Highways and Road Conditions

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Challenges On Road Conditions

The NDDOT is faced with many challenges in keeping our highways in good condition.

- Many county, township and state roadways were designed and built in the 1950's and 60's, and were originally built to handle small loads for agriculture traffic (small grains and ranching) and were not built to carry the heavy loads associated with the large farm operations and oil development of today.

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Challenges On Road Conditions

Overweight loads:

- Illegally overweight truckloads can seriously damage county and township roadways as well as state highways.
- Increased axle weight is the primary cause of road and pavement damage because every axle passing over a highway consumes a portion of the pavement's life.

Over width and over height equipment:

- The size of vehicles and equipment has changed dramatically over the years.
- State bridge clearance ranges from 14 to 16 feet depending on the bridge.
- Traffic lanes are 12 feet wide.

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Oversize Loads

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Oversize Loads

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Truck-Pavement Interaction

The gross vehicle weight (GVW) of a vehicle is not the prime determinant of a vehicle's impact on pavements.

- Pavements are stressed by loads on individual axles and axle groups directly in contact with the pavement.
- The GVW, along with the number and types of axles and the spacing between axles, determines the axle loads.

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Axle Weight and Gross Vehicle Weight

There are two aspects of truck weight that are interdependent and that interact with the highway infrastructure -- axle weight (loading) and GVW.

The effect of axle weight is more significant to pavements and short-span bridges, whereas GVW is of more significance to long-span bridges.

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What is an ESAL?

ESAL is an acronym for **E**quivalent **S**ingle **A**xle **L**oad.

- Concept developed out of the American Association of State Highway Officials (AASHTO) Road Test (early 1960's).
- Establishes a pavement damage relationship for axles carrying different loads.

ESAL = 18,000 pound load on a single axle with dual tires.

