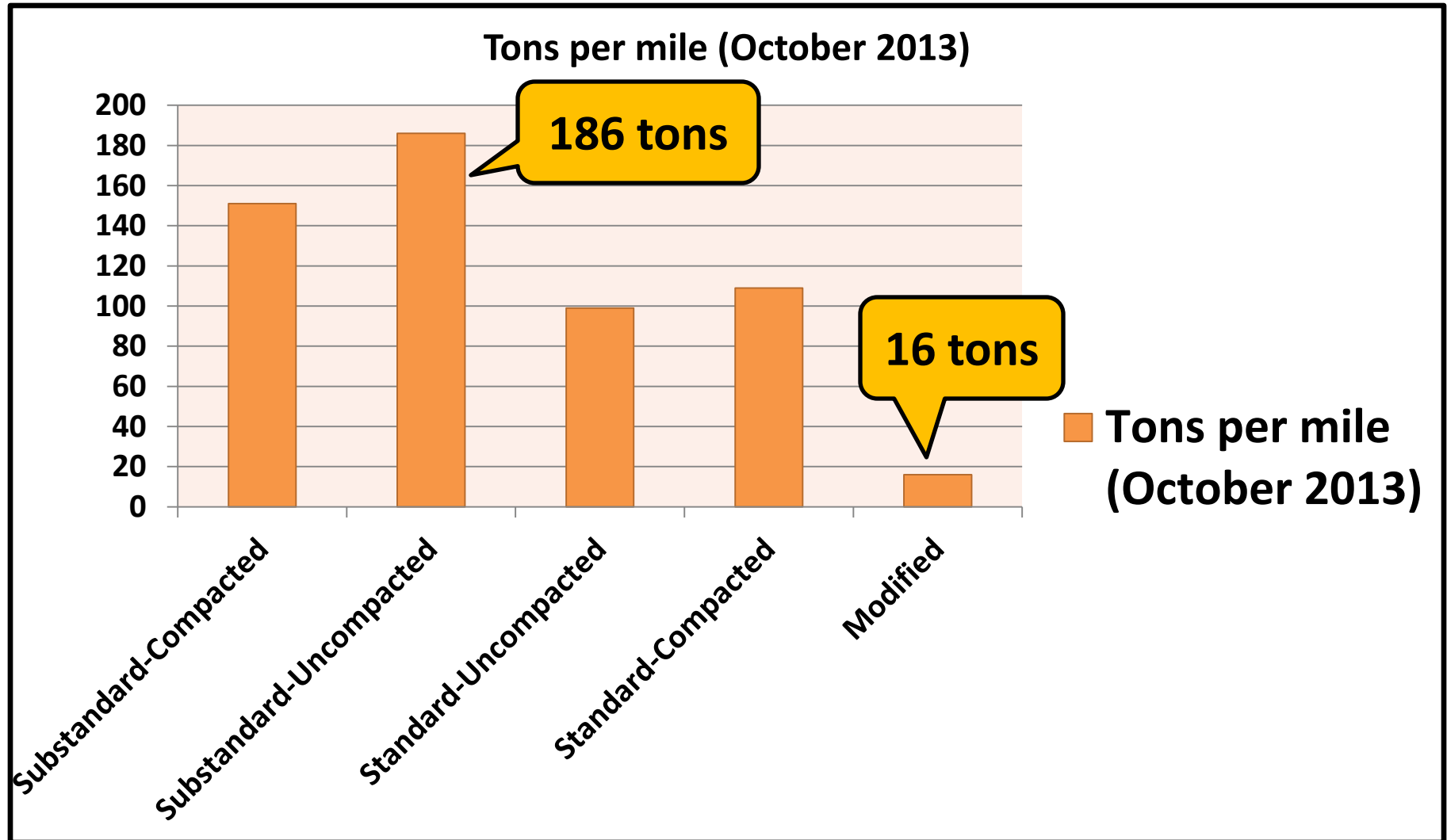
Station		SD-BK-1
Date	Precip	
10/01/2013		
10/02/2013		
10/03/2013		
10/04/2013		
10/05/2013		
10/06/2013		
10/07/2013		
10/08/2013		
10/09/2013		
10/10/2013		
10/11/2013		
10/12/2013	1	
10/13/2013	0	
10/14/2013	1	
10/15/2013		
10/16/2013		
10/17/2013		
10/18/2013	47 *	
10/19/2013	03	
10/20/2013	--	
Totals :	2.94	

Cooler, wetter season in 2013 – 2.94 inches of rain in previous 20 days – most of that in three days prior to the last test.

