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NDDOT DMS GUIDELINES

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1. FORWARD

This document specifies the North Dakota Department of Transportation (NDDOT) Dynamic Message Sign (DMS) Guidelines. DMS are important traffic control devices that enhance the safety and mobility of the traveling public. As such, DMS installation and operations must meet national and state standards in order to ensure consistency across the state.

The NDDOT DMS Guidelines address DMS design, installation, and operations. It is the NDDOT policy that every DMS installed on the state system and operated by NDDOT authorized staff must follow these guidelines.

2. DEFINITIONS

The terms Changeable Message Sign (CMS), Dynamic Message Sign (DMS), and Variable Message Sign (VMS) have often been used interchangeably to describe the same device technology. In general, the term DMS is used to refer to both CMS and VMS. The technology typically utilizes a lighted matrix display to provide relevant and timely information to motorists. These signs are capable of displaying various messages and can either be permanent or temporary fixtures.

A DMS includes the following major components: sign face, sign housing, controller, and if present, the controller cabinet.

3. DMS PROCUREMENT

The process for acquiring a DMS requires careful planning and coordination to ensure the sign meets NDDOT guidelines and standards and also performs the desired function. This process may be divided into three main phases (see Figure 1):

1. Sign Planning
2. Message Design
3. Concept of Operations
4. Systems Engineering Process

The NDDOT recommends the following steps whenever possible prior to making a decision on sign purchases:

1. Clearly establish the objectives of the sign
2. Prepare the messages necessary to accomplish the objectives
3. Determine legibility distance for motorists to read and comprehend the messages
4. Determine DMS location to allow motorists to read, comprehend, and react to the messages
5. Identify type and extent of local factors that might affect the legibility of the sign
6. Identify the environmental conditions under which the DMS will operate.
7. Determine the target value and legibility of candidate signs
8. Determine the costs of candidate signs
9. Select the sign that will allow the selected messages to be read under all environmental conditions within the cost constraints of the agency