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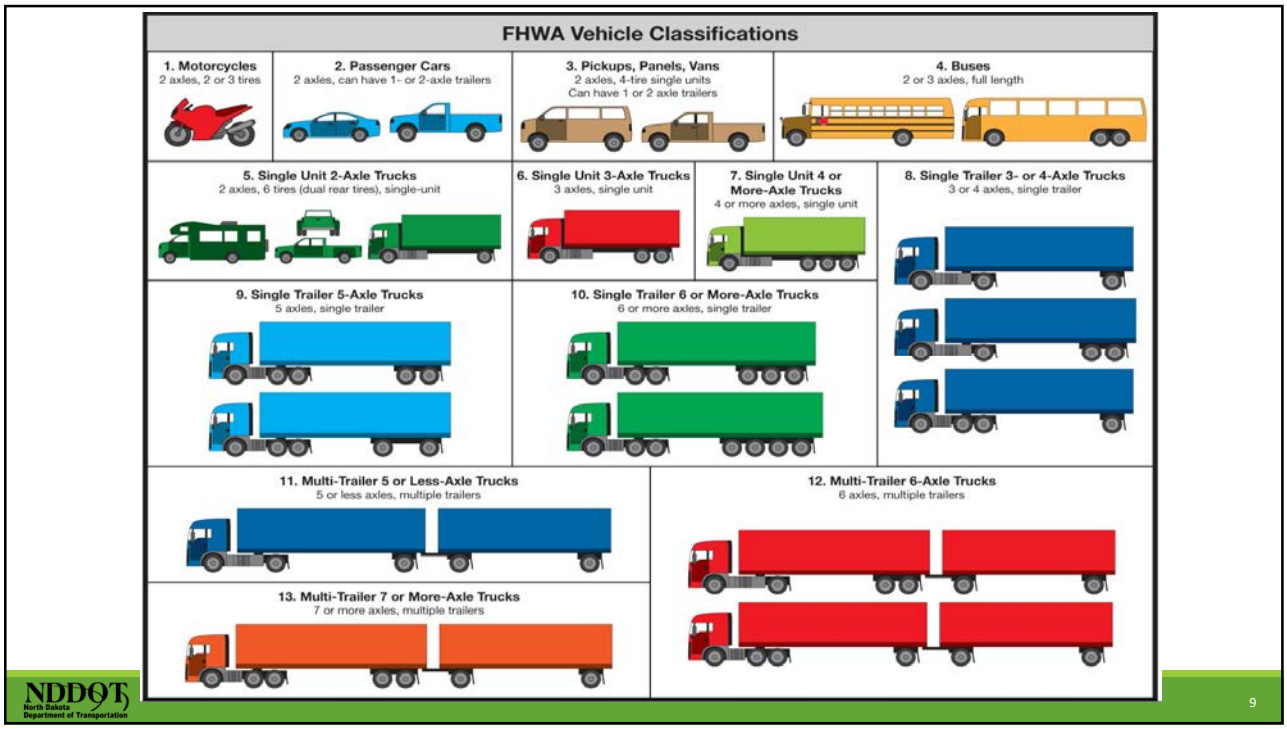
FHWA Vehicle Classifications
1. Motorcycles
2 axles, 2 or 3 tires
2. Passenger Cars
2 axles, can have 1- or 2-axle trailers
3. Pickups, Panels, Vans
2 axles, 4-tire single units
Can have 1 or 2 axle trailers
4. Buses
2 or 3 axles, full length
5. Single Unit 2-Axle Trucks
2 axles, 6 tires (dual rear tires), single-unit
6. Single Unit 3-Axle Trucks
3 axles, single unit
7. Single Unit 4 or More-Axle Trucks
4 or more axles, single unit
8. Single Trailer 3- or 4-Axle Trucks
3 or 4 axles, single trailer
9. Single Trailer 5-Axle Trucks
5 axles, single trailer
10. Single Trailer 6 or More-Axle Trucks
6 or more axles, single trailer
11. Multi-Trailer 5 or Less-Axle Trucks
5 or less axles, multiple trailers
12. Multi-Trailer 6-Axle Trucks
6 axles, multiple trailers
13. Multi-Trailer 7 or More-Axle Trucks
7 or more axles, multiple trailers
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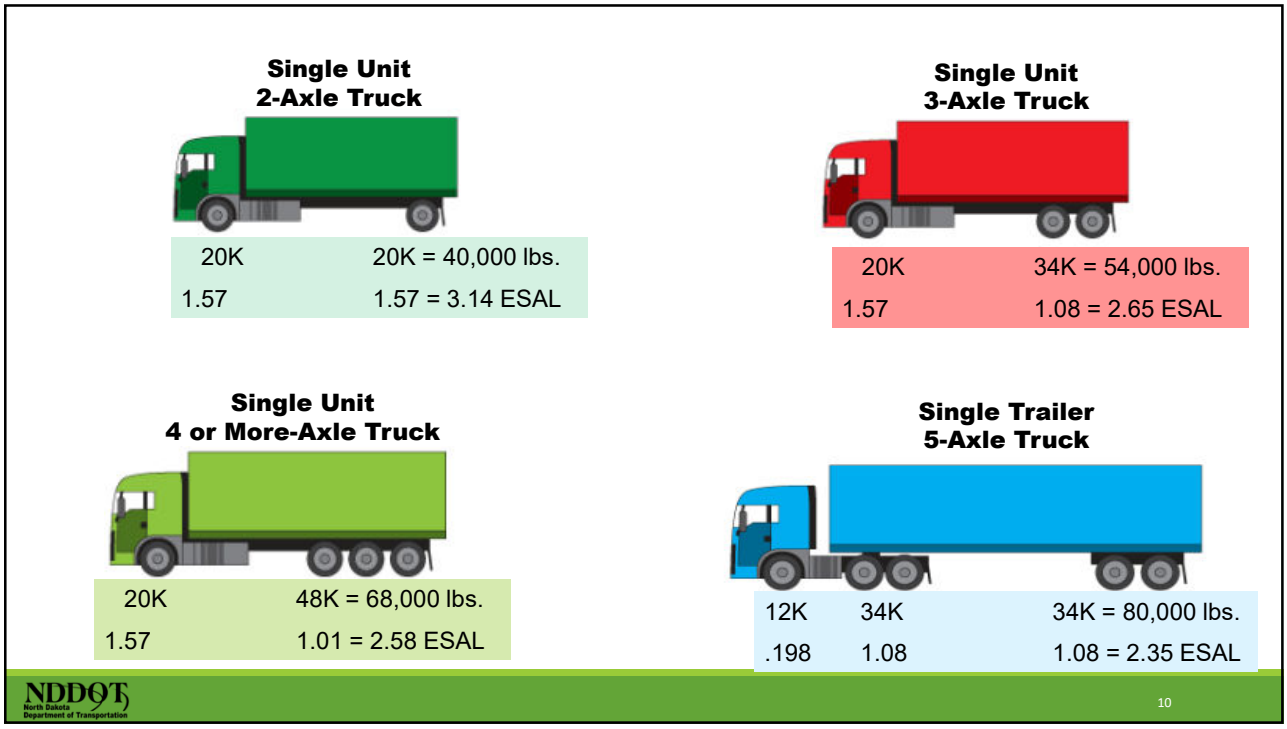
Single Unit
2-Axle Truck
20K
20K = 40,000 lbs.
1.57
1.57 = 3.14 ESAL
Single Unit
3-Axle Truck
20K
34K = 54,000 lbs.
1.57
1.08 = 2.65 ESAL
Single Unit
4 or More-Axle Truck
20K
48K = 68,000 lbs.
1.57
1.01 = 2.58 ESAL
Single Trailer
5-Axle Truck
12K
34K
34K = 80,000 lbs.
.198
1.08
1.08 = 2.35 ESAL
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Single Trailer
6 or More-Axle Truck