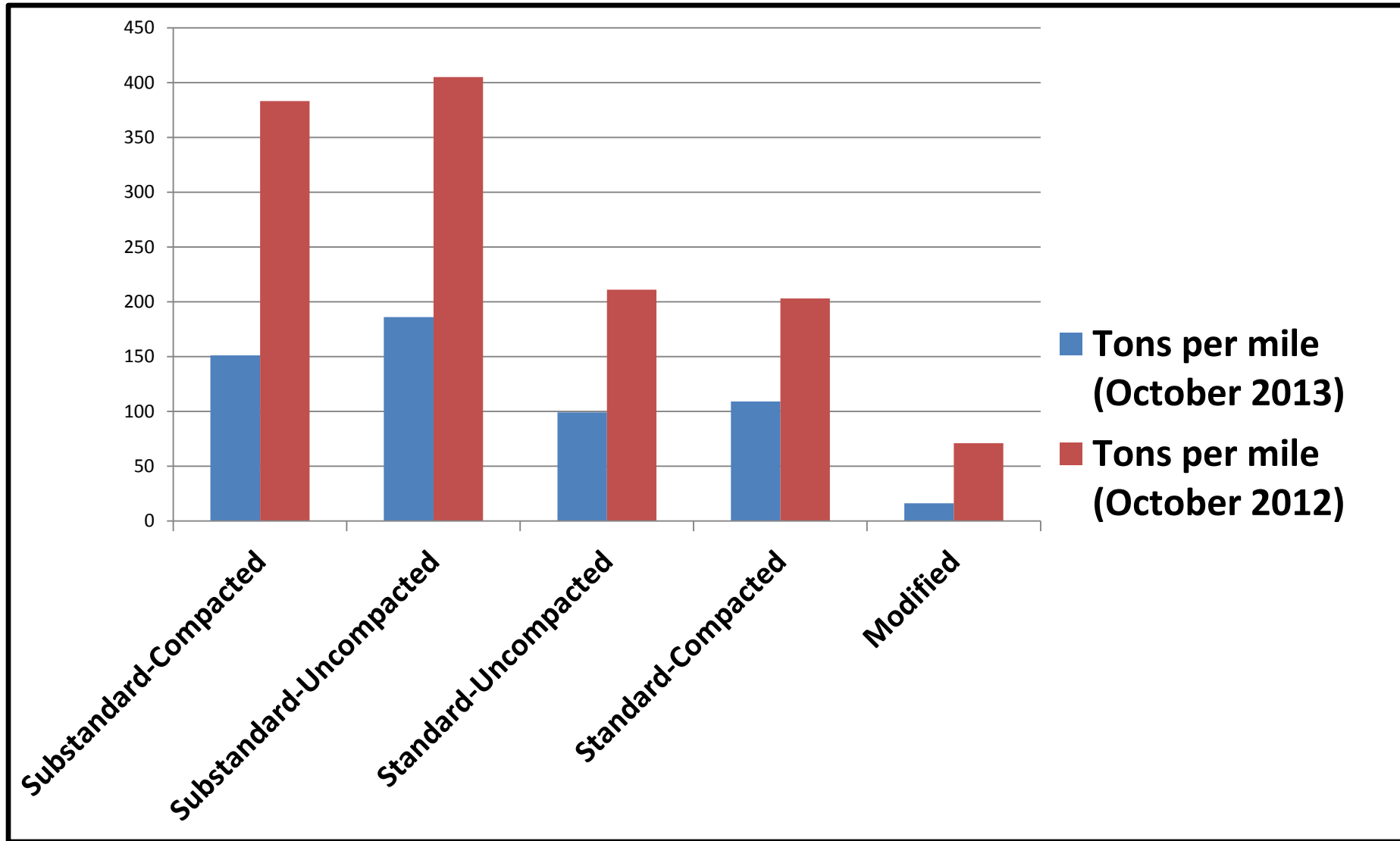
Brookings Section – Loose Aggregate 2012



