

Missile Road

How PI is helping our National Security

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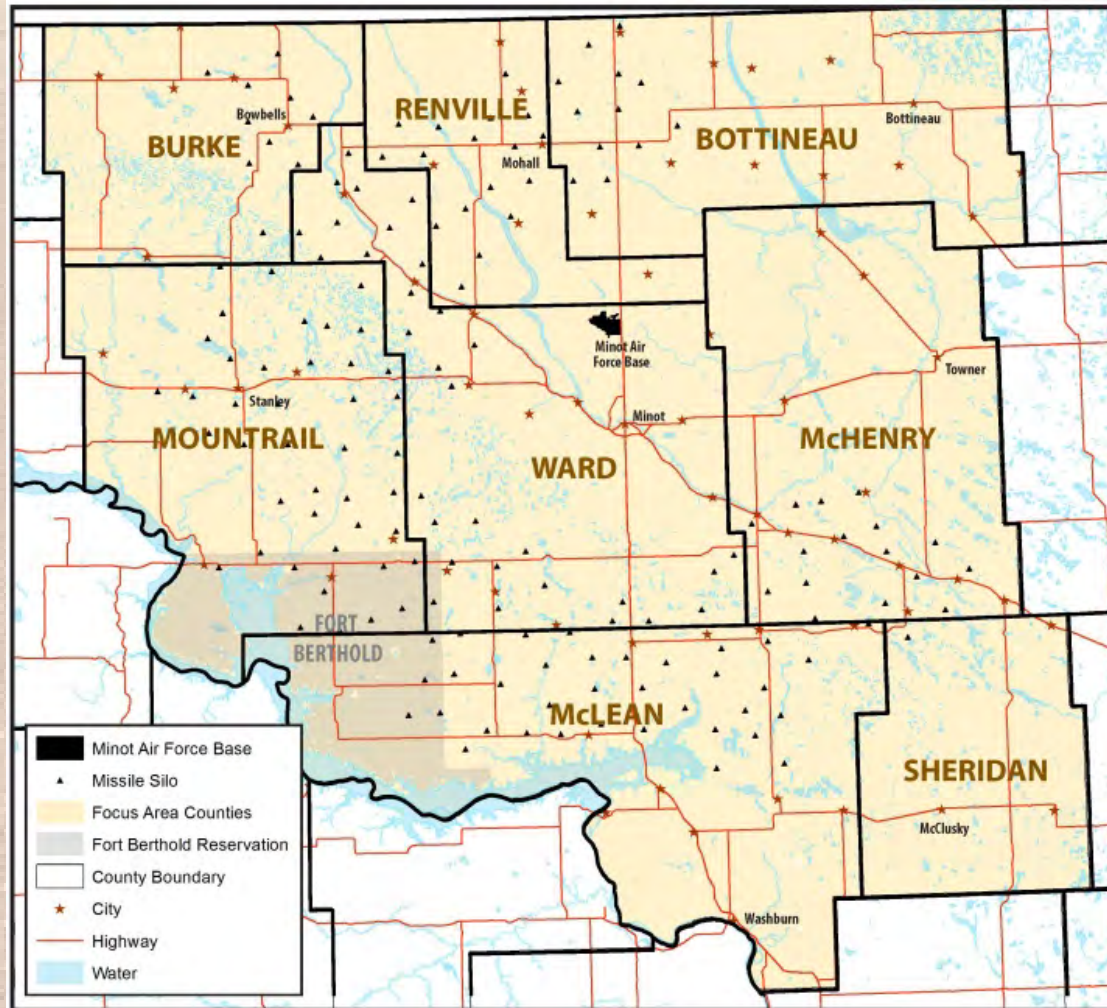


32nd Annual North Central Local Roads Conference
Rapid City, SD - October 18-19, 2017

Agenda

- Minot Missile Complex • 5 Min
- Defense Access Road Program • 5 Min
- Transporter Erector (TE) and Routes • 15 Min
- TE Route (gravel road) Issues • 10 Min
- Lessons Learned • 10 Min