12K	34K	48K = 94,000 lbs.
.198	1.08	1.01 = 2.29 ESAL

Multi-Trailer
7 or More-Axle Truck

12K	34K	34K	20K	20K=120,000 lbs.
.198	1.08	1.08	1.57	1.57 = 5.49 ESAL

Multi-Trailer
7 or More-Axle Truck

12K	33K	28K	28K	28K=129,000 lbs.
.198	1.00	.493	.493	.493 = 2.67 ESAL

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Pavement Considerations

Engineers design roads to accommodate projected vehicle loads, in particular, heavy vehicle axle loads.

- The life of a pavement is related to the magnitude and frequency of these heavy axle loads. Pavement engineers use the concept of an equivalent single-axle load (ESAL) to measure the effects of heavy vehicles on pavements.
- Any truck axle configuration and weight can be converted to this common unit of measure. Adding axles to a truck can greatly reduce the impact on pavement.

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Effect of ESALs on pavements

The effect of ESALs on pavements is not constant throughout the calendar year.

During the winter when the ground is frozen, a given traffic loading does much less damage to pavements than at other times of the year.

During the spring, pavement layers are generally in a saturated, weakened state due to partial thaw conditions and trapped water. A given traffic loading during spring thaw results in five to eight times more damage to pavements than that same loading at other times of the year

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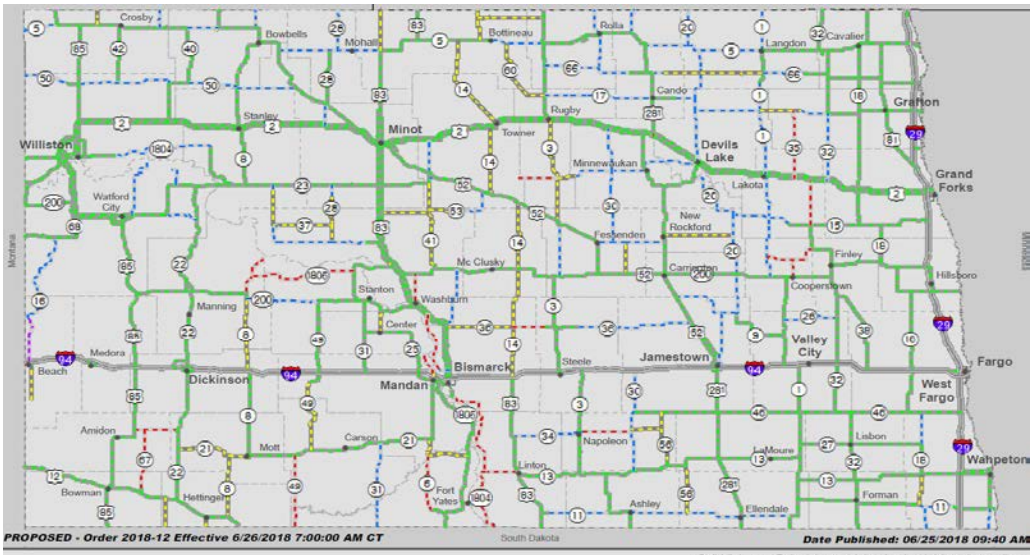
Spring Load Restrictions



