

# Principles of Road Maintenance and Management

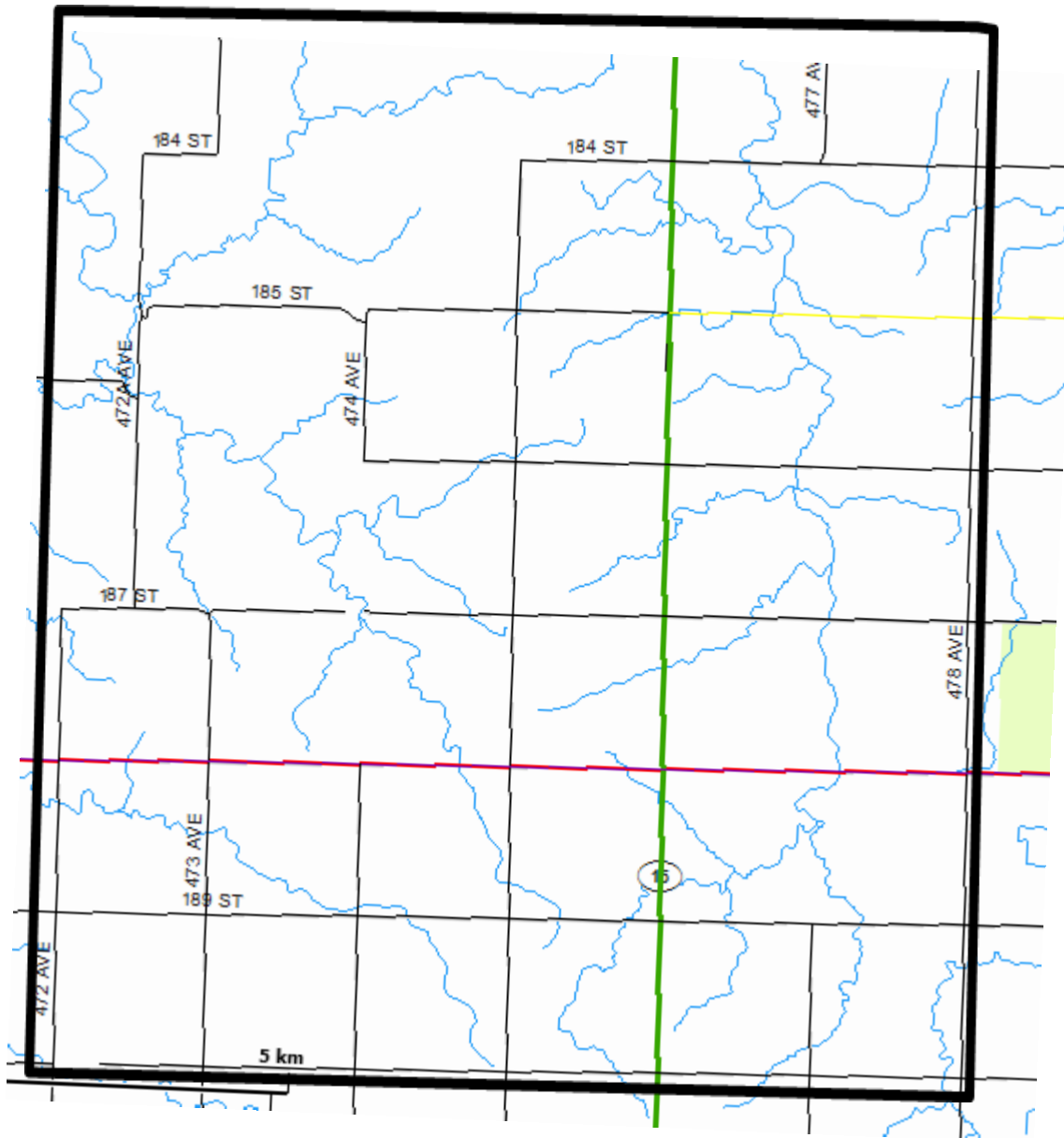
**12-6-2011**

**Huron, SD**

**Presented by SDLTAP Staff**

# Doing a Better Job of the Managing the Road- Setting Priorities

1. Have a plan – five years out is good.
2. Prioritize road system (those serving residents, connectors, mail/school routes, field access only)
3. Inspection –
  - A. Gravel thickness
  - B. Shape of surface and shoulder
  - C. Drainage
  - D. Traffic signs in good condition
  - E. R-O-W problems



Typical township in SD

46 miles on Township system

Priority one:  
24 miles are critical access for permanent residents.

