Advancements In Technology Deliver Better Roads At Lower Cost

Soils Treated with EMC SQUARED Stabilizer Replace Crushed Aggregate for 15 Miles of Heavily Trafficked County Roads in the Bakken Oil Field

Water ponded against embankment of County Route 5, stabilized with EMC SQUARED System subgrade


Drill rig operation adjacent to County Route 5, supported by heavy oil field service truck traffic


Photos on this page, front and rear cover courtesy of Lee Evans, P.E., Allied Engineering Services, Inc.

Completed Road Project
Constructed on top of EMC SQUARED® stabilized subgrade shown at right

Cost Saving Road Construction Technology Proves Successful for 15 Miles of Heavily Trafficked County Roads in the Bakken Oil Field

Advanced Engineering and Stabilization Technology Provide Million Dollar Cost-Savings

Located in the center of North Dakota's Bakken Oil Boom, Mountrail County utilized advanced engineering and construction technology to greatly reduce the amount of aggregate base rock required for two county road projects. The roads were redesigned from light duty farm roads to service the around the clock traffic of the oil field service trucks, aggregate haul trucks, construction equipment and oil field drill rigs operating in what has been the number one oil producing county in the state of North Dakota. Aggregate base rock is among the many construction materials that have skyrocketed in cost due to the tremendous market demand in the region and increasing transportation costs. The project design engineering consultants, Allied Engineering Services, Inc. (AES), investigated construction options to reduce costs. Conventional design would require a twenty-six inch thick aggregate base layer to properly support an asphalt pavement surface course to service the heavy oil field service truck traffic. Based upon the use of Mechanistic-Empirical Pavement Design (M-E) methodology, advanced laboratory and field test methods and an innovative stabilization product, the project engineers were able to develop a design which eliminated the requirement for fourteen inches of costly aggregate base rock and two inches of asphalt pavement over the 15 mile total length of the two construction projects. The alternative they selected involved treating a twelve inch thick layer of locally available native soil with a concentrated liquid stabilization product technology known as the EMC SQUARED® System. The environmentally friendly and economical EMC SQUARED System products are incorporated in the compaction water applied as part of the conventional moisture content adjustment and subgrade compaction operations typical of high standard road construction projects. The results of the Resilient Modulus laboratory tests and Falling Weight Deflectometer (FWD) field tests included in this case study confirm that the subgrade treated with the EMC SQUARED System product provided a stabilized layer with stiffness, or modulus, equal or better than the layer of crushed aggregate that it replaced.

Road Project Under Construction
Trimming and final compaction of stabilized subgrade

Based upon the input from Resilient Modulus testing of the stabilized subgrade soils, the M-E Design indicated that the two roads could be constructed on stabilized subgrades, thereby eliminating the requirement of almost 18,000 tons of imported aggregate base rock per mile of road. For added perspective, at 25 tons of aggregate per load, which eliminated 720 truck trips for each mile of road constructed. Key to this accomplishment was the extensive soil classification testing for both road projects and the resilient modulus testing conducted as preliminary steps so that the project design engineers would have the data necessary to develop the alternative structural section design. The resilient modulus method, which incorporates repeated loading in the test procedure to model the dynamic effects of heavy loads constantly impacting that subgrade, showed that the EMC SQUARED® System treatment more than doubled the average modulus value, or stiffness, of the subgrade after seven days of curing time, and improved it by four times after twenty-one days of curing time.

The conventional design for these county road projects was asphalt pavement on a twenty-six inch (26") thick layer of untreated aggregate base course material, and even thicker layers for more problematic areas of native subgrade. The alternative M-E designs for these roads that were selected for actual construction included an asphalt pavement layer of reduced thickness on a twelve-inch (12") thick layer of untreated aggregate base course materials placed on a twelve-inch (12") thick subgrade stabilized with the EMC SQUARED System treatment.