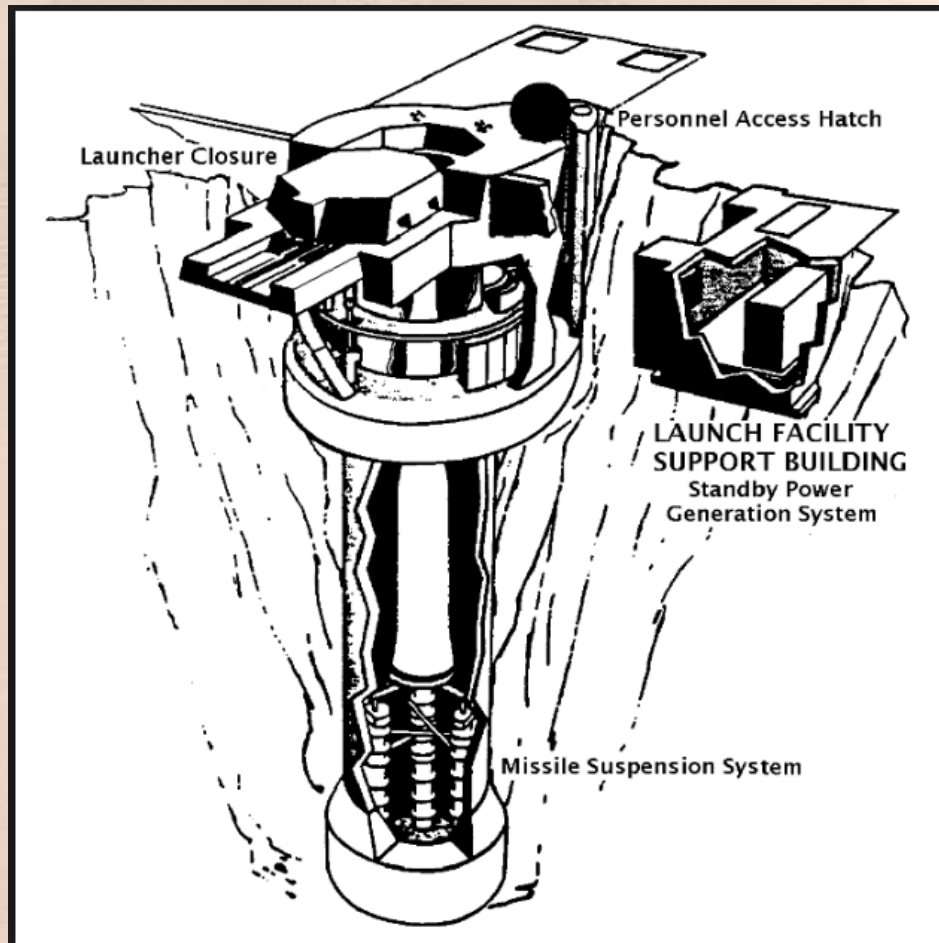
Minot Missile Complex



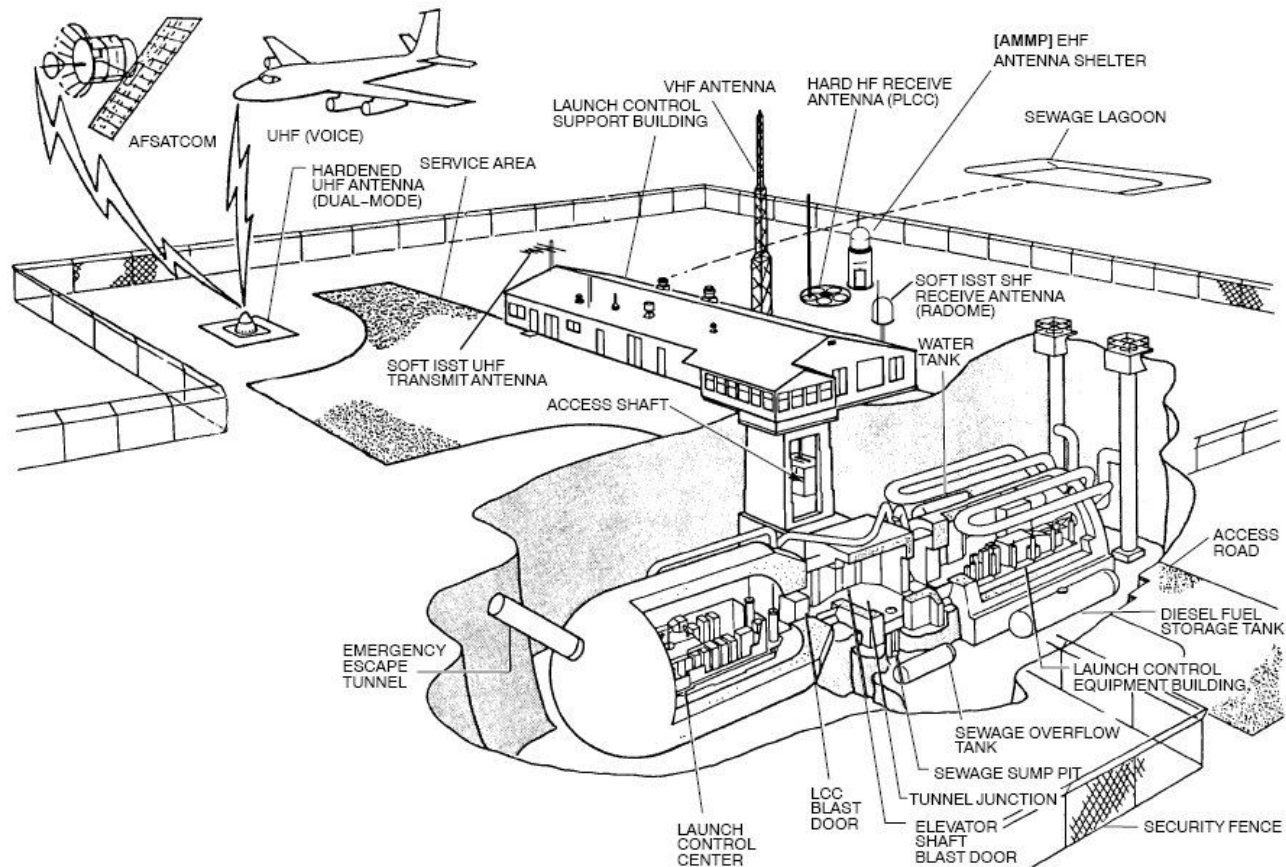
Minot Missile Complex

- 150 Launch Facilities
- 15 Missile Alert Facilities
- Over 8,500 Square Miles (12% of North Dakota)
- 8 Counties have sites

Launch Facility



Missile Alert Facility



Defense Access Road Program

- Implemented 1959
- Allows Air Force operations and maintenance funding to be used for maintaining the missile road network
- Up to 100% Federal-aid eligible

Defense Access Road Program

- Regravelling
- Extraordinary maintenance
 - Spot Maintenance
 - Emergency Repairs
- Extraordinary snow removal



Erosion Repair



Grade Raises



Culvert Replacement



Defense Access Road Program

- Provides a means for the Federal Government to pay its fair share of the cost for repairs and re-graveling to missile routes to ensure their continued ability to support the missile Transporter Erector vehicle.

Defense Access Road Program

- The Air Force needs addressed by this program exceed the requirements of civilian traffic funded by local highway agencies
- Transporter-Erector (TE) Route
 - A road specifically designated for use by the TE vehicle for access to missile sites.