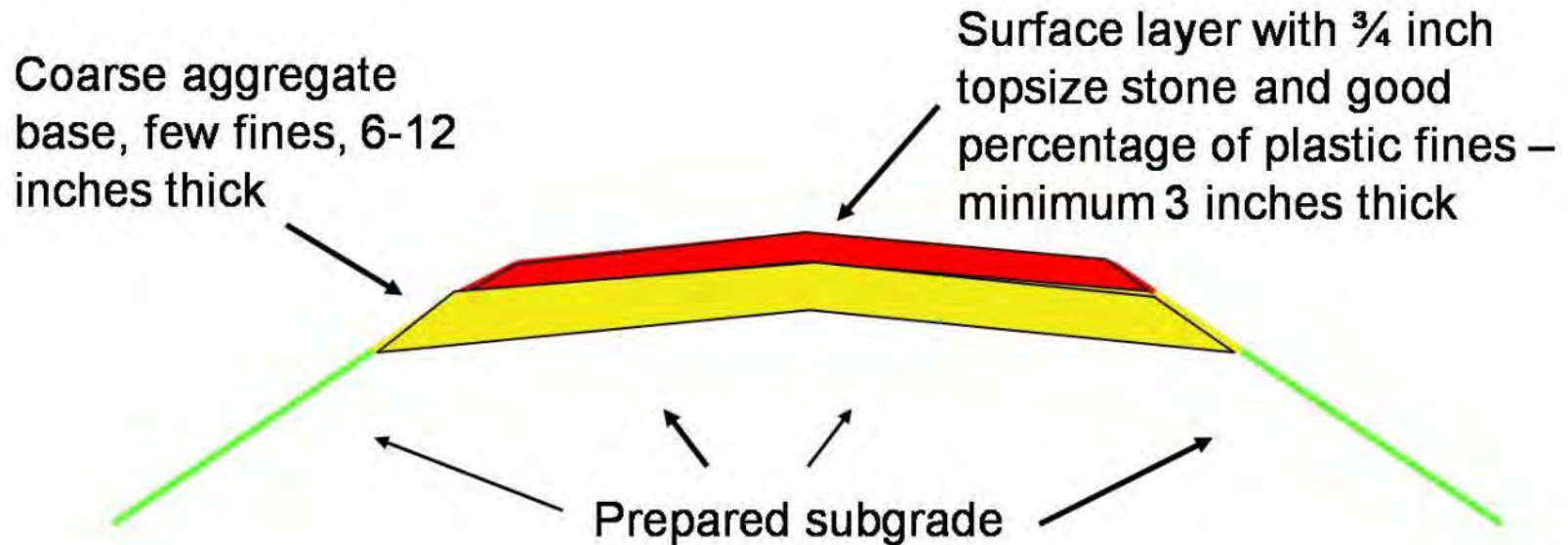
Priority two:  
12 miles have no residents, but are mail or school bus routes.

Priority three:  
10 miles are field access only.

# Critical Issues in Managing Roadway Maintenance

- **Roadway Shape**
- **Drainage**
- **Surface Gravel Selection**

# Basic Geometry:



Not the “real”, but the ideal!

# A real cross section:





MAY 18 2007





# Gravel Quantities for Specified Thickness

- One inch of gravel on a 20 ft road top requires 407 cubic yards or 570 tons per mile.
- Two inches of gravel on a 20 ft road top requires 816 cubic yards or 1142 tons per mile.
- Three inches of gravel on a 20 ft road top requires 1222 cubic yards or 1710 tons per mile.

# Tremendous gravel loss in recent flooding



# Gravel Rds Maint & Design

## Green Book and “Little Green Book”



## Gravel Rds Maint & Design

“Nearly 80% of the roads in the US have traffic volumes of 400 vehicles per day or less.”!! (quote from Little Green Book)

It becomes very difficult to construct and maintain these very low-volume roads to a high geometric standard.

# Guidelines for Total Roadway Width for New Construction of Very Low-Volume Local Roads in Rural Areas

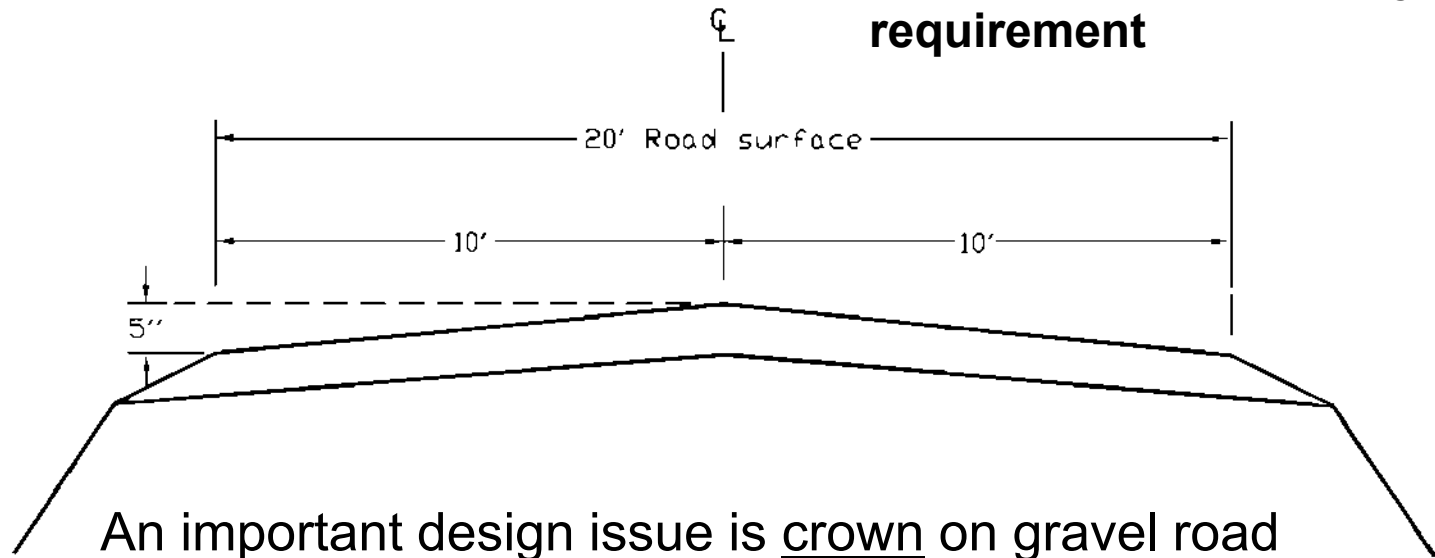
From: **AASHTO – Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT <400)**