Accompanying the investment in preliminary soil classification and resilient modulus testing, the county made a commitment on the more problematic of the two projects, Mountrail County Route 5, also known as Ross Road, or 90th Avenue NW/55th Street NW, to have project engineer AES utilize laboratory resilient modulus testing services and nondestructive field testing with Falling Weight Deflectometer (FWD) equipment as quality control measures during field construction. Samplings of the engineering tests conducted for this project follow. The FWD tests allow the project engineer to evaluate the relationship between the modulus values used as the basis for the structural section design values, and the modulus values achieved in the actual constructed road project. Similar to the laboratory Resilient Modulus testing, field evaluation by Falling Weight Deflectometer equipment also provides modulus value measurements. The advantages of FWD equipment are that it can be utilized to evaluate the strength of the subgrade and other structural section layers after road construction has been completed, it can test many locations along the length of the road in a single day and the data can be provided within days of the field testing. Unlike Resilient Modulus testing in the laboratory, which evaluates the strength of the stabilized subgrade soil as a single element (elemental testing) in the road design, the FWD field testing for this project was programed for a full depth evaluation of subgrade conditions. In this case, the testing firm made the decision to measure down to a depth of one hundred-twenty-inches (120"), or ten feet deep, and averaging in the modulus of the twelve inches (12") of stabilized subgrade along with nine feet of untreated soil in the native subgrade below the stabilized

Road Project Under Construction
Construction traffic driving on EMC SQUARED® stabilized subgrade

layer, functioning as a composite system, and evaluated as a single system in the testing analysis (systemic testing). Because of the more rapid feedback offered by FWD testing, AES transitioned the quality control program as the project progressed from laboratory resilient modulus testing, which required daily collection and shipment of stabilized soil samples to the testing lab, to use of FWD field testing for more timely test results. As stated in the testing engineer's letter included in this case study, which summarizes the FWD testing conducted for this project, the field test results confirmed that the stiffness of the stabilized subgrade was higher than the design values, based upon the laboratory Resilient Modulus testing, that the project engineer had used as his input to provide the pavement structural section design.

Complicating the design assignment for the Mountrail County Route 5 project was the significant variability in the native soils types available for construction of the stabilized subgrade and the considerable variation in the topography and drainage conditions along the alignment of this 9.1 mile road project. With Atterberg Limits testing of the native subgrade soils sampled from the road alignment providing Plasticity Index results ranging from PI 7 for a Silty Clayey Sand up to a PI 35 for an expansive Fat Clay, the modulus values of the native soils were highly variable. The EMC SQUARED System stabilizer treatment demonstrated its broad-spectrum effectiveness in improving the stiffness and load bearing capacity of the full range of soil types on this project.

This area of Mountrail County has the constantly varying topography and poor drainage conditions typical of much of Northwestern North Dakota and the Bakken Field area. The terrain varies from undulating to rolling. Lakes, ponds and widespread swampy conditions predominate in areas where there is no natural drainage. The Mountrail County Route 5 project alignment included all these poor drainage conditions, running through a terrain dotted with lakes and duck ponds, better suited for waterfowl habitat than road building. One section of the road was built through a lake. Areas of native subgrade along this alignment included swampy undrained soils and fat expansive clays soils. Rather than generate a costly conventional road structural design for the entire length of the road to accommodate these limited areas with poor soils and extremely low strength native subgrades in the wetlands areas, the M-E Design methodology was used to further address the problem areas along the road alignment; the section of road being constructed through the lake being one example. Approximately 1.82 miles, or twenty percent of the 9.1 mile long road project required a thickened aggregate base course layer, in addition to the stabilized subgrade, in order to meet design requirements for a road traversing such highly variable ground conditions.

The second Mountrail County road constructed using the same M-E Design developed by Allied Engineering Services, Inc., with the EMC SQUARED System stabilized subgrade, was Mountrail County Route 10 (also known as 51st Street NW, or Belden Road), running six miles east from North Dakota Highway 8 at Belden.

Road Project Under Construction

Placement of aggregate base course material on EMC SQUARED® stabilized subgrade

While the County Route 10 Project is not the subject of this case study, Project Engeer Lee Evans, following his most recent inspection of the two paved roads constructed above the EMC SQUARED System stabilized subgrade, commented that both roads are in excellent condition. “Both roads look and ride great from a structural and performance standpoint. No issues whatsoever!”