TE Vehicle

April 4, 2017



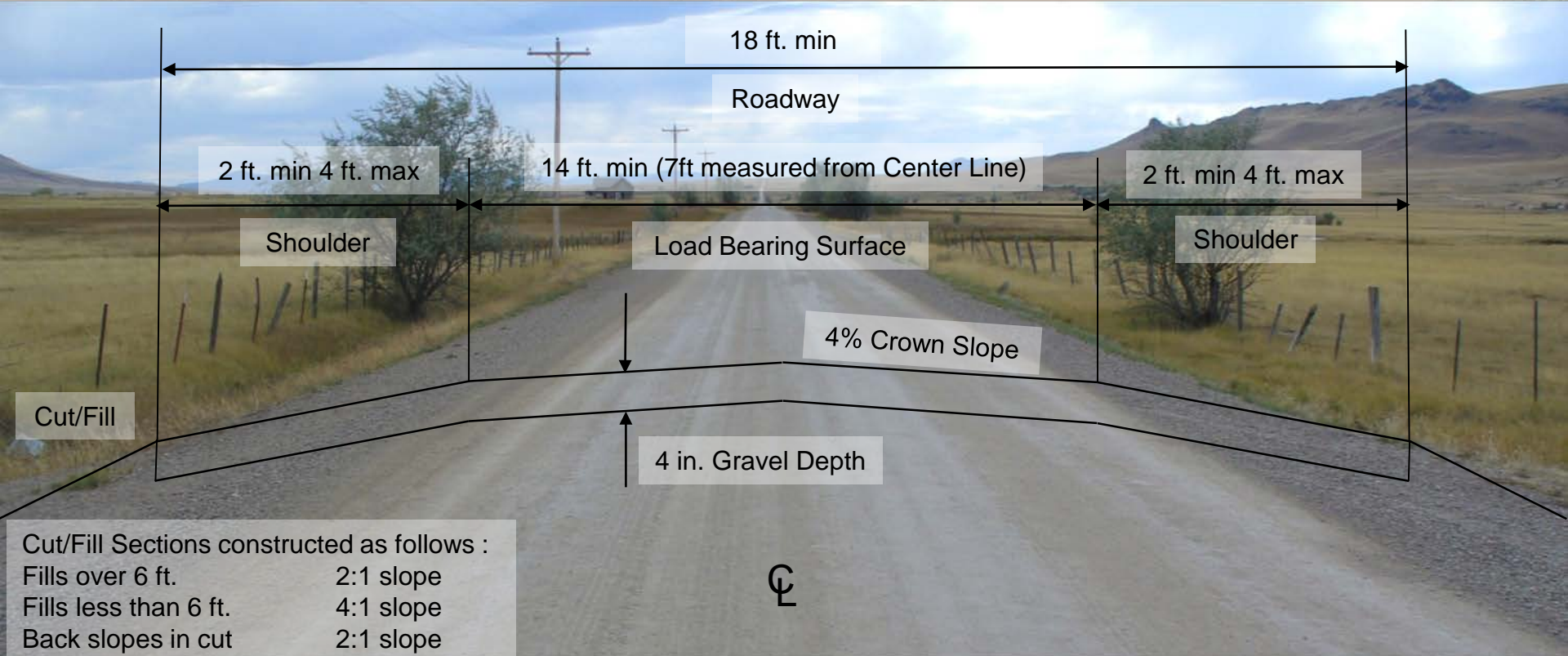
TE Vehicle



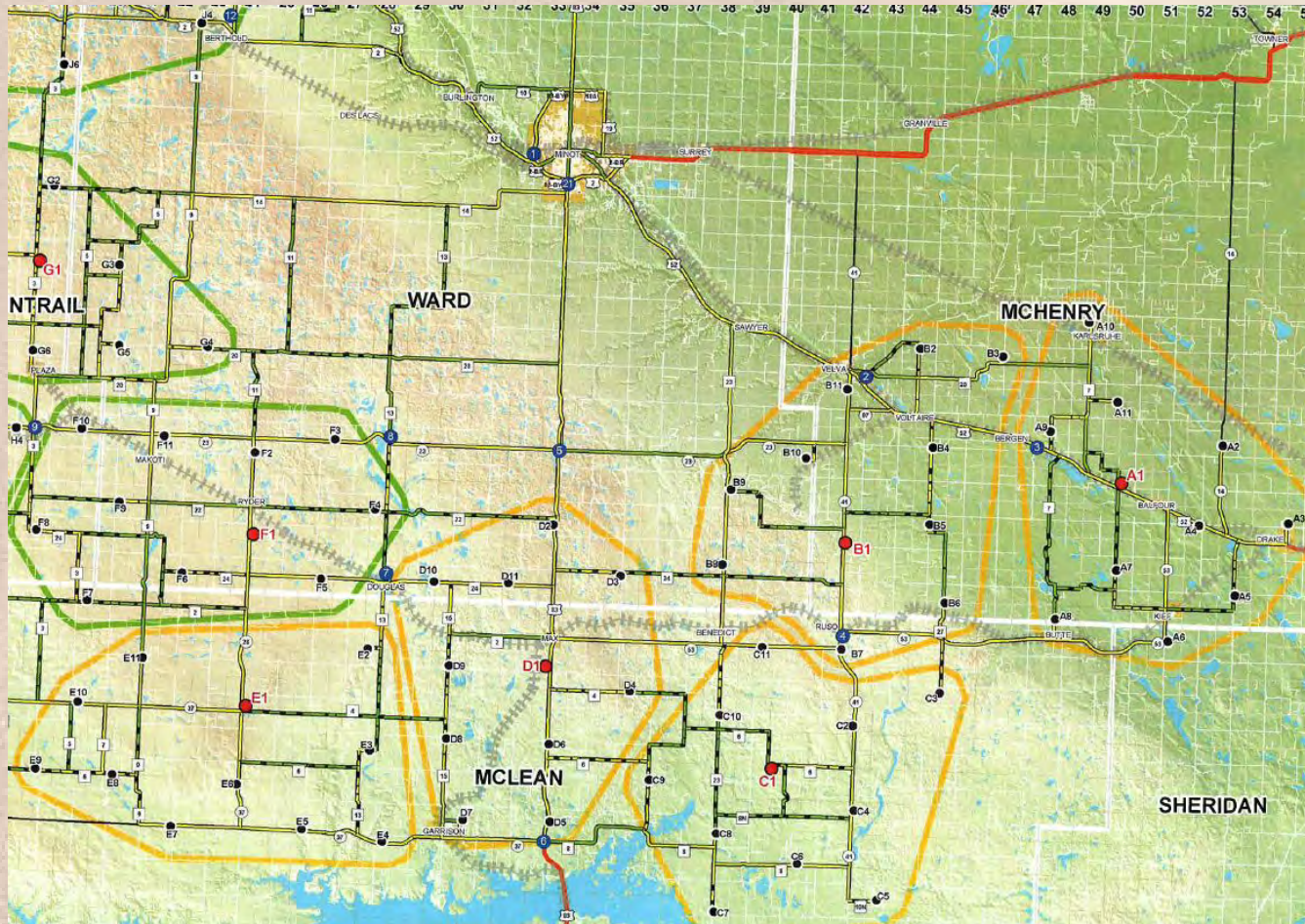
Transporter Erector

- 143,768 lbs loaded
- Travels only on approved TE Routes
- Approved TE Routes in North Dakota
 - Over 900 miles paved State and County Roads
 - Over 300 miles of gravel County and Township Roads

TE Route Standards



Sample TE Routes



North Dakota TE Graveling Projects

- Common Gravel road issues
 - Soft areas
 - Poor Roadway Shape
 - Washboards
 - Float

North Dakota TE Graveling Projects

- Most roads receive 2” to 4” of new gravel
 - Some projects allow the gravel depth to vary between 0 to 4 inches.
 - This allows gravel to be placed thicker on the hill tops or other areas that additional depth is needed.
 - 5 to 10 tons of gravel is included for each approach and intersection to provide a transition.