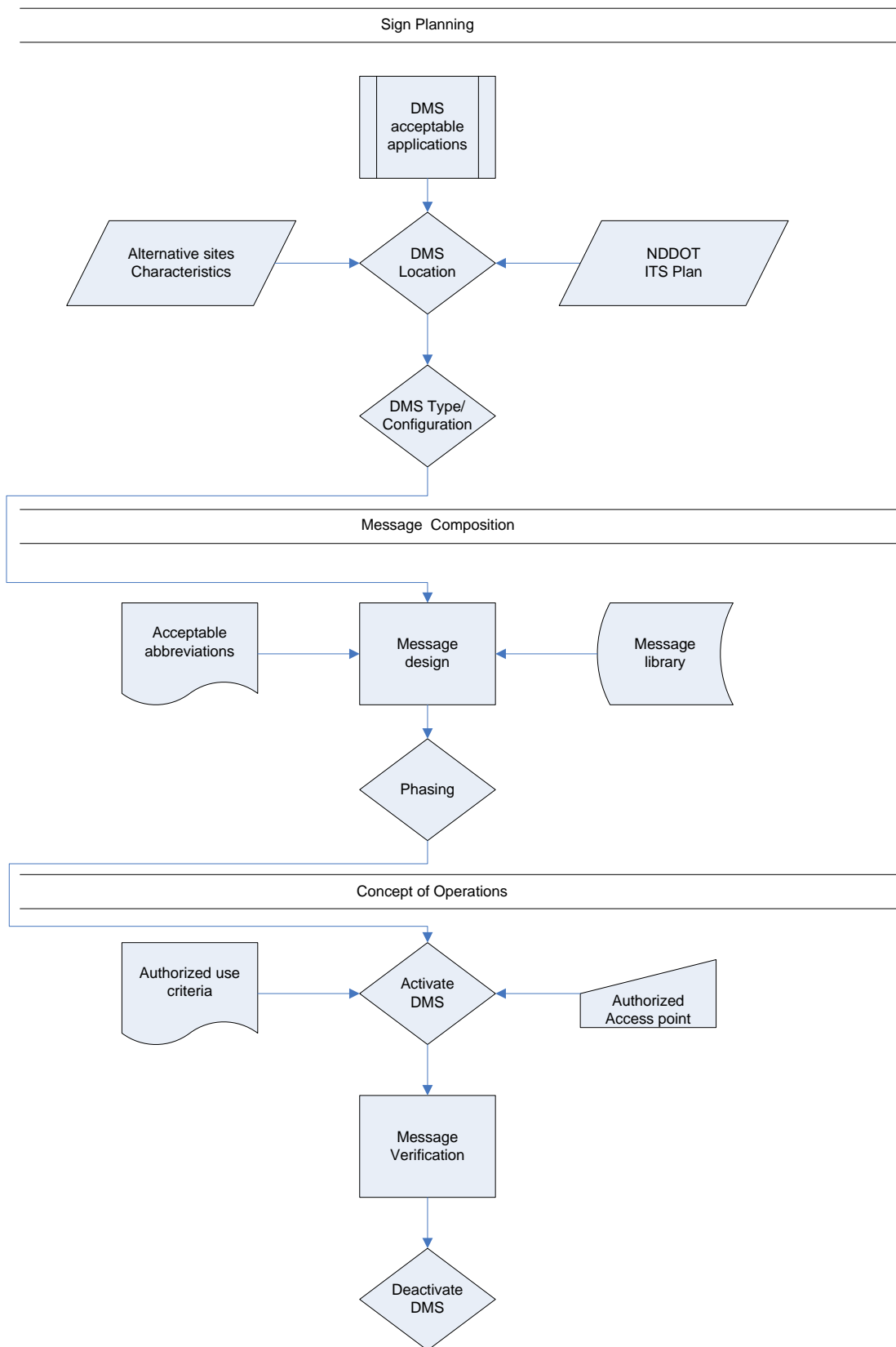


Figure 1 NDDOT DMS Decision Process

4. DMS DESIGN

This section addresses the following aspects of the DMS design process:

1. Sign location
2. Sign type
3. Sign size

4.1. Sign Location

The general location of the DMS is determined based on the need and desired application. Generally, the location should provide adequate viewing time for the motorists and allow them to react properly (i.e., before a highway ramp if an alternative route is advised). The final location of the DMS must satisfy criteria that may include the following factors:

1. Safety clear zone
2. Geometrics (vertical and horizontal alignment)
3. Operating speeds
4. Presence of other structures (i.e., bridges, other highway signs)
5. Location of utilities (power supply, communications, etc)
6. Location of other DMS (if used in a series)

A combination of these factors as well as the desired message length influence the location of the DMS in order to ensure drivers have adequate time to view the message. There are three major components related to the motorist viewing of the sign which include: detect the presence of a DMS, read the message, and decide on a course of action (see Figure 2).

The message viewing distance and the speed that the driver is traveling dictate the amount of time he/she has available to read a DMS. Any obstruction that comes between the motorist and the sign within the minimum required viewing distance hinders the motorist from reading the entire message. At higher speeds, distances as great as 800 feet are needed for messages that contain four units of information. The required viewing distance also dictates the minimum requirements for the letter size used for the message. Finally, the offset (horizontal distance from the sign as a function of travel lane) will require additional sight distance to clearly view and react to the sign (Figure 3).