County roads in North Dakota and many other states with extreme cold climates are subject to spring load restrictions to protect the expensive asphalt pavements from damage while the subgrade soils that were frozen sometimes several feet deep or more over the winter lose their stiffness and stability during the spring thaw. While most of the county roads in Mountrail County and other counties throughout the State of North Dakota were subject to load restrictions (limiting the maximum axle weights and gross weights permitted on the road during the period of restriction), the County Engineer for Mountrail County made the determination that newly reconstructed County Route 5, built on top of the stabilized subgrade, would not require any load restrictions during the spring thaw season. Truck traffic was allowed full use of the road without any load restrictions beyond the legal limits of 20,000 pounds per single axle and a gross weight limit of 105,500 pounds. For additional perspective on the heavy loading these county roads are receiving in the leading oil producing county in North Dakota’s Bakken Field area, the local NDFreePress news reported on a sting operation conducted by the Mountrail County Sherriff’s Department and the North Dakota Highway Patrol in late winter, which found that 70 percent of the trucks that they checked were overloaded (over the legal weight limits). Monitoring the County Route 5 Project during the spring, season when overweight and oversized loads were on the road during drill rig moves, Project Engineer Lee Evans commented that there was zero deflection in pavement. Mountrail County reports that the Average Daily Traffic (ADT) count for County Route 5 is approximately 3,200 passes, approximately half of which is heavy truck traffic. That works out to approximately one truck per minute on a 24 hour per day, seven days per week basis. Route 5 is built through an area with high ground water and soft subgrade conditions in a cold region noted for extremely low winter temperatures and severe freeze-thaw cycles. The stabilized moisture barrier performance of the EMC SQUARED System subgrade treatment has proven to be an excellent match for roads supporting heavily loaded oilfield service truck traffic in the middle of the oil boom activity in the Bakken Field. At the six year mark, the word from local residents is the road still looks like the day it was paved.

Subgrade stabilization makes more sense than ever under roads in severe cold climate areas that are subject to high frequency truck traffic with heavy loads — often over the legal weight limit, even during the spring thaw season. As notable as is the strong performance of these two roads, the important fact is that they were constructed at far lower cost and environmental impact as the result of replacing the fourteen inch thick aggregate subbase layer required by conventional road design with twelve inches of native soil stabilized using the long-lasting and economical EMC SQUARED System stabilization product technology.

The grain size distribution curves, Atterberg limits chart and USDA Textural Classification chart normalized to 100 percent passing 2.00 mm are included with this report. We thank you for using Pioneer Technical Services for your geotechnical and materials testing requirements. If you have any questions regarding these results, please contact Todd Lorenzen or Paul Bushnell at (406) 443-6053.

Sincerely,
PIONEER TECHNICAL SERVICES, INC.

Todd Lorenzen, P.E.
Senior Geotechnical Engineer

Paul Bushnell
Materials Testing Supervisor

Table 5 – Ross Road South - Classifications, Particle Sizes, Atterberg Limits

Lab No.	Classification			Gradation Analysis				Atterberg Limits		
	USDA	USCS	AASHTO	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit	Plastic Limit	Plasticity Index
10671	----	Sandy Lean Clay (CL)	A-6(7)	8.2	31.8	60.0		35	16	19
10672	Loam	Sandy Lean Clay (CL)	A-6(10)	0.9	30.6	46.5	22.0	38	22	16
10673	----	Sandy Lean Clay (CL)	A-6(12)	3.8	34.0	62.2		37	13	24
10674	Clay Loam	Sandy Lean Clay (CL)	A-6(12)	1.6	32.5	40.1	25.8	38	17	21
10675	----	Sandy Lean Clay (CL)	A-6(9)	7.1	34.6	58.3		38	17	21
10676	Loam	Sandy Lean Clay (CL)	A-6(11)	0.5	29.5	46.0	23.9	36	17	19
10677	----	Sandy Lean Clay (CL)	A-6(11)	1.5	34.3	64.1		37	16	21
10678	Clay Loam	Sandy Lean Clay (CL)	A-6(13)	2.1	30.5	40.8	26.6	36	13	23
10679	----	Sandy Lean Clay (CL)	A-6(8)	2.7	30.5	66.8		31	16	15
10680	Loam	Lean Clay with Sand (CL)	A-7-6(15)	1.7	22.5	50.6	25.2	41	21	20
10681	----	Lean Clay with Sand (CL)	A-7-6(22)	0.9	18.5	80.6		49	23	26
10682	Clay Loam	Lean Clay with Sand (CL)	A-7-6(20)	0.8	19.3	50.7	29.2	46	21	25
10683	----	Silty, Clayey Sand (SC-SM)	A-4(0)	0.0	60.0	39.9		23	16	7
10684	Loam	Sandy Lean Clay (CL)	A-6(8)	7.0	34.8	43.0	15.2	40	23	17
10685	----	Lean Clay (CL)	A-6(17)	6.9	5.8	87.4		34	13	21
10686	Loam	Sandy Lean Clay (CL)	A-6(8)	2.1	37.3	39.6	21.0	37	19	18
10687	----	Sandy Lean Clay (CL)	A-7-6(13)	0.6	32.1	67.3		42	20	22
10688	Clay Loam	Sandy Lean Clay (CL)	A-6(12)	1.8	31.3	39.8	27.1	36	14	22
10689	----	Lean Clay with Sand (CL)	A-7-6(22)	2.7	14.9	82.5		48	22	26
10690	Clay	Lean Clay (CL)	A-7-6(28)	0.0	2.9	50.6	46.5	44	17	27
10691	----	Fat Clay (CH)	A-7-6(33)	3.9	7.0	89.1		53	18	35
10692	Loam	Sandy Lean Clay (CL)	A-6(5)	1.0	40.6	43.4	15.0	32	18	14
10693	Loam	Sandy Lean Clay (CL)	A-6(8)	9.9	32.2	37.8	20.2	39	20	19
10694	----	Lean Clay with Sand (CL)	A-7-6(11)	0.7	28.8	70.4		42	25	17
10695	Clay Loam	Sandy Lean Clay (CL)	A-7-6(13)	2.9	34.7	32.1	30.3	44	19	25