Soft Spot Repair

- Dry Out and Repack
- Subcut and Replace
- Add Fabric



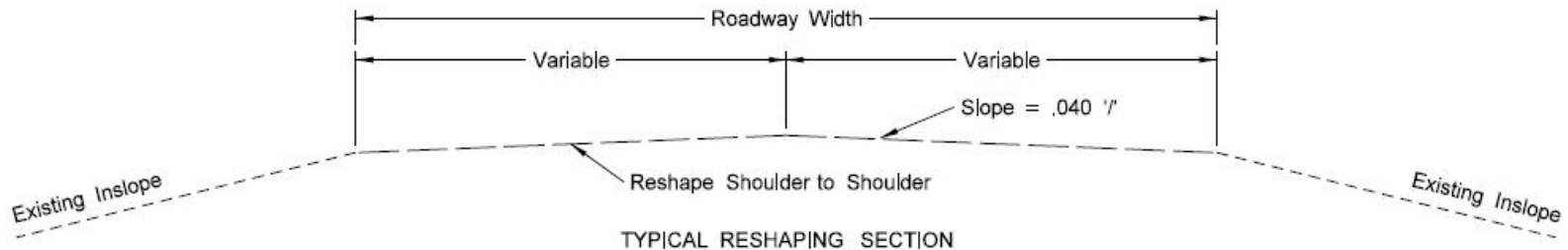
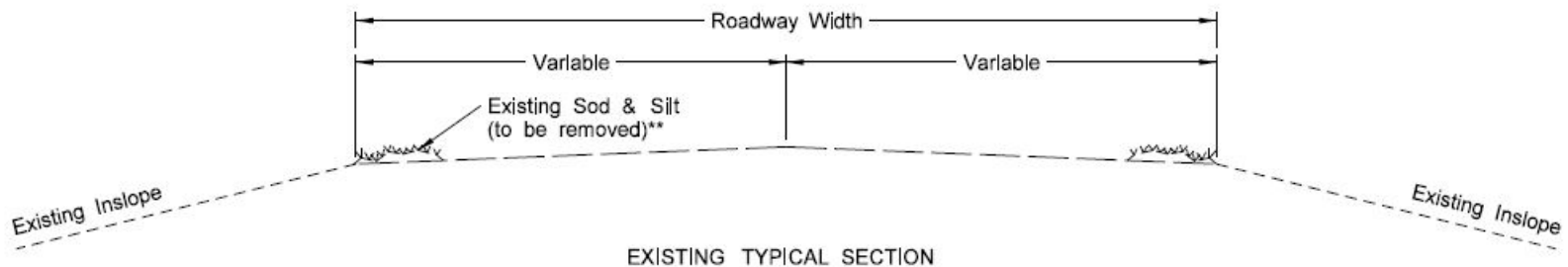
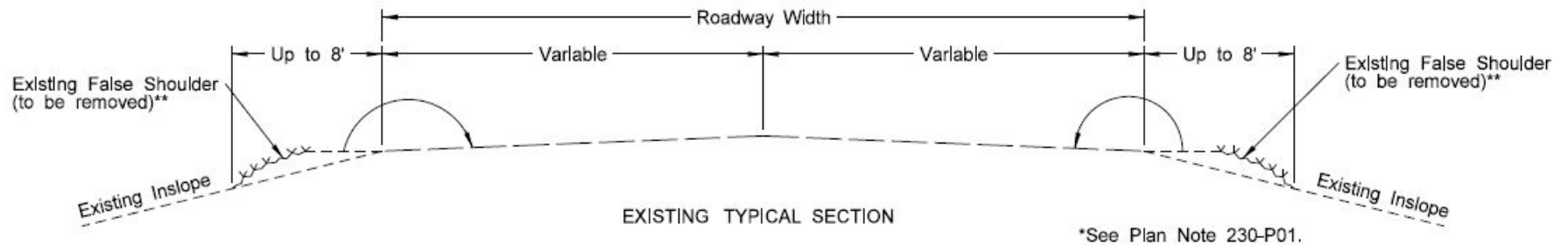
Roadway Shape

Poor Crown



**False
Shoulder**

Roadway Shape



Roadway Shape

- Reestablish Ditch/Shoulder Line
- Remove sod from roadbed
- Mow and disk area of inslope to pull up
- Minimize the vegetation brought to surface (sometimes a hay rake is used)
- Crown Road to 4%

Roadway Shape

- Breaking up sod with disk



Roadway Shape

- Windrow from pulling shoulder



Roadway Shape

- Reshaped road prior to adding gravel



Why Reshape the Road?



Washboards and Float

- Past Solution
 - Modified gradation to require more fines (minus 200)
 - Received Complaints from Public
 - No control of Plasticity Index (PI), may have been too much



Washboards and Float

- 2016 Solution
 - Added a PI requirement in 2016
 - Required PI of 4-9
 - Deduct if PI outside of the 4-9
 - Reject material if PI greater than 12



Surface Gravel Spec

Sieve	% Passing
1 inch	100
¾ inch	70-100
#4	38-75
#8	22-62
#30	12-45
#200	7-15

- Plasticity Index (PI) of 4-9 (used in 2016)
 - Conservative side of recommended 4-12

Lessons Learned

- Roads with PI closer to 9 are performing better than lower PI roads.
 - Next project will have PI range of 4-12
- Assure clay (not topsoil) is the material added to increase PI
- Watering, laydown, and compaction are required for a successful graveling project
- Gravel with higher PI takes more water to pack

Lessons Learned

- PI test results are not always consistent
- It takes 2 days to get PI test results
- Difficult to achieve PI and not exceed the minus 200 spec
- It took time to achieve proper PI balance
- Fat clays are better for PI
- Clay needs to be chopped up

Benefits of Testing

- Gravel Pits
 - Some meet PI without adding clay
 - Some needed imported clay to meet the PI requirements
- Without testing you don't know what you are getting

Final Laydown

Rubber
Tire
Roller



Final Laydown



Water
Truck

Finished Product



Finished Product Video



Summary

- Test your material so you know what you are getting
 - Meet surface gravel gradation
 - Include PI in the test, PI of 4-12 recommended
- Water and pack when adding gravel to a road

FHWA Gravel Road Construction & Maintenance Guide

- <https://www.fhwa.dot.gov/construction/pubs/ots15002.pdf>

Questions?



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