Design speed (km/h)	Major access	Minor access	Recreational & scenic	Industrial/commercial access	Resource recovery	Agricultural Access
15	-	18.0	18.0	20.0	20.0	22.0
20	-	18.0	18.0	20.0	20.0	24.0
25	18.0	18.0	18.0	21.0	21.0	24.0
30	18.0	18.0	18.0	22.5	22.5	24.0
35	18.0	18.0	18.0	22.5	22.5	24.0
40	18.0	18.0	20.0	22.5	-	24.0
45	20.0	20.0	20.0	23.0	-	26.0
50	20.0	20.0	20.0	24.5	-	-
55	22.0	-	22.0	-	-	-
60	22.0	-	-	-	-	-

**Note: Total roadway width includes the width of both traveled way and shoulders.**

# Design Issue – Crown:

**20 ft. roadway width shown here meets SD statutory requirement**



An important design issue is crown on gravel road surfaces. Generally recommended crown for gravel surfaces is 4% which is double the crown used in pavements.

# Design Issue – Crown: (con't)



**Clear illustration of 2% crown on road to the left and 4% on the road to the right. Water will not drain off an aggregate surface with only 2% crown. This must be addressed in design and during construction.**

# Design Issue – Crown: (con't)

There are conflicting views on crown:

- 1/3 to 1/2 in. per ft. recommended by NACE manual *Blading Aggregate Surfaces – 1986 edition*.
- 2 to 6% for “low-type pavements” recommended by AASHTO Green Book pg 387 – 2001 edition.



## Design Issue – Crown: (con't)

- The FHWA *Gravel Roads Manual* recommends crown at or near 4%.

Note: in arid and semi-arid regions, gravel roads may perform with less crown, but don't use less than 3%.

## Design Issue – Surface Gravel

- The issue of good surface gravel (aggregate) cannot be emphasized enough!!
- Good aggregate surfacing differs from base and other construction gravels.
- When it's right, problems diminish!

# Design Issue – Surface Gravel (con't)

Surface aggregate differs from base aggregate in two fundamental ways:

- The need for more plastic fines to serve as binder.
- Smaller top-sized stone that will remain embedded in the surface.

# Design Issue – Surface Gravel (con't)

**Similar ADT, Similar geometrics, but different surface materials!**



# Design Issue – Surface Gravel (con't)

Corrugation or “washboarding” which is surface distress that is directly related to surface aggregate specification.



# Premium Gravel!



A skid mark on a gravel road!

# Design Issue – Surface Gravel (con't)

## Sample specifications comparison:

**Table 1. Example of Gradation Requirements and Plasticity for Two Types of Materials.**

Requirement Sieve	Aggregate Base Course Percent Passing	Gravel Surfacing Percent Passing
1"	100	
3/4"	80-100	100
1/2"	68-91	
No. 4	46-70	50-78
No. 8	34-54	37-67
No. 40	13-35	13-35
No. 200	3-12	4-15
Plasticity Index	0-6	4-12

*From South Dakota Standard Specifications. (16)*

# Quality Surface Aggregate – Sometimes not easy to obtain





# Surface gravel intact after long winter – no maintenance since previous fall



# More blending or “manufacturing” in the future?



# Processing material from a natural clay source



**Road mixing natural clay with clean gravel to get high quality surface gravel**





- **Seven percent natural clay with a plasticity index of 17 being added to  $\frac{3}{4}$  minus surface gravel with low percentage of fines and minimum plasticity.**
- **The goal is to produce a surface gravel with an outstanding binding characteristic.**



# Surface Gravel Quality Test

- Some miscellaneous information from a current surface gravel test project in SD
- Four Test Sections:
  - Substandard, but commonly used material.
  - Standard spec material placed without compaction.
  - Standard spec material placed with compaction
  - Modified material for very high quality surface gravel.