July 21, 2011

Subject: Laboratory Testing,
Fabrication And Testing of Resilient
Modulus Specimens, Delivered Soil
Samples, Commerce City. Co

Job No. **11-1116**

Mr. Craig Madsen
Allied Engineering Services, Inc.
32 Discovery Drive
Bozeman, Montana 59718

Dear Mr. Madsen,

As requested analytical testing was completed on four composite samples of soil compiled from 10 individual soil samples delivered to our laboratory by your representative. The composite samples were compiled based on the testing schedule dated 5/31/22 that was delivered to our laboratory with the samples. After compiling the composite samples, Modified Proctors were run and 4" x 8" Resilient Modulus Specimens were fabricated and cured based on the specifications detailed in the testing schedule. Additionally, Resilient Modulus specimens were fabricated and cured on specimens treated with the EMC Squared Liquid Stabilizer that was shipped to our lab with the soil samples. The dosage of EMC Squared that was added to the treated soil samples was calculated as outlined in the EMC Squared Technical Bulletin No.8337.EMC^2 that was provided to our lab by your representatives.

The following testing was completed for each of the composite samples in general accordance with the respective standards, Modified Proctor (ASTM D 1557) and Resilient Modulus of Soils (AASHTO T-307).

The results of the testing are attached.

If you have any questions regarding this data, please do not hesitate to contact our office.

GROUND ENGINEERING CONSULTANTS, INC.

Sincerely,

Nick Andrade
Laboratory Supervisor

Reviewed By James B. Kowalsky, P.E.

Non-Stabilized Soil Material Cured for 7 Days

GROUND
ENGINEERING CONSULTANTS

RESILIENT MODULUS OF SUBGRADE SOILS AASHTO T 307

Job Name: Allied Engineering Lab Testing 2011
Job Number: 11-1116
Date: 06/20/11
Sample # Composite B
Received From: Allied Engineering Services, Inc
Location: Ross Road South - Ross ND (AESI Project # 11013)
Soil Type: Non-Stabilized Material Cured At Room Temperature For 7 Days
Density *(pcf)*: 115.5 Sample Height *(inches)*: 8.001
Moisture Content *(%)*: 12.0 Sample Diameter *(inches)*: 4.002

Chamber Pressure *(psi)*	Axial Load *(psi)*	Resilient Modulus *(psi)*	Recoverable Deformation *(inches x 10^{-3})*
6.0	2.0	5,213	2.1
6.0	4.0	4,162	7.3
6.0	6.0	4,116	10.4
6.0	8.0	4,471	13.2
6.0	10.0	4,732	15.4
4.0	2.0	4,400	3.6
4.0	4.0	3,925	7.7
4.0	6.0	4,025	10.8
4.0	8.0	4,410	12.8
4.0	10.0	4,882	14.7
2.0	2.0	4,462	3.6
2.0	4.0	4,056	7.5
2.0	6.0	4,221	10.3
2.0	8.0	4,593	12.7
2.0	10.0	5,016	14.3

Testing performed in accordance with AASHTO T-307
Samples were conditioned for 500 cycles under a confining pressure of 6 psi with an axial load of 4 psi prior to testing.
Each Cell Pressure and Axial Load was applied for 100 cycles; the Resilient Modulus shown above is the average of the last 3 cycles recorded (generated by the software, no additional data is available).