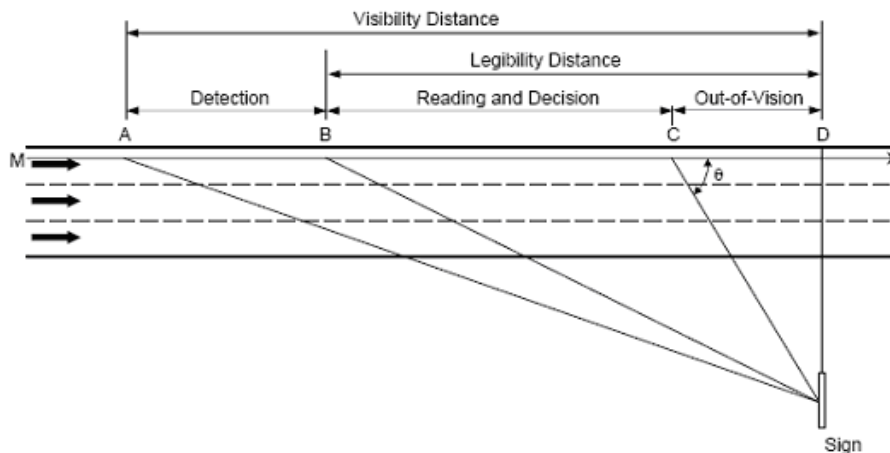


Figure 2 DMS Driver Reaction Components

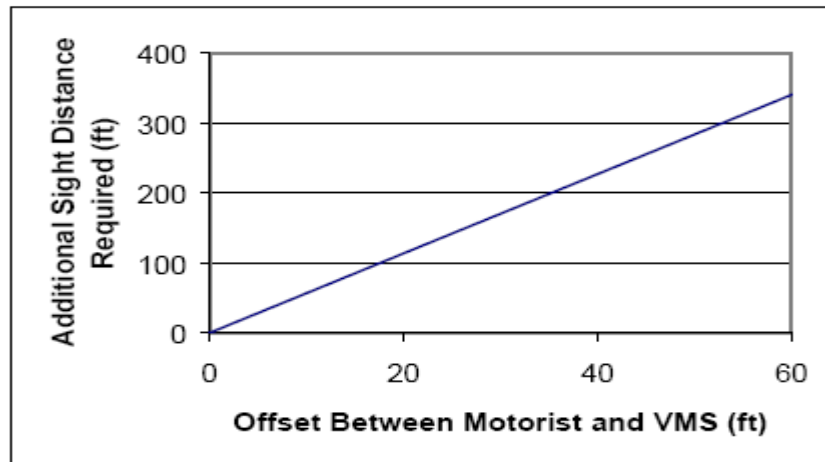


Figure 3 Additional Sight distance Required for DMS Offset (in addition to basic visibility distance)

4.2.DMS Types

The two general types of DMS are permanent and portable. Permanent signs can vary in size, but they normally have a capacity of three lines with 12-18 characters each. Portable DMS usually are 3-lines with eight characters each.

4.3.DMS Size

There are several DMS types and configurations available in the market today. Generally, the size and configuration of the sign are determined by the desired function, the location, and other traffic/environmental factors. Signs may be broadly categorized as permanent or portable. Portable DMS are smaller and offer less functionality than permanent signs. However, they are very useful for temporary applications, such as work zones. Permanent DMS are the general standard for freeway applications.

The recommended size for a DMS varies depending on location (type of roadway facility), and placement (overhead, offset, etc). The MUTCD provides guidance on the maximum number of units of information that can be displayed on a DMS based on type of DMS, travel speed, and sun position. In cases where portable DMS are used, it may be necessary to reduce the maximum number of units of information because of sight distance restrictions to the DMS due to vertical grades or horizontal curves. Additional guidelines are given for sight distance restrictions to the DMS because of heavy rain or fog.

The MUTCD requires DMS, when used in a regulatory function, to be the same sign size and display the required letter height and legend format that correspond to the type of roadway facility and design speed as static signs. The minimum Character size for a DMS is 10.6 inches, but may often require larger sizes than the minimum. A size of 18 inches should be used where traffic speeds are greater than 55 mph, in areas of persistent inclement weather, or where complex driving tasks are involved (MUTCD, Table 2E-2).

5. DMS OPERATIONS

This section provides guidelines on various aspects of DMS operations, including:

1. Accepted uses
2. Authority to operate
3. Message formats
4. Message display
5. Message termination

Generally, the use of DMS is intended for conveying timely and relevant information about the road, traffic conditions, or weather that may not be addressed with static control devices. The main advantages of using DMS are their flexibility in addressing information needs for scenarios or conditions that change with time (non-recurring) and extend beyond a single geographical location. Additionally, the use of a DMS must require some type of action from the drivers, i.e. reduce speeds, take alternate route, etc.