Brooking Section – Loose aggregate 2013



Loose aggregate comparison 2012 & 2013



Corrugation (Washboard)

- **No corrugation observed on any sections meeting at least minimum standard specification.**
- **However, substandard section had corrugation the beginning of light corrugation only two days after blade maintenance after nearly three inches of rain.**

Change in Roadway Width

Constructed Width – 21.5 ft on all sections



Constructed Width

Current Width – Oct 2013

Constructed Width

Current Width – Oct 2013

Constructed Width

Current Width – Oct 2013

Current width ranges from 22 ft on modified section (top bar) to 25.25 ft on substandard section (bottom bar)

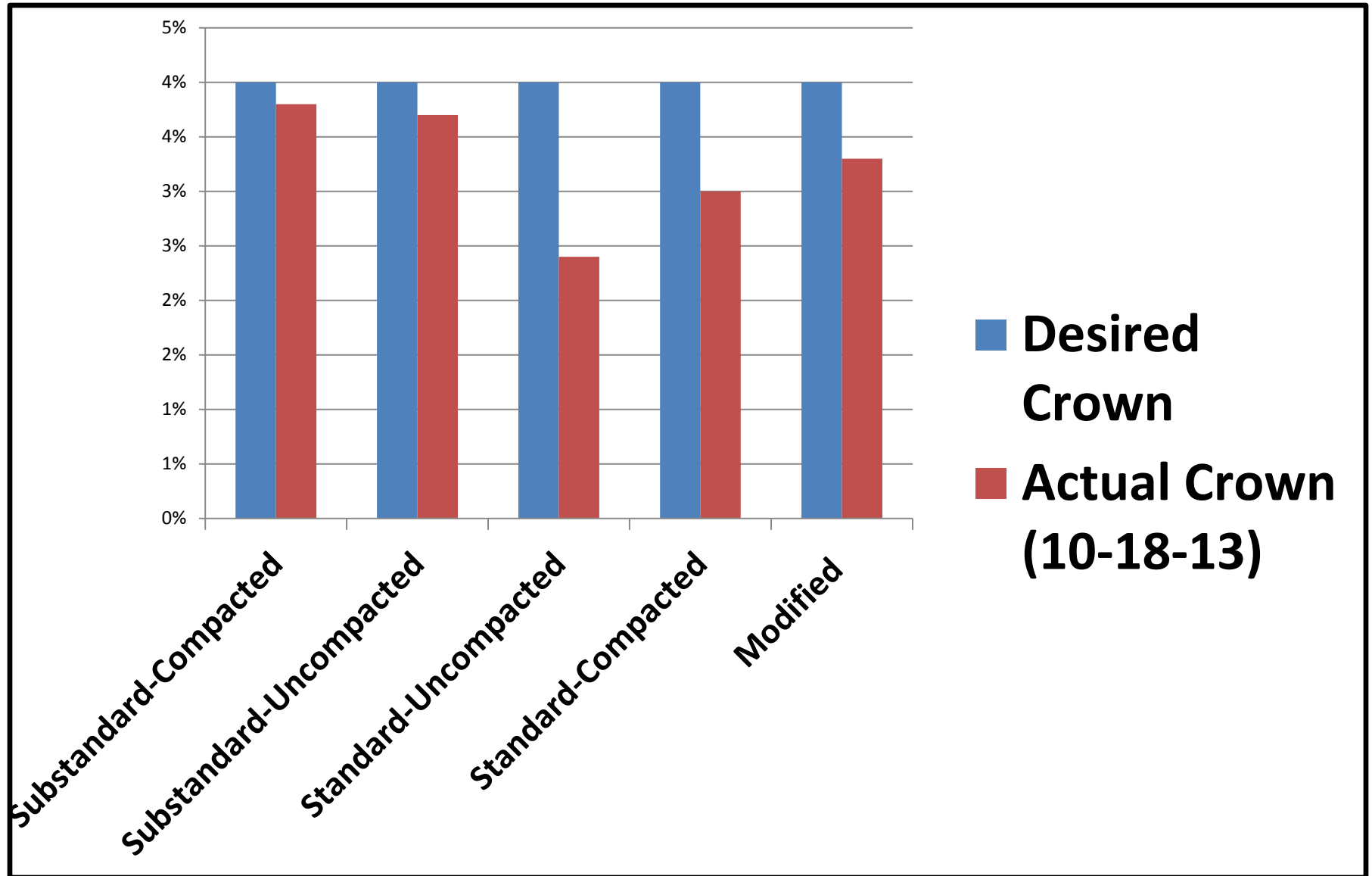
Substandard section – aggregate has moved outward over 4 ft since construction