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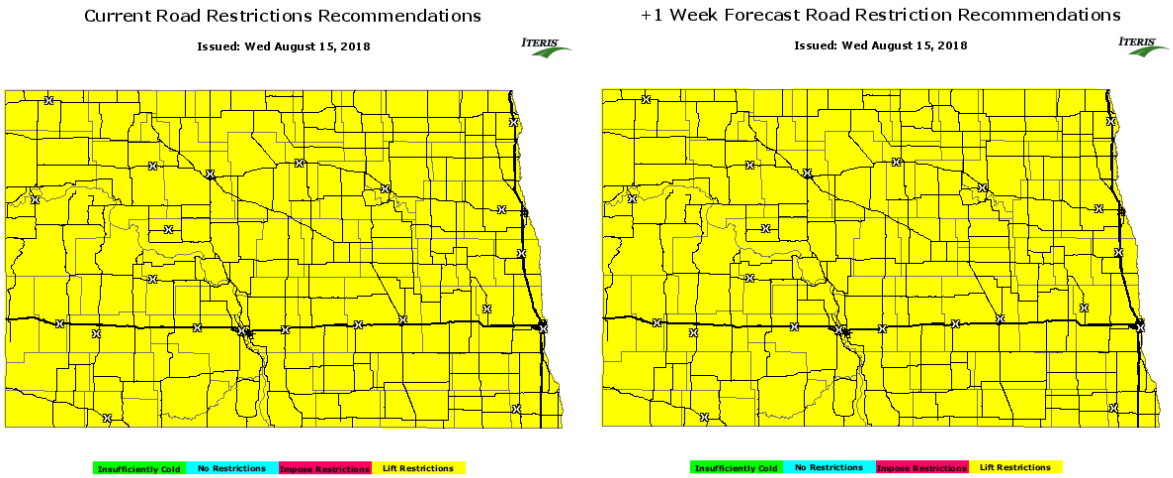
Tools used to determine Spring Load Restrictions



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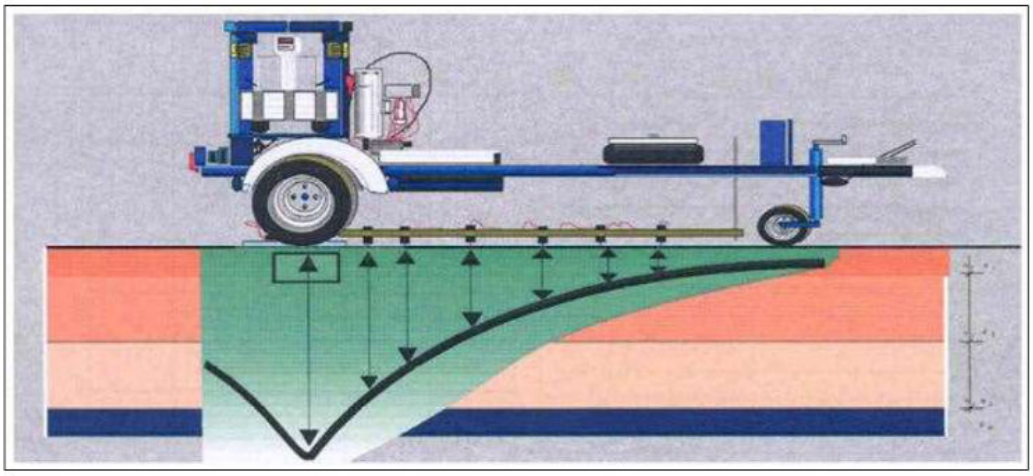
Tools used to determine Spring Load Restrictions