Comments:

The sample was remolded to approximately 95% of the maximum dry density and at approximately the respective optimum moisture content based on a modified proctor (ASTM D 1557).

Soil Treated with EMC SQUARED Stabilizer
Cured for 7 Days

GROUND
ENGINEERING CONSULTANTS

RESILIENT MODULUS OF SUBGRADE SOILS AASHTO T 307

Job Name: Allied Engineering Lab Testing 2011
Job Number: 11-1116
Date: 06/20/11
Sample # Composite B
Received From: Allied Engineering Services, Inc
Location: Ross Road South - Ross ND (AESI Project # 11013)
Soil Type: Treated With EMC Squared Stabilizer And Cured At Room Temperature For 7 Days
Density *(pcf)*: 115.4 Sample Height *(inches)*: 8.000
Moisture Content *(%)*: 12.5 Sample Diameter *(inches)*: 4.000

Chamber Pressure *(psi)*	Axial Load *(psi)*	Resilient Modulus *(psi)*	Recoverable Deformation *(inches x 10^{-3})*
6.0	2.0	14,542	0.8
6.0	4.0	12,785	2.2
6.0	6.0	12,874	3.1
6.0	8.0	12,479	4.2
6.0	10.0	12,387	5.0
4.0	2.0	11,409	1.4
4.0	4.0	11,268	2.7
4.0	6.0	11,573	3.6
4.0	8.0	11,931	4.3
4.0	10.0	12,419	5.0
2.0	2.0	12,047	1.3
2.0	4.0	11,471	2.5
2.0	6.0	11,900	3.5
2.0	8.0	12,194	4.1
2.0	10.0	13,357	4.8

Testing performed in accordance with AASHTO T-307
Samples were conditioned for 500 cycles under a confining pressure of 6 psi with an axial load of 4 psi prior to testing.
Each Cell Pressure and Axial Load was applied for 100 cycles; the Resilient Modulus shown above is the average of the last 3 cycles recorded (generated by the software, no additional data is available).

Comments:

The sample was remolded to approximately 95% of the maximum dry density and at approximately the respective optimum moisture content based on a modified proctor (ASTM D 1557).

Soil Treated with EMC SQUARED Stabilizer
Cured for 21 Days

GROUND
ENGINEERING CONSULTANTS

RESILIENT MODULUS OF SUBGRADE SOILS AASHTO T 307

Job Name: Allied Engineering Lab Testing 2011
Job Number: 11-1116
Date: 07/20/11
Sample # Composite B
Received From: Allied Engineering Services, Inc
Location: Ross Road South - Ross ND (AESI Project # 11013)
Soil Type: Treated With EMC Squared Stabilizer And Cured At Room Temperature For 21 Days
Density *(pcf)*: 115.6 Sample Height *(inches)*: 8.000
Moisture Content *(%)*: 12.4 Sample Diameter *(inches)*: 4.000

Chamber Pressure *(psi)*	Axial Load *(psi)*	Resilient Modulus *(psi)*	Recoverable Deformation *(inches x 10^{-3})*
6.0	2.0	22,525	0.3
6.0	4.0	27,968	1.0
6.0	6.0	25,586	1.5
6.0	8.0	24,082	2.0
6.0	10.0	25,013	2.3
4.0	2.0	30,831	0.4
4.0	4.0	26,156	1.0
4.0	6.0	23,497	1.5
4.0	8.0	25,185	1.9
4.0	10.0	24,944	2.5
2.0	2.0	34,582	0.3
2.0	4.0	27,188	0.9
2.0	6.0	23,705	1.5
2.0	8.0	23,673	2.0
2.0	10.0	24,811	2.8

Testing performed in general accordance with AASHTO T-307
Samples were conditioned for 500 cycles under a confining pressure of 6 psi with an axial load of 4 psi prior to testing.
Each Cell Pressure and Axial Load was applied for 100 cycles; the Resilient Modulus shown above is the average of the last 3 cycles recorded (generated by the software, no additional data is available).