**Modified section has moved outward
only six inches since construction**

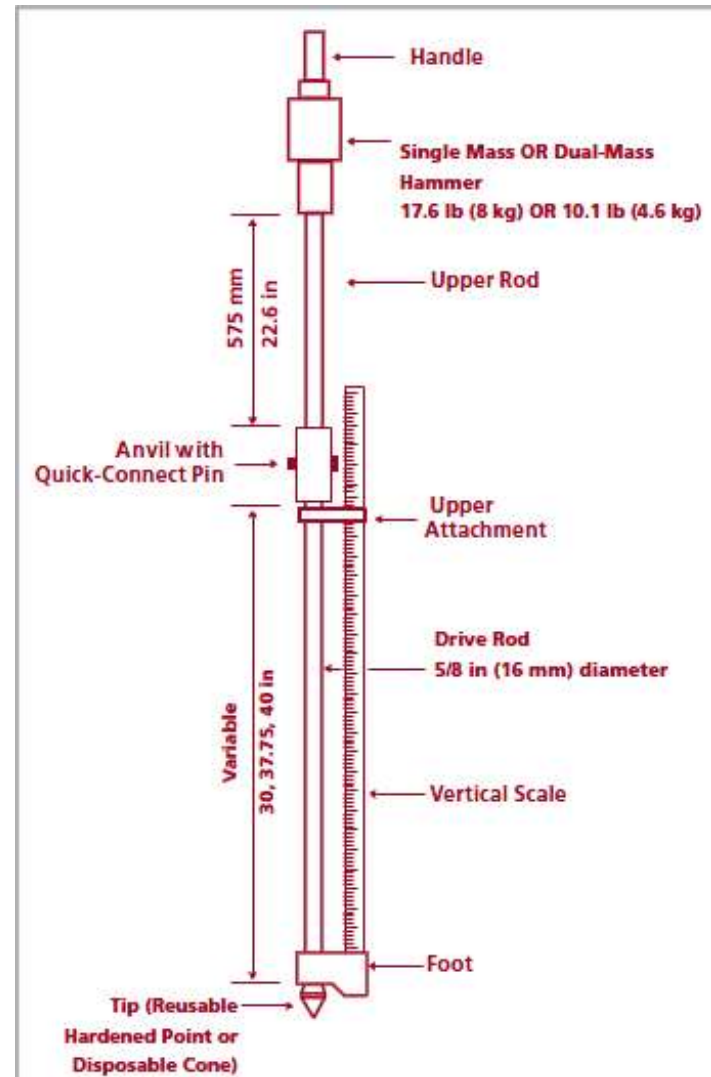


Problems with roadway crown



Dynamic Cone Penetrometer Testing

- Provide a measure of the in-situ strength of the base and subgrade
- A 17.6-pound weight is raised to a height of 1.8 feet and then dropped, driving the cone into the soil
- The variation in blows needed to drive the rod to a specified depth is an indicator of strength and stability of the subgrade