# Observation after only 31 days!

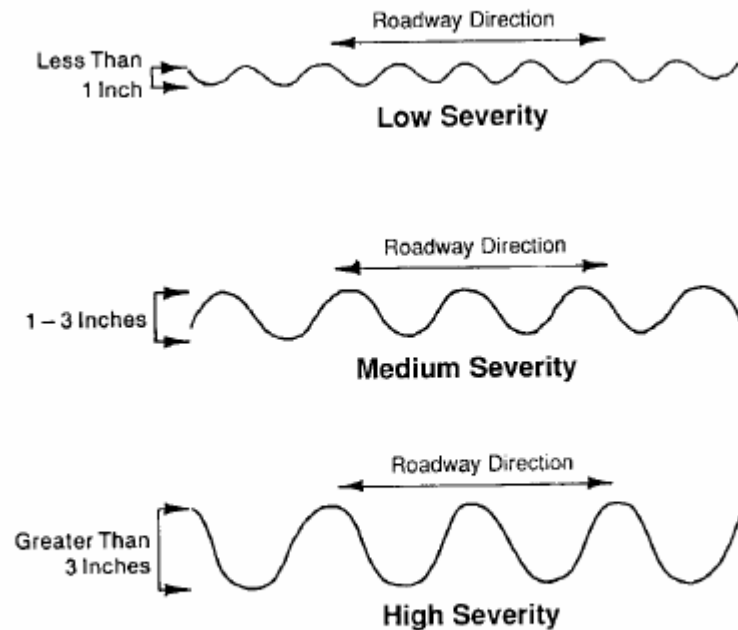


**Some corrugation on substandard section observed on 25% of the test section.**



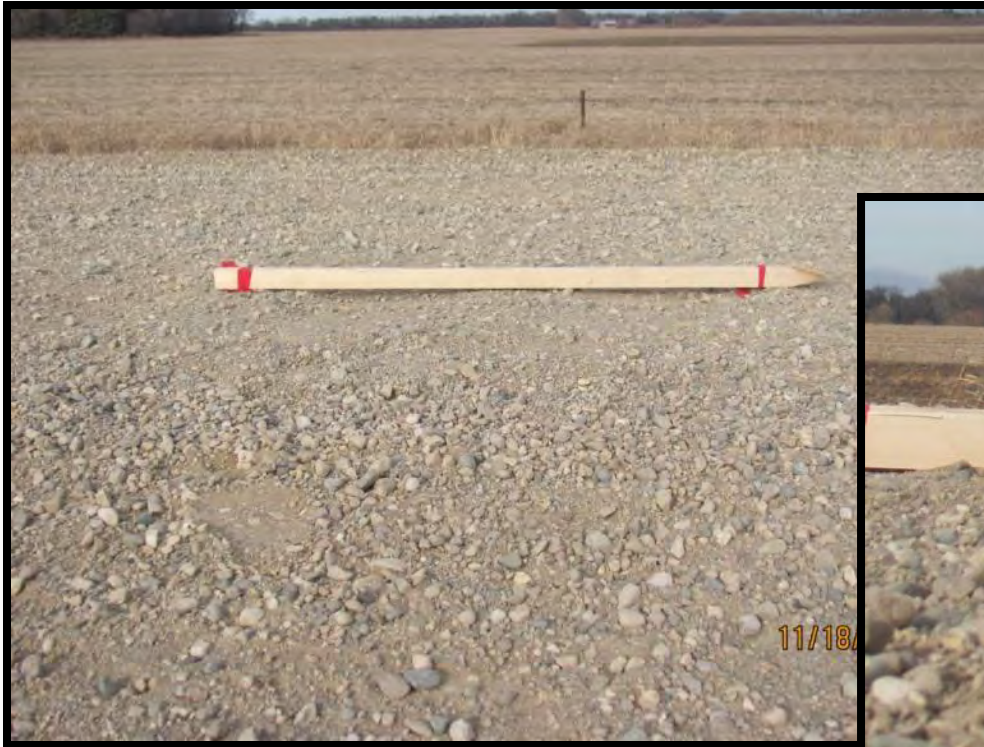
# Corrugation Measurement on Substandard Section

- Criteria from US Army Corps of Engineers Manual page B-7:



*a. Severity levels.*

# Corrugation on Substandard Section



**Corrugation measured between  
.75 to 1.2 inches.**

# Corrugation on Standard and Modified Material Sections



**No corrugation observed on either of these test sections.**

# Design Issue – Stage Construction

- In my experience, if a road/street is to be maintained three years or more as an unpaved road, use material and crown specification for gravel roads.
- If less than three years, use base aggregate and crown specification for pavement. (It will be hard to maintain in the interim).

# Design Issue – Stage Construction

(con't)

Little Crown  
and poor  
surface  
aggregate,  
but road is to  
paved in three  
years.



# Gravel Roads – Managing Maintenance

There are two primary issues:

- Managing frequency of blade maintenance.
- Keeping control of shape on traveled way and shoulder.

# Crown



**One of the biggest challenges in gravel road maintenance.**







**Some roads have too little crown, some have too much.**



**Imagine a cattle trailer on this road.**



**The road has 13 inches of crown on a 20' top**

# “Two Track” Road



# Crown Gauge is Helpful



# Electronic Slope Reading











# Manageable Road Width

Width of bladed surface of  
14 ft. and 16 ft.  
moldboards set at  $30^\circ$  and  $45^\circ$