Comments:

The sample was remolded to approximately 95% of the maximum dry density and at approximately the respective optimum moisture content based on a modified proctor (ASTM D 1557).

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
• ENVIRONMENTAL
• GEOTECHNICAL
• MATERIALS
• FORENSICS

July 20, 2012

Mr. Lee Evans
Allied Engineering
32 Discovery Drive
Bozeman, MT 59718

RE: Non-destructive Pavement Evaluation
Ross Road Project
Mountrail County, North Dakota
Report No. 28-0562

Dear Mr. Evans:

We are submitting this letter report of the pavement evaluation we performed on the pavement of the Ross Road Project, located in Mountrail County, North Dakota.

1.0 BACKGROUND

Mountrail County is reconstructing 55th Street NW (Ross Road Project) located in Mountrail County, North Dakota. The design called for a 12" stabilized subgrade with chemical stabilizer called EMC^2 which is supposed to provide a resilient modulus of greater than 12 ksi. At the time of AET performing field testing there was a layer of base gravel in place on top of the stabilized subgrade.

To evaluate the strength of the pavement layers and the overall pavement, Falling Weight Deflectometer (FWD) testing was performed in the field. The FWD equipment is capable of providing test data that allows the simultaneous calculation of Resilient Modulus (similar to elastic modulus) of gravel, concrete, and bituminous surfaces, as well as aggregate base and subgrade in a non-destructive manner while testing the performance of a large area of pavement in a single day. The FWD produces a force impulse through the layers which closely simulates a moving wheel load and it provides a means to determine the equivalency of various materials in relation to their ability to support dynamic or repetitive loading.

The testing was performed at 500-foot spacing in each of the driving lanes producing net 250-foot spacing along the roadway alignment on June 20, 2012. The base gravel layer thicknesses were measured by Allied Engineering and were used as an input for back-calculating the Resilient Modulus of pavement layers from FWD data. A sample of base gravel was taken in the middle of the tested section.

1 ksi = 1000 psi

2.0 RESULTS

The 55^{th} Street NW project was under construction and closed to traffic during FWD testing. A thunder storm passed the site prior to FWD testing, resulting in the aggregate base layer (the surface layer during testing) to become saturated.

Thirty four locations on the base gravel were selected for FWD testing and thirty two locations for measuring the thickness of base gravel. The thickness of base gravel ranged from 3.8 to 15 inches. The back-calculated resilient modulus results are shown in the following table.

Road	From	To	Base Modulus (ksi)			Subgrade Modulus (ksi)		
			Avg	**CV**	**15th**	**Avg**	**CV**	**15th**
55^{th} Street NW	TH 1804	1.5 mi E	8.6	68%	3.3	16.4	26%	12.8

Note: Avg – Average; CV – Coefficient of Variation, %; 15^{th} – 15^{th} Percentile.

As shown in the table above, the base gravel strength is highly variable (CV = 68% for the base modulus). Our review of the base gravel sample indicates that base material is poorly graded sand and gravel (not crushed) and wet. As a result, the averaged base modulus is lower than that of a typical aggregate subbase gravel (15 ksi). The subgrade modulus has a reasonable variability and has a value higher than the expected value (12.8 ksi) at the 85^{th} reliability.

3.0 CONCLUSIONS

The values of back calculated (from field FWD testing) resilient moduli of the stabilized subgrade are higher than the design value, so that the subgrade appears to be adequate to withstand the traffic loading in the design at the 85^{th} reliability.

The base gravel is low in strength, and the strength is highly variable due to a relatively high sand content, low amount of crushed material, high moisture content and low compaction. The base gravel should be dried and recompacted prior to placement of the bituminous surfacing, or it is likely that it will rut when exposed to heavy truck loading.