5.1. Accepted DMS Uses

It is NDDOT policy that DMS are only used for warranted conditions listed below. Any other use of DMS must be pre-approved from the NDDOT's Maintenance and Engineering Services. A DMS message should not replace the use of standard signing and pavement markings. If the same message is to be displayed day in and day out, then a DMS should not be used, but rather a static sign should be considered. See section 5.5.

There are four general application areas for DMS, including:

1. Early warning
Provide motorists with advance notice of hazardous traffic conditions (reduced speeds, queuing), such as at an accident site.
2. Advisory
Advise motorists about problem along their route that allows them to anticipate potential hazardous conditions or avoid problem areas by choosing alternative routes. An example of this application is advanced information on traffic congestion at a flooded highway located some distance from current location.
3. Routing (alternative route)
Alternative route messages influence motorists to travel to their chosen destination by using different routes than originally intended. In cases when the freeway is physically closed as a result of a crash, or natural disaster, the motorists are notified that an alternative route must be used.
4. Emergency/Security
These messages deal with critical security or emergency messages, such as AMBER messages.

The NDDOT has identified six situations that would warrant the use of a DMS message, which include the following:

1. Crash: to help with traffic control near the scene, inform motorists of potential impacts, and advise motorists of their required actions.
 - a. The crash must be visually confirmed by law enforcement officers or NDDOT personnel.

- b. The crash or effects of the crash must be negatively impacting the flow of traffic in the area of the crash.
 - c. The crash must take longer than 30 minutes to be cleared. This decision will be made by law enforcement at the scene. If it will take less than 30 minutes to be cleared, a DMS message shall not be used due to the short amount of time.
- 2. Roadwork: a DMS can be utilized for roadwork whether it is construction or maintenance purposes in order to help with traffic control around and within the work zone, improve work zone safety for work crews and the motorists, inform motorists of potential impacts, and advise motorists of their required actions.
 - a. Both maintenance work and construction work are included. Maintenance work is considered short term projects lasting less than 30 days, while construction work can be considered short term (less than 30 days) or long term (more than 30 days).
 - b. Maintenance work must adversely affect normal traffic patterns and result in traffic congestion.
 - c. Construction work must adversely affect normal traffic patterns and congestion. In addition, if a message is used for long term work, it is necessary that the message will be managed and changed throughout the project as conditions change. If a message is to remain consistent more than three days, then a static sign should be considered.
- 3. Weather Advisories: inform motorists of specific areas where traffic conditions are significantly impacted. General advisories related to general weather or roadway conditions are not to be allowed, i.e. "Icy Roads". An example of specific conditions is, "Road Closed, Fargo to Grand Forks."
- 4. AMBER Alert: inform motorists of child abductions by instructing them to tune in to designated media for additional information.
 - a. AMBER Alert must be issued by NDHP
- 5. Special Events: a DMS may be used during special events that cause congestion or traffic issues to help with traffic control in the congested areas. The message could also be used to inform motorists of the impacts, and advise motorists of what action they should take, i.e. alternate routes, parking location, etc.
- 6. Safety Campaigns: DMS messages can be utilized for the purpose of assisting the state in getting out safety campaign messages statewide.
 - a. Message can only be displayed for short periods (not to exceed 2 days) and only when authorized.

5.2. Authority to Operate

Only authorized personnel from the NDDOT and other approved agencies are authorized to operate DMS. All DMS operators must abide by NDDOT DMS Guidelines. Passwords and phone numbers to the boards should only be given out to people who are authorized and properly trained to program them.

5.3.Message Format

The general NDDOT standard in formatting messages is ensuring consistency across the state, i.e., use consistent messages in response to similar situations statewide. Stored predefined messages (in the IDI software) may address most general situations. If the situation requires a message other than a predefined set, then the following rules shall be applied. Only acceptable abbreviations may be used in composing messages. Appendix A contains a list of acceptable and non-acceptable abbreviations.