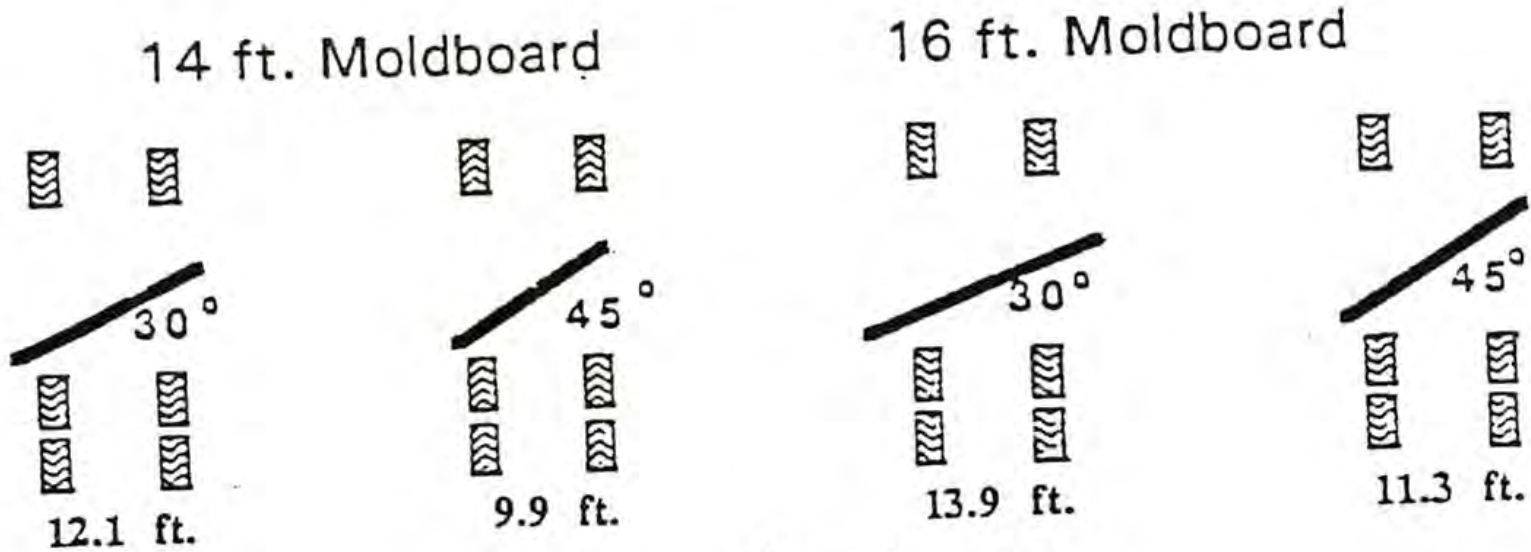


Figure 8



**Crown should be near  $\frac{1}{2}$  inch per ft (or 4%)**



**Example: 24 ft roadway should have approx. 6 inches of crown.**

# The Next Challenge – High Shoulders!





# Outstanding example!



# Shouldering Operations





# Similar ADT, Similar geometrics, but different surface materials!



**Get ready to face the challenges of  
maintaining gravel roads in the future!**

---

**Thanks!**

# Culvert Installation

- **Annual Culvert Inspection Requirement per SDCL 31-14-33.**
  - **In the future, FEMA will require a culvert inspection report before any culvert replacements are approved.**
  - **FEMA is going to make it harder to collect on “blown out culverts” to make sure it wasn't due to the culvert being plugged or in poor repair.**
- **Installation Techniques.**

# Managing the Right-of-Way

- **Farming in R-O-W**
- **Fencing in R-O-W**
- **Drainage in R-O-W**

# Right of Way Issues (con't)



# Right of Way Issues (con't)



OCT 3 2008

# Managing the R-O-W

*Know what the SD statutes say:*

- 31-13-56 Baled or stacked hay must be removed by Nov 1.**
- 31-32-1 It is unlawful for anyone to intentionally damage a highway or bridge. One cannot be allowed to dig up, remove, displace, break or in any way injure or destroy a public highway or bridge.**
- 31-13-2 No one can willfully plow up or obstruct a public highway or bridge or place a dangerous object in the roadway.**

# Managing the R-O-W (con't)

## ***SD Statutes (cont)***

**•31-32-3.1 No one can intentionally dump any material or cargo on or within the highway R-O-W**

**•31-32-7 No unauthorized person can injure, remove, destroy or otherwise alter a highway grade or fill, obstruct, or otherwise alter a ditch which drains a highway grade or otherwise injure a highway in any manner.**



**A very serious example:**









# Managing the R-O-W (con't)

## ***SD Statutes (cont)***

- 31-32-8 Any township or other public agency may recover their losses from the person who damaged the highway or ditch which led to injury or obstruction.**
- 31-32-9 The governing agency has a duty to remove obstructions and repair damage to roads and streets and is authorized to recover the amount expended from the person who caused the damage.**

# Managing the R-O-W (con't)

## ***SD Statutes (cont)***

**•31-32-16 A tree or other object which overhangs the roadway and is likely to cause damage or injury to those traveling the road is a public nuisance and remedies are provided to have it removed.**

**This may seem unlikely, but one incident occurred in SD where a combine swerved to avoid overhanging tree branches and went off the roadway and was damaged. A claim was filed!**

## Managing the R-O-W (con't)

***What are some options for controlling the problem?***

- Make an annual inspection of the road system and note the problems within the R-O-W.**
- Notify landowners (in writing) who are violators and let them know what the agency expects them to do. Be reasonable and act according to statute.**
- Be consistent and uniform in how you handle similar situations.**
- In some situations, it may be wise to get legal advice.**

# Managing the R-O-W (con't)

## *Options for controlling the problem (cont)*

- **Try to be proactive and communicate at annual meeting the need to keep the R-O-Ws clear.**
- **Consider a carefully worded mailing to residents and landowners explaining the problems and the liability that is created for the agency and the expense of taking care of these matters. Explain it ultimately is paid by their tax dollars.**
- **Don't threaten and not carry through.**



# Managing the R-O-W (con't)

**Let's Share!**

- How have you handled these problems?
- What has worked and what hasn't?