1 ksi = 1000 psi

Non-destructive Pavement Evaluation
Ross Road Project, Montrail County, ND
AET Project # 28-00562

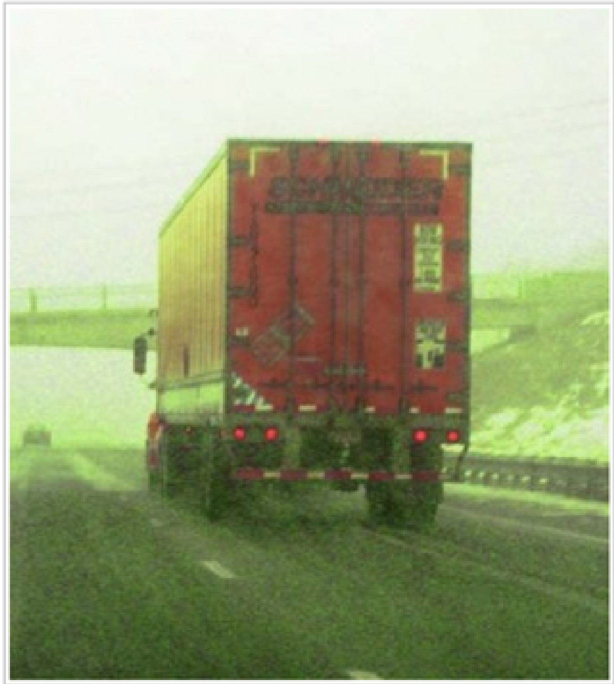
Layer Moduli by Test Location

Station	Lane	Subbase		Subgrade * Modulus, ksi	Lane Side
		Depth, in.	Modulus, ksi		
406+52	L	4.8	7.0	14.8	N
407+72	R	4.8	6.5	14.2	S
410+45	L	11.0	30.5	19.5	N
413+72	R	10.0	6.5	13.6	S
415+73	L	11.0	9.8	18.1	N
418+37	R	8.5	9.5	14.6	S
421+01	L	9.8	8.4	26.1	N
423+65	R	8.0	8.0	15.2	S
426+72	L	11.0	3.3	9.6	N
428+93	R	7.5	7.1	12.9	S
431+28	L	9.0	2.9	14.7	N
434+12	R	10.0	8.6	15.4	S
436+85	L	12.0	10.8	12.9	N
439+49	R	11.5	11.2	14.0	S
442+13	L	9.3	8.0	13.6	N
444+84	R	8.8	6.7	11.9	S
447+41	L	11.5	23.4	20.2	N
450+56	R	8.5	14.9	23.7	S
452+69	L	8.0	14.1	27.5	N
455+33	R	3.8	1.3	13.1	S
457+97	L	8.5	5.1	11.9	N
460+72	R	8.5	5.4	15.5	S
463+12	L	5.0	6.7	12.7	N
468+04	L	6.5	3.7	17.6	N
471+28	R	6.0	2.0	14.3	S
473+88	L	6.0	4.8	23.1	N
476+72	R	4.5	2.5	11.8	S
479+09	L	6.5	6.3	12.8	N
481+72	R	9.0	8.4	19.7	S
484+37	L	9.0	14.2	20.3	N
487+01	R	15.0	9.2	18.3	S
488+16	R	15.0	12.0	15.8	S
489+65	L	10.0	2.8	16.4	N
489+65	R	10.0	11.0	20.1	S
489+95	TH 1804				

***Note: According to the author of this report, Mr. Chunhua Han, P.E., of American Engineering Testing Inc. (AET), this FWD testing was set up as a single layer analysis incorporating both the 12 inch thick stabilized subgrade layer and the 108 inches of native subgrade below in the test results reported here.**