5.3.1. One Panel Message

Line One: state problem (i.e. road closed or crash)
Line Two: present location or distance ahead (i.e. Ahead or At ---)
Line Three:display the recommended driver action (i.e. Prepare to Stop)

5.3.2. Two Panel Message

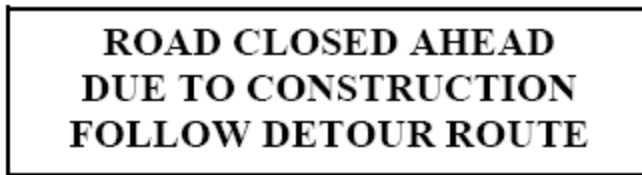
When one panel is insufficient to relay the message, two panels may be used. When two panels are deployed the following format shall be applied:

<u>Panel One</u>	<u>Panel Two</u>
Line One: state problem	Line One: display recommended action
Line Two: state problem/present location	Line Two: display recommended action
Line Three: present location	Line Three: display recommended action

5.3.3. Message Length

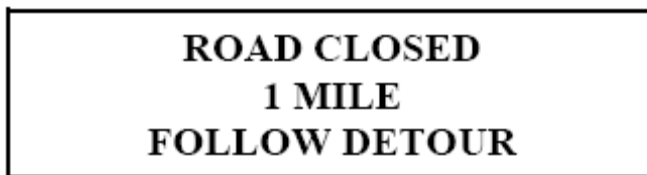
Message length refers to either the number of words or number of characters and spaces displayed on a DMS. Message length is limited by DMS character capacity. If a message does not fit then it must be reduced by using acceptable abbreviations, eliminating redundant words, and/or c) partitioning the message in two phases. See example below.

Long message



**ROAD CLOSED AHEAD
DUE TO CONSTRUCTION
FOLLOW DETOUR ROUTE**

Revised message



**ROAD CLOSED
1 MILE
FOLLOW DETOUR**

It is NDDOT policy that no messages shall exceed eight (8) words. However, an Amber Alert on permanent signs may be longer.

5.3.4. Message Abbreviations

The NDDOT policy on acceptable and non-acceptable abbreviations shall follow the Manual on Uniform Traffic Control Devices. Appendix A lists acceptable and non-acceptable abbreviations as well as a set of acceptable abbreviations for geographical names in North Dakota.

5.4. Message Display

Two-phase message displays are allowable for messages that may not be displayed in a single phase. However, the design of these messages must follow section 5.3.1 and 5.3.2 of these guidelines.

Only 2-phase messages are allowed under NDDOT policy. If additional phases are needed, a second DMS may be used to carry the additional information. The second DMS must meet all NDDOT DMS design and operation guidelines.

It is NDDOT general policy that DMS messages (or lines) shall not be flashed since flashing can significantly increase the amount of time required to read the sign. The only exception for this policy is when roads are closed due to incidents or weather. In those cases, messages may be flashed at a slow rate, but allowing drivers to read each phase (4 seconds per phase).

5.5. Message Termination

It is NDDOT policy that each event requiring the activation of a DMS must have a termination time. Messages should only be displayed when conditions warrant (and are relevant and valid) for the duration of the DMS activation.

For longer-term events lasting more than three days, a static sign should be considered. The exception would be notifying the public for an upcoming project that will affect their travel. In that case the message may be displayed for up to one week prior to the start date of the project.

It is the policy of the NDDOT that DMS are used for alerting travelers to changing conditions over a short period of time.

6. SOFTWARE

It is the NDDOT policy that DMS operators utilize NDDOT approved DMS design and operating software (IDI and DMS Composer).