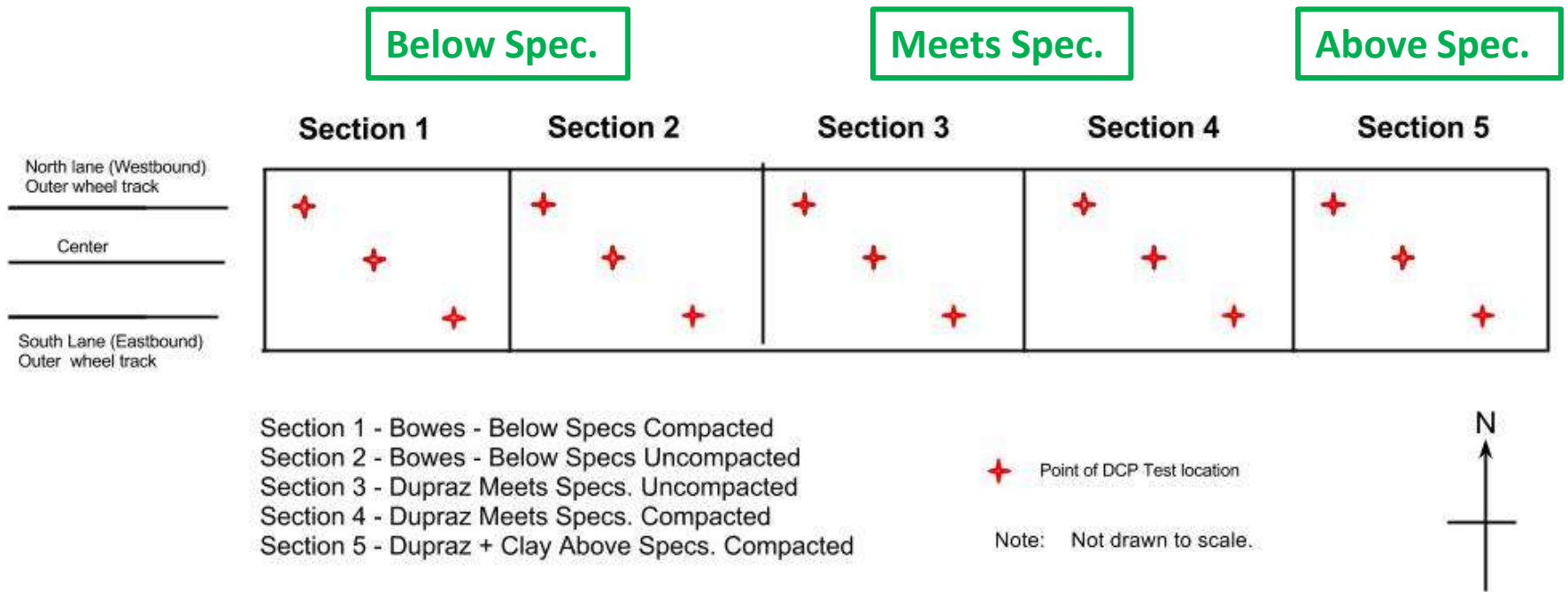
Field Use of Dynamic Cone Penetrometer

- Provide a measure of the in-situ strength of the subgrade
- A 17.6-pound weight is raised to a height of 1.8 foot and then dropped, driving the cone into the soil
- The variation in blows needed to drive the rod to a specified depth is an indicator of strength and stability of the subgrade