FALLING WEIGHT DEFLECTOMETER



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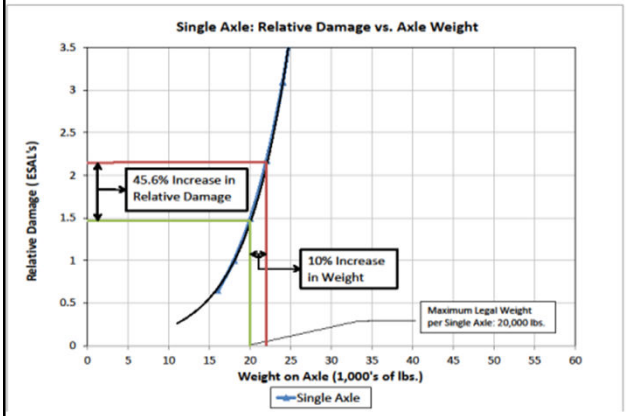
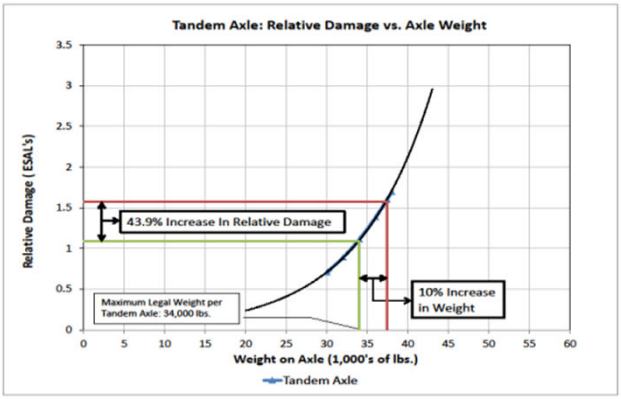
Overloads cause increased road damage

The chart below illustrates how a single axle overload causes increased road damage:



The chart below shows how a 10% tandem axle overload increases road damage by nearly 44%, compared to a legal tandem of 34,000 pounds.



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Overloads cause increased road damage

Overweight truckloads cause rutting and other damage to US Highway 85 in western North Dakota during the oil boom.

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House Bill 1321 – 10% Harvest Permit

A farmers farm vehicle or a motor carrier hired by a farmer to exceed the weight limitations in subsections 1 and 2 by ten percent.

- The permits must provide only for movement of agricultural products:
  - From the field of harvest to the point of initial storage or to the first point of sale and transfer of possession during harvest; or
  - From the point of initial storage to the first point of sale and transfer of possession during the current year's harvest.

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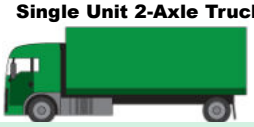
10% Harvest Permit

Single Unit 2-Axle Truck



20K	20K = 40,000 lbs.
1.57	1.57 = 3.14 ESAL
22K	22K = 44,000 lbs.
2.38	2.38 = 4.76 ESAL

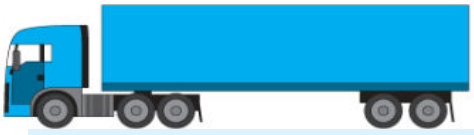
Single Unit 3-Axle Truck

20K	34K = 54,000 lbs.
1.57	1.08 = 2.65 ESAL
22K	37.4K = 59,400 lbs.
2.38	1.70 = 4.08 ESAL

Single Unit 4 or More-Axle Truck

20K	48K = 68,000 lbs.
1.57	1.01 = 2.58 ESAL
22K	52.8K = 74,800 lbs.
2.38	1.51 = 3.89 ESAL

Single Trailer 5-Axle Truck



12K	34K	34K = 80,000 lbs.
.198	1.08	1.08 = 2.35 ESAL
13.2K	37.4K	37.4K = 88,000 lbs.
.294	1.70	1.70 = 3.69 ESAL

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10% Harvest Permit

Single Trailer 6 or More-Axle Truck

12K	34K	48K = 94,000 lbs.
.198	1.08	1.01 = 2.29 ESAL
13.2K	37.4K	52.8K = 103,400 lbs.
.294	1.70	1.51 = 3.50 ESAL

Multi-Trailer 7 or More-Axle Truck

12K	34K	34K	20K	20K=120,000 lbs.
.198	1.08	1.08	1.57	1.57 = 5.49 ESAL

X Over 105,000 lbs.