# Managing Drainage

- **Culverts**
- **Ditches**
- **Bridges**



**Culverts need maintenance!**



# Drainage - Ditches





SEP 28 2005



SEP 28 2005



**Sometimes a major reshape is needed – even on very low volume roads.**

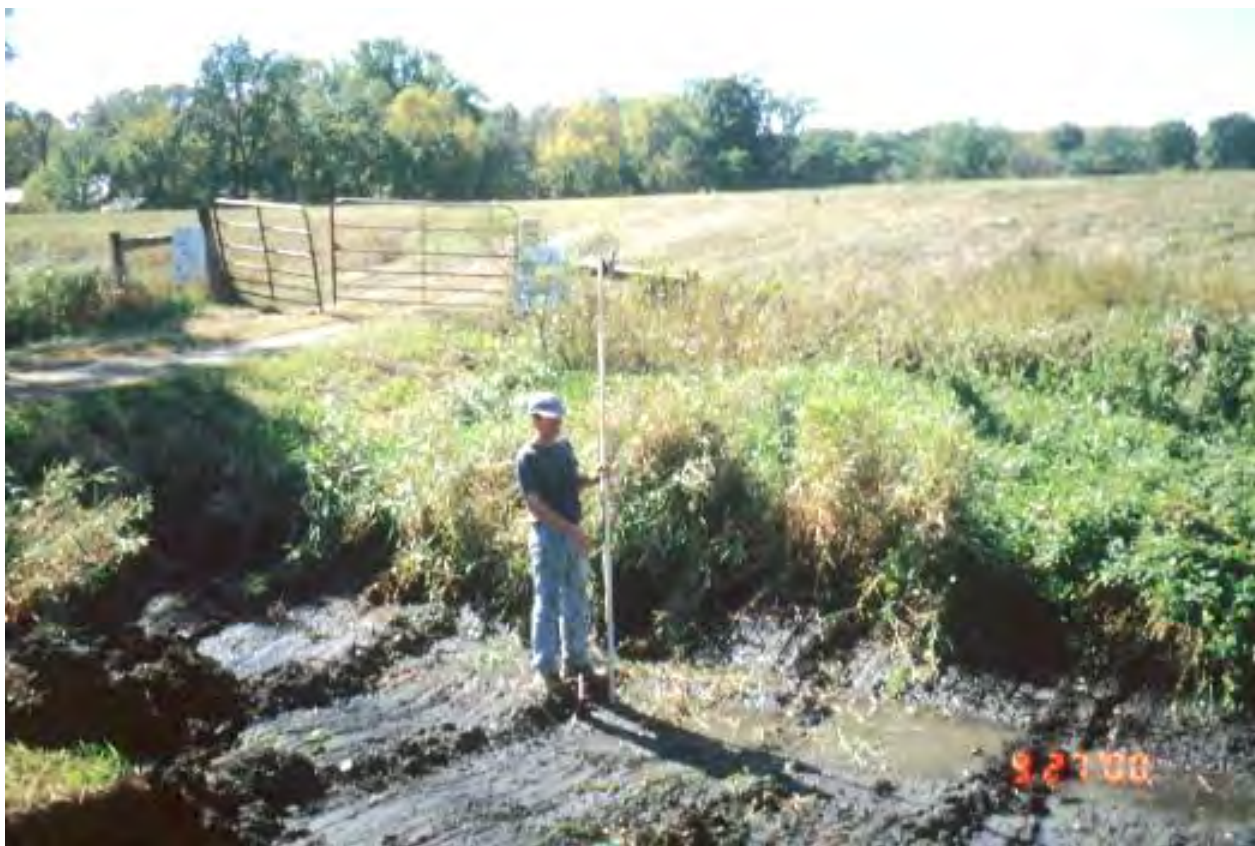




**•Drainage improvement will have to be done before any surface improvement is done here.**



**•An example of correcting drainage problems in the creek bottom area shown above on a SD local road.**



**•Extensive ditch cleaning was done with careful attention given to restoring correct ditch and culvert elevation.**



- **Several culverts had to be removed and reset at correct elevation.**
- **One culvert had been placed approximately 1.5 feet higher than an upstream culvert!!**







**•Example of their finished work with the ditch cleaned and reshaped and a new culvert placed at the correct elevation.**

# Misc Information on entrances

- **SDCL 31-24-1. Duty of highway authorities to provide access to abutting property at public expense--New construction. If the construction, improvement, and repair of any public highway by the state, or by any county or township, leaves a ditch or elevation along the roadside and deprives any abutting landowner of easy and convenient access from the owner's land to the highway, the highway authority -----**



# Misc Information on entrances (con't)

---- shall provide the owner of the abutting tract or farm, as well as each church, school, park, playground, or other public building or ground, with one point of easy and convenient access to a public highway by constructing at the public expense, such grades, approaches, bridges, culverts, or other structures as may be ----- only applies to new construction.