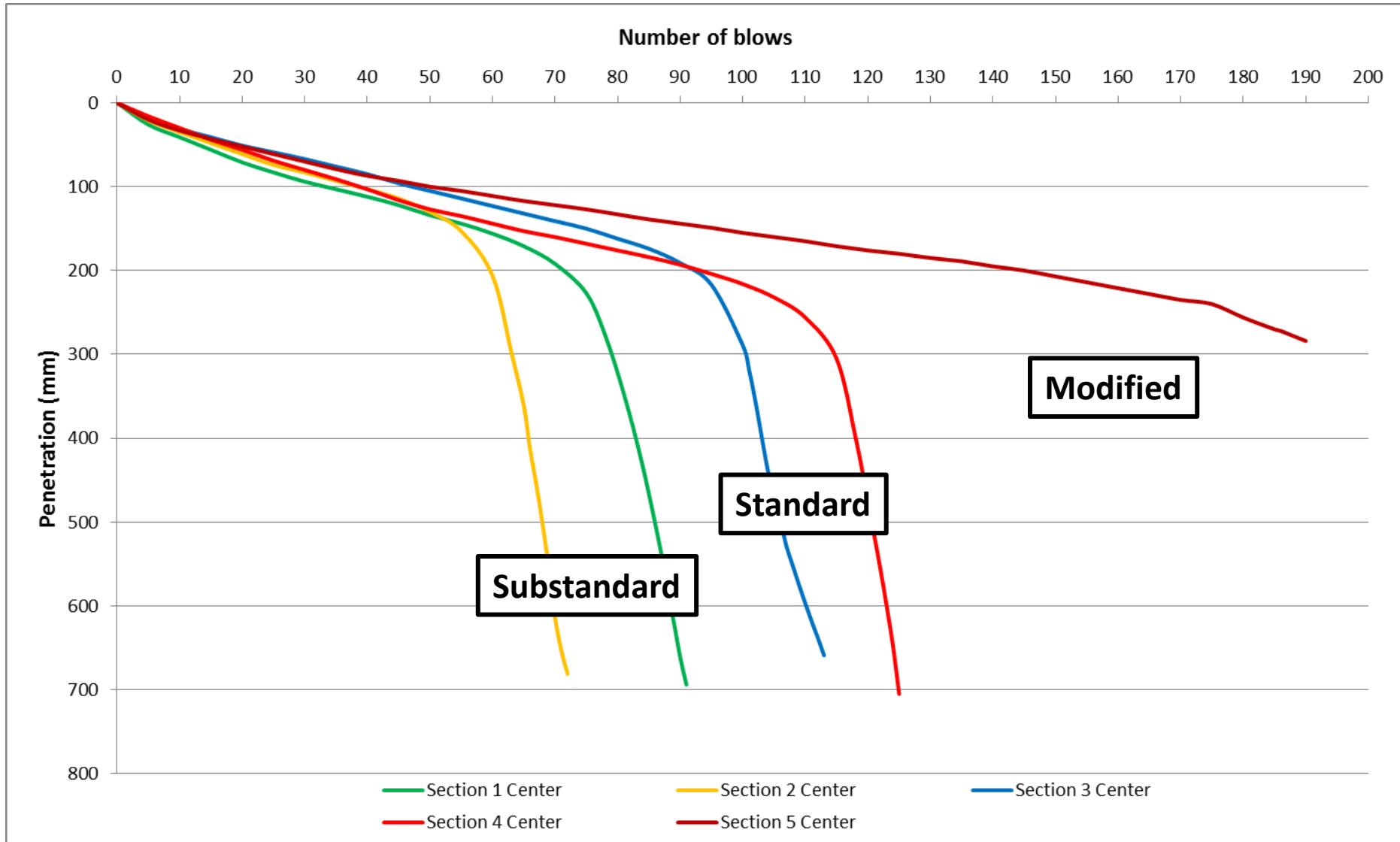
Test location layout

- **Brookings Co. Gravel Test Section (214th St.)**



DCP Results

Different trend in strength in modified section:



View of Substandard section – 10-18-13



View of Modified section – 10-18-13



Does the modified section rut in wet weather? No, virtually no rutting observed.