Highway Patrol Mountrail County Check Reveals 70 Percent of Trucks Overweight

By NDFreePress Staff on March 6, 2013

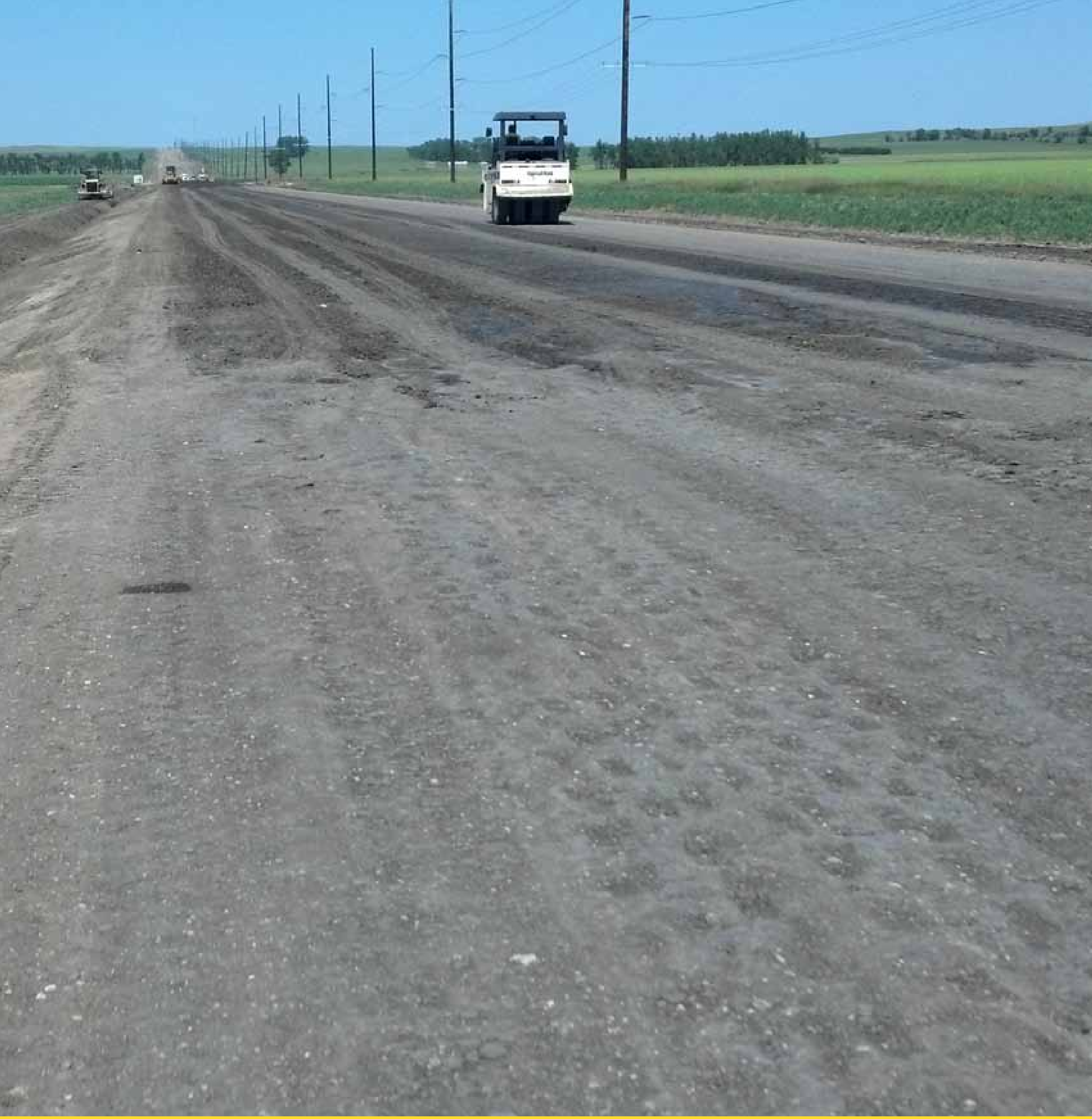


Bismarck, N.D. – The North Dakota Highway Patrol, along with the Mountrail County Sheriff's Department, conducted a one-day commercial motor vehicle saturation. The event was held Feb. 27 in Stanley, New Town, Parshall and surrounding areas with the goal of identifying and addressing risk factors within the trucking industry to enhance the safety and welfare of all North Dakota motorists.

Fourteen vehicles were weighed with 10 in excess of legal weight allowances. Overweight vehicles contribute to accelerated deterioration of roadway surfaces, resulting in safety concerns for motorists and expensive repairs for taxpayers. The operators of the overweight vehicles were assessed civil penalties. The combined fees collected for weight violations exceeded $22,500.

Roadside inspections of drivers and commercial motor vehicles were conducted for compliance with federal and state regulations. Twelve drivers and vehicles were inspected, revealing 13 violations. The process included inspecting commercial motor vehicles and checking the qualifications of the drivers who operate them.

The NDHP and Mountrail County plan to continue collaborative weight enforcement efforts to help maintain the integrity of county roads and state highways.



Road Project Under Construction
Trimming and final compaction of stabilized subgrade