**•Once good drainage is established, it must be maintained.**



- **The opposite side of the intersection is shown here. The end of the culvert is completely buried by debris.**
- **The new asphalt placed on the radius has already been damaged from water washing over the intersection.**



- **Sometimes, you simply cannot drain the water!**
- **A grade raise is necessary here before any base improvement or asphalt work is considered.**



- **The final elevation of the new subgrade will be well above the water on this road.**
- **This makes base and surface work much easier and gives a far greater chance for good long term performance.**

Discussion?

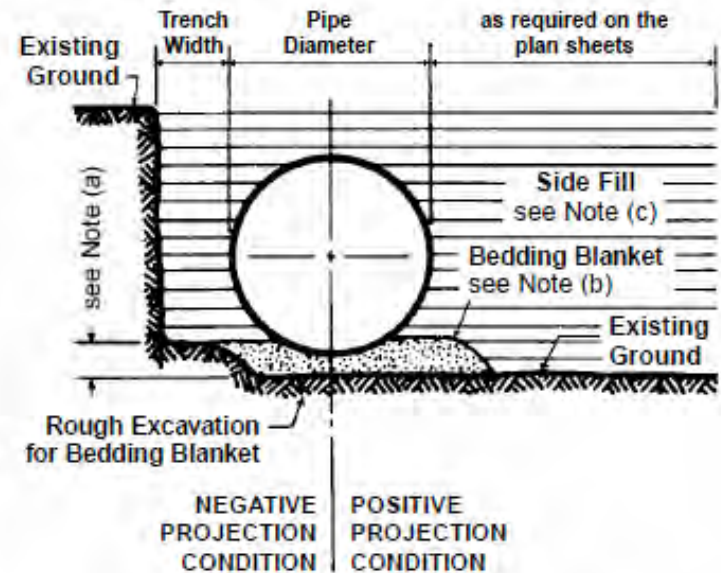
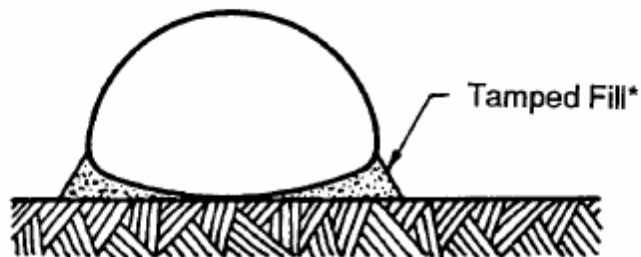
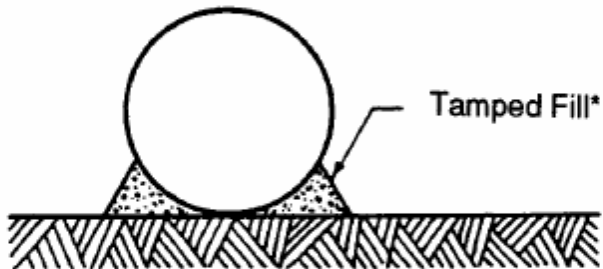
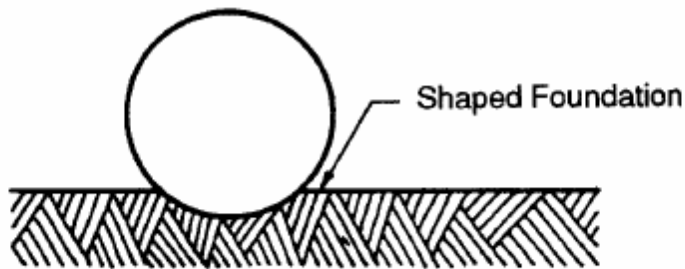
# Culvert Installation Basics

- Too much emphasis cannot be placed on the necessity of adequate compaction of backfill. Faulty compaction has led to more trouble with pipe installations, flexible and rigid, than all other factors combined! (From *Installation Manual for Corrugated Steel Pipe* – NATIONAL CORRUGATED STEEL PIPE ASSOCIATION)
- Things to consider in compaction:
  - The type of soil
  - Moisture condition
  - How the soil is placed
  - Compaction methods

# Culvert Installation Basics – Con't

- **Things to consider in compaction:**
  - **The type of soil**
  - **Moisture condition**
  - **How the soil is placed**
  - **Compaction methods**





(A) Pipe Installation and Bedding

(c) Side fill to be compacted in 6 to 8 inches (.15 to .20 meters) of compacted layers to density specified for adjacent embankment, but not less than 90% Standard Proctor Density (AASHTO T99).