7. APPENDIX A – ABBREVIATIONS

WORD MESSAGE	STANDARD ABBREVIATION
Afternoon / Evening	PM
Alternate	ALT
Avenue	AVE
Bicycle	BIKE
Boulevard	BLVD
Cannot	CANT
CB Radio	CB
Center	CNTR
Civil Defense	CD
Compressed Natural Gas	CNG
Crossing (other than Highway-rail)	XING
Diesel Fuel	D
Do Not	DON'T
Drive	DR
East	E
Eastbound	EB
Electric Vehicle	EV
Emergency	EMER
Entrance, Enter	ENT
Expressway	EXPWY
Feet	FT
FM Radio	FM
Freeway	FRWY, FWY
Friday	FRI
Hazardous Cargo	HC
Hazardous Material	HAZMAT
High Occupancy Vehicle	HOV
Highway	HWY
Highway-Rail Grade Crossing Pavement Marking	RXR
Hospital	H
Hour(s)	HR
Information	INFO
It is	ITS
Junction / Intersection	JCT
Kilogram	Kg
Kilometer(s)	KM
Kilometers Per Hour	km/h
Lane	LN
Left	LFT

WORD MESSAGE	STANDARD ABBREVIATION
Liquid Propane Gas	LP-GAS
Maintenance	MAINT
Meter(s)	M
Metric Ton	t
Mile(s)	MI
Miles Per Hour	MPH or M.P.H.
Minute(s)	MIN
Monday	MON
Morning / Late Night	AM
Normal	NORM
North	N
Northbound	NB
Parking	PKING
Pedestrian	PED
Pounds	LBS
Right	RHT
Road	RD
Saturday	SAT
Service	SERV
Shoulder	SHLDR
Slippery	SLIP
South	S
Southbound	SB
Speed	SPD
Street	ST
Sunday	SUN
Telephone	PHONE
Temporary	TEMP
Thursday	THURS
Tires With Lugs	LUGS
Tons of Weight	T
Traffic	TRAF
Travelers	TRAVLRS
Tuesday	TUES
Two-Way Intersection	2-WAY
Two-Wheeled Vehicle	CYCLES
US Numbered Route	US
Vehicles	VEH
Warning	WARN
Wednesday	WED
West	W
Westbound	WB
Will Not	WONT

Abbreviations Accepted only with prompt Word

WORD	ABBREVIATION	PROMPT WORD
Access	ACCS	Road
Ahead	AHD	Fog*
Blocked	BLKD	Lane*
Bridge	BRDG	[Name]*
Condition	COND	Traffic*
Congested	CONG	Traffic*
Construction	CONST	Ahead
Downtown	DWNTN	Traffic*
Eastbound	E-BND	Traffic
Exit	EX, EXT	Next*
Express	EXP	Lane
Frontage	FRNTG	Road
Hazardous	HAZ	Driving
Interstate	I	[Number]
Local	LOC	Traffic
Lower	LWR	Level
Major	MAJ	Accident
Minor	MNR	Accident
Northbound	N-BND	Traffic
Oversized	OVRSZ	Load
Prepare	PREP	To Stop
Pavement	PVMT	Wet*
Quality	QLTY	Air*
Roadwork	RDWK	Ahead [Distance]
Route	RT	Best*
Southbound	S-BND	Traffic
Township	TWNSHP	Limits
Turnpike	TRNPK	[Name]*
Upper	UPR	Level
Vehicle	VEH	Stalled*
Westbound	W-BND	Traffic

* These prompt words should precede the abbreviation

Unacceptable Abbreviations

ABBREVIATION	INTENDED WORD	COMMON MISINTERPRETATIONS
ACC	Accident	Access (Road)
CLRS	Clears	Colors
DLY	Delay	Daily
FDR	Feeder	Federal
L	Left	Lane (Merge)
LT	Light (Traffic)	Left
PARK	Parking	Park
POLL	Pollution (Index)	Poll
RED	Reduce	Red
STAD	Stadium	Standard
WRNG	Warning	Wrong

NDDOT Special Abbreviations

WORD	ABBREVIATION
Casselton	Casslton
Devils Lake	Dvls Lk
Dickinson	Dicknson
Grand Forks	Grnd Frk
Hillsboro	Hllsboro
Jamestown	Jmstown
South Dakota	S Dakota
Valley City	Val City
West Fargo	W. Fargo
Williston	Willston