Multi-Trailer 7 or More-Axle Truck

12K	33K	28K	28K	28K=129,000 lbs.
.198	1.00	.493	.493	.493 = 2.67 ESAL

X Over 105,000 lbs.

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Designated Highway Network for 129,000 lbs

- The NDDOT worked with advisory committee members from agriculture, trucking and other industries to develop a designated network.
- The designated network consists of Interstates 94 and 29, U.S. Highway 2, as well as portions of Highways 85, 83, and 52.

This network will now allow permits for a legally loaded truck with a gross weight of 129,000 lbs. compared to previous 105,500 lbs., allowing shippers to be more efficient and make less trips.

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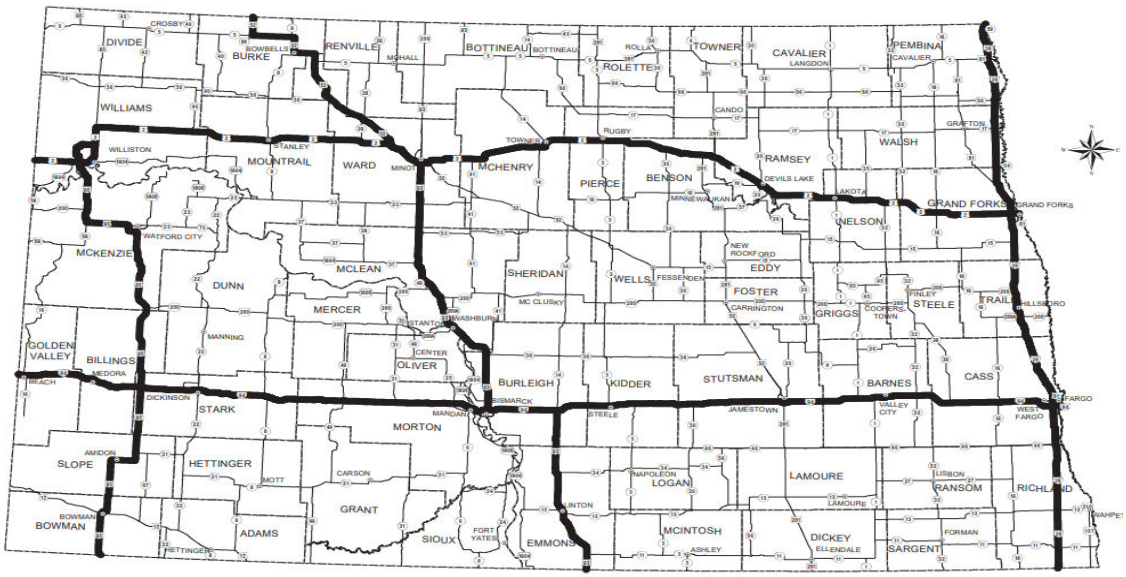
Designated Highway Network for 129,000 lbs



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Need Your Help
Right of Way Encroachments

- **Right of Way Encroachments:**
  - Highway right of way areas are designed for safety of the traveling public. Any item or crop placed in the right of way that does not meet state or federal requirements is illegal and can affect motorist safety.

  Some items we see are:
    - Drain tile or other drainage equipment
    - Crops extending into the right of way area

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Need Your Help
Right of Way Encroachments

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Summary

- The NDDOT understands and supports the need to move commodities and promote economic viability of the state.
- It is essential to ensure the state's large investment in the transportation system is protected.
- Township, county, city and state agencies are responsible for providing mobility and a safe transportation system, which can't be accomplished if motorists are damaging bridges and roads.
- Working together with the Ag industry and other highway users can ensure we have a road system that is economical and safe.

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