# ***Culvert Installation***

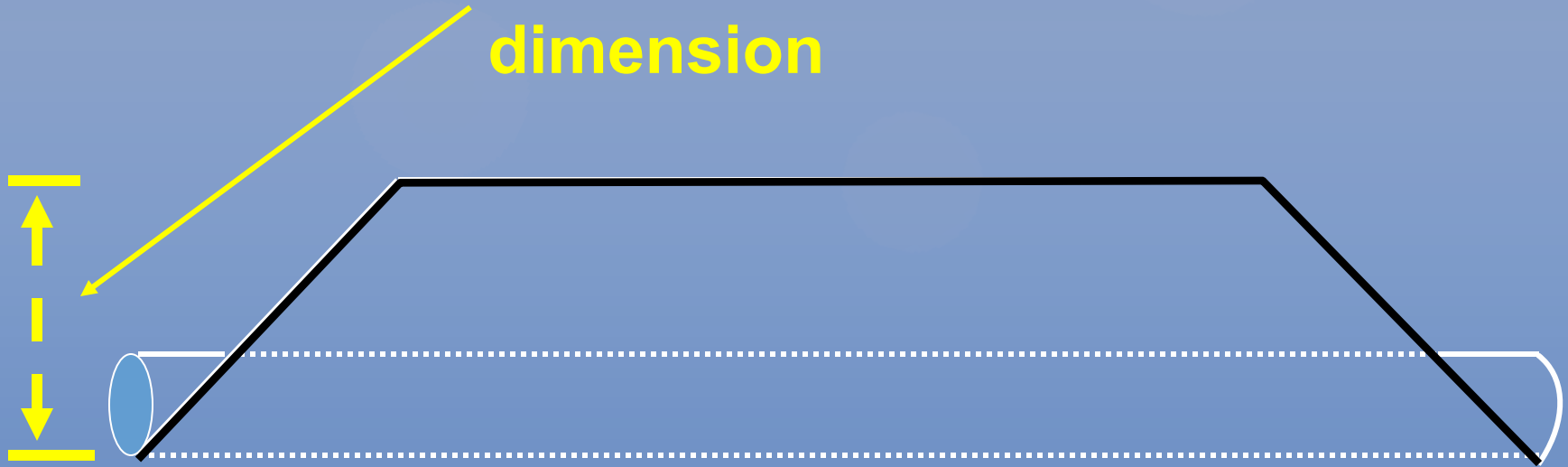
Determine Correct Length by measuring two dimensions:

- The height of grade
- The width of the roadway

Note Illustrations that follow

# Culvert Installation – Determining Correct Length

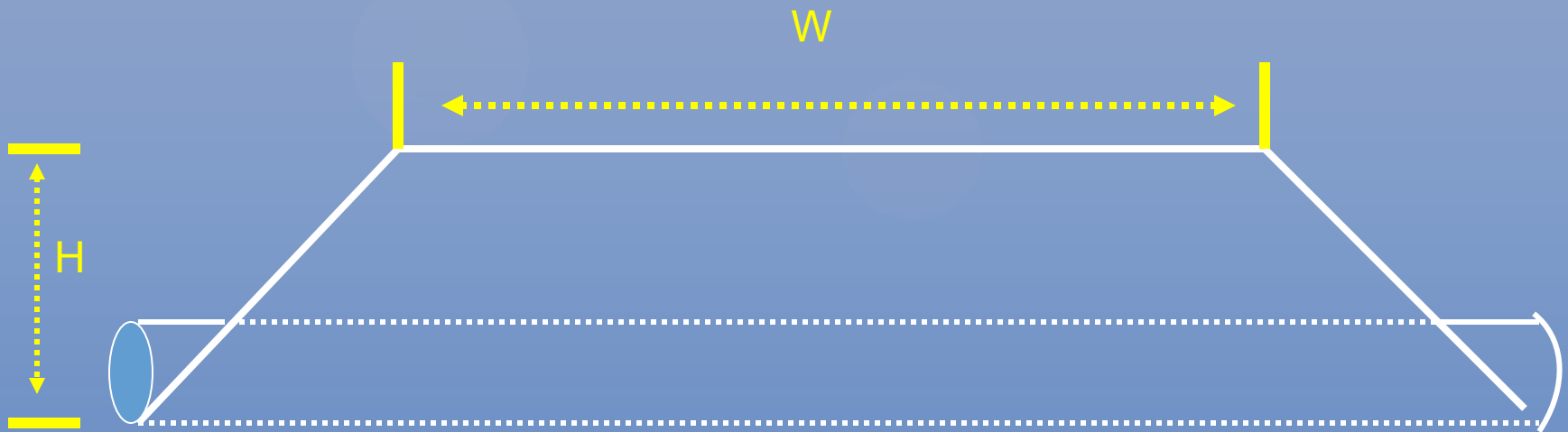
Height of grade is this dimension



**Width of roadway is this dimension**



Total culvert length is calculated by taking the height (H) of grade x 2 x 2 (assuming a minimum 2:1 inslope) and then adding roadway width (W).



**If all of this seems confusing and not necessary -----**

**Then consider the results when it isn't done as illustrated at the following SD Twp site where a pipe was installed this past summer:**

**End of pipe is just off edge of roadway at this point**







The correct length of this pipe was either never calculated or was calculated incorrectly. The end of the pipe does not extend out far enough from the road shoulder.



Because of this, the road shoulder will tend to erode and wash away every time a heavy rainfall occurs and cause liability risk and frequent repairs.

# Excellent example of proper length calculation



















# End protection is important on larger pipe











**Discussion?**



# Joint County/Township Cooperation & Communication Panel

- **County Panel Members:**
  - **Greg Vavra – Jerauld Co Hwy Supt**
  - **Lenny Urich – Edmunds Co Hwy Supt**
  - **Bill Lengkeek – Lyman Co Hwy Supt**
  - **Ron Blachford – Hand Co Hwy Supt**
- **SDATAT Board Members**

# Topics of Discussion

- **What is the County doing for townships ?**

**Examples:**

- **Blading?**
- **Snow Removal?**
- **Sign Installation?**
- **Other?**
- **What is working?**
- **What isn't working?**