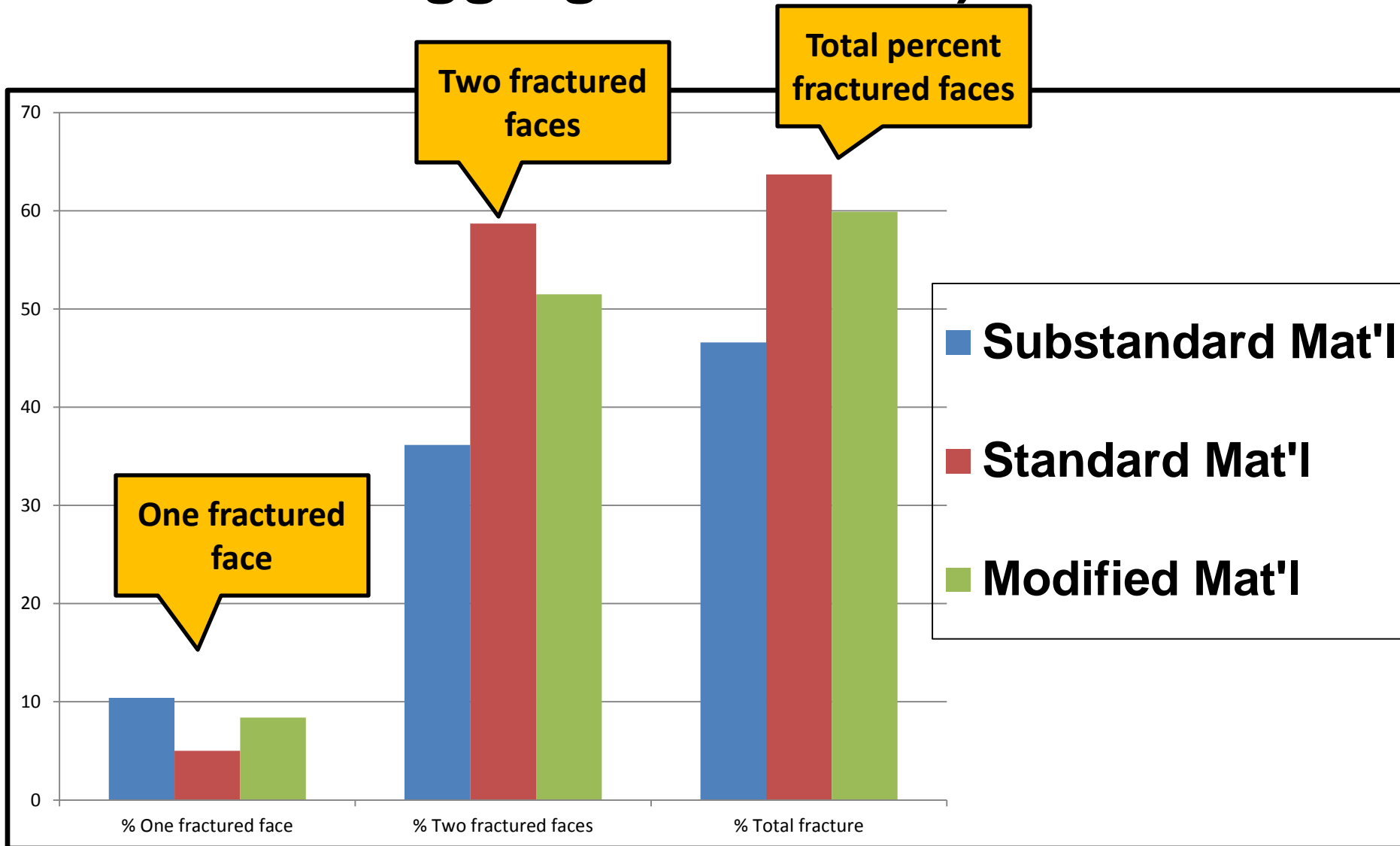
**Any traffic on
this road?**



Some other aggregate comparisons:

Material Type	Percent fractured faces
Substandard – one inch top size control	2FF=36.15% 1FF=10.4% Total=46.6%
Standard – three-quarter inch top size control	2FF=58.7% 1FF=5.0% Total = 63.7%
Modified – three quarter inch top size control	2FF=51.5% 1FF=8.4% Total = 59.9%

Percent of fracture of stone (natural aggregate sources)



Concluding Points

- **Meeting basic SDDOT standard surface gravel specification reduces loose aggregate by 1/3 to 1/2.**
- **Widest differential was in Brookings County near end of corn harvest in 2012 with 405 tons of loose aggregate on substandard section to only 71 tons on modified section.**
- **No corrugation ever observed on standard or modified material.**

Concluding Points (Con't)

- Most interesting fact thus far: Brookings has done blade maintenance up to four times on substandard section to only once on modified!
- A negative aspect: we are getting a lot of push-back from aggregate producers who would prefer to produce as they always have – no close control of % passing the #200 seive and plasticity index.

THANK YOU!