

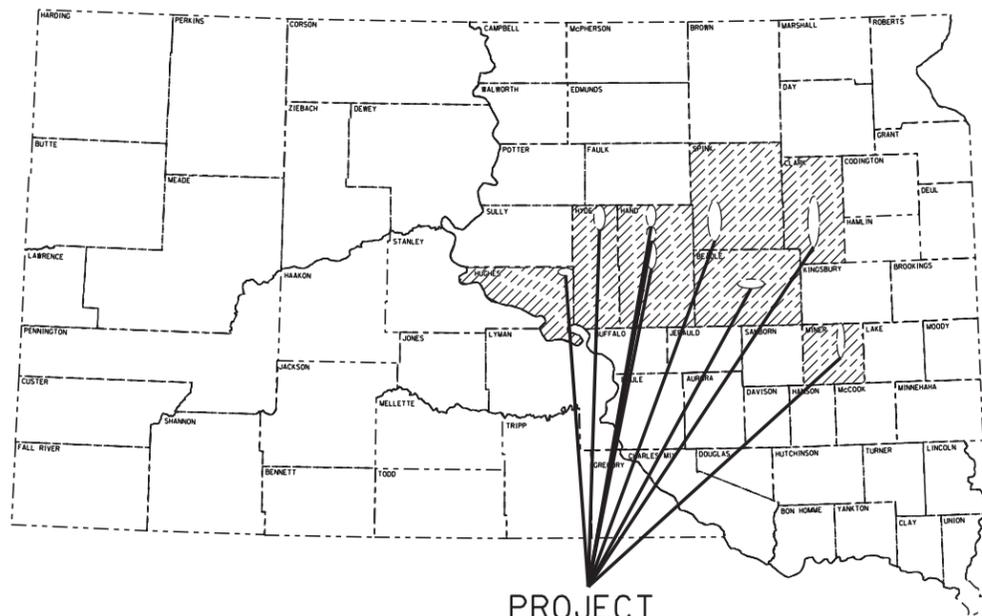
STATE OF SOUTH DAKOTA
DEPARTMENT OF TRANSPORTATION

PLANS FOR PROPOSED
Project NH-P 0013(26)
US HWY 14 & 281
SD HWY 26, 25, 45, & 47
BEADLE, CLARK, HAND, HUGHES, HYDE,
KINGSBURY, MINER, & SPINK COUNTIES

ASPHALT SURFACE TREATMENT
(SAND SEAL)
PCN 045U

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PROJECT

BEGIN SEGMENT 1
STATION 0 + 00.0
MRM 88.86 + 0.000
MILEAGE: 46.679

**SD HWY 25
SEGMENT #1
KINGSBURY & MINER COUNTIES
LENGTH: 13.115 MILES**

END SEGMENT 1
STATION 692 + 47.2
MRM 101.77+ 0.217
MILEAGE: 59.794

DESIGN DESIGNATION

ADT (2013)	917
ADT (2033)	1063
DHV	115
D	50.0%
T DHV	2.5
T*ADT	21.0%
V	65 MPH

STORM WATER PERMIT

(NONE REQUIRED)

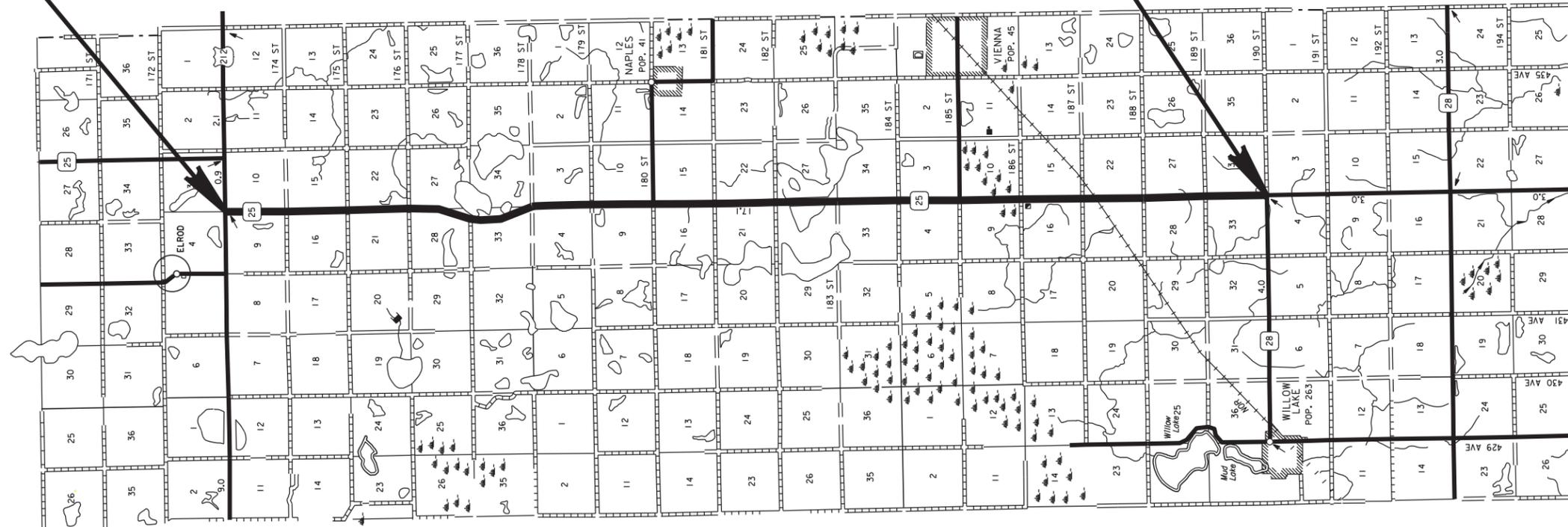


GROSS LENGTH 87.483 MILES
LENGTH OF EXCEPTIONS 0.069 MILES
NET LENGTH 87.413 MILES

SD HWY 25 SEGMENT #2 CLARK COUNTY LENGTH: 17.033 MILES

END SEGMENT 2
STATION 899 + 28.96
MRM 148.91 + 0.001
MILEAGE: 103.729

BEGIN SEGMENT 2
STATION 0 + 00.0
MRM 131.87 + 0.000
MILEAGE: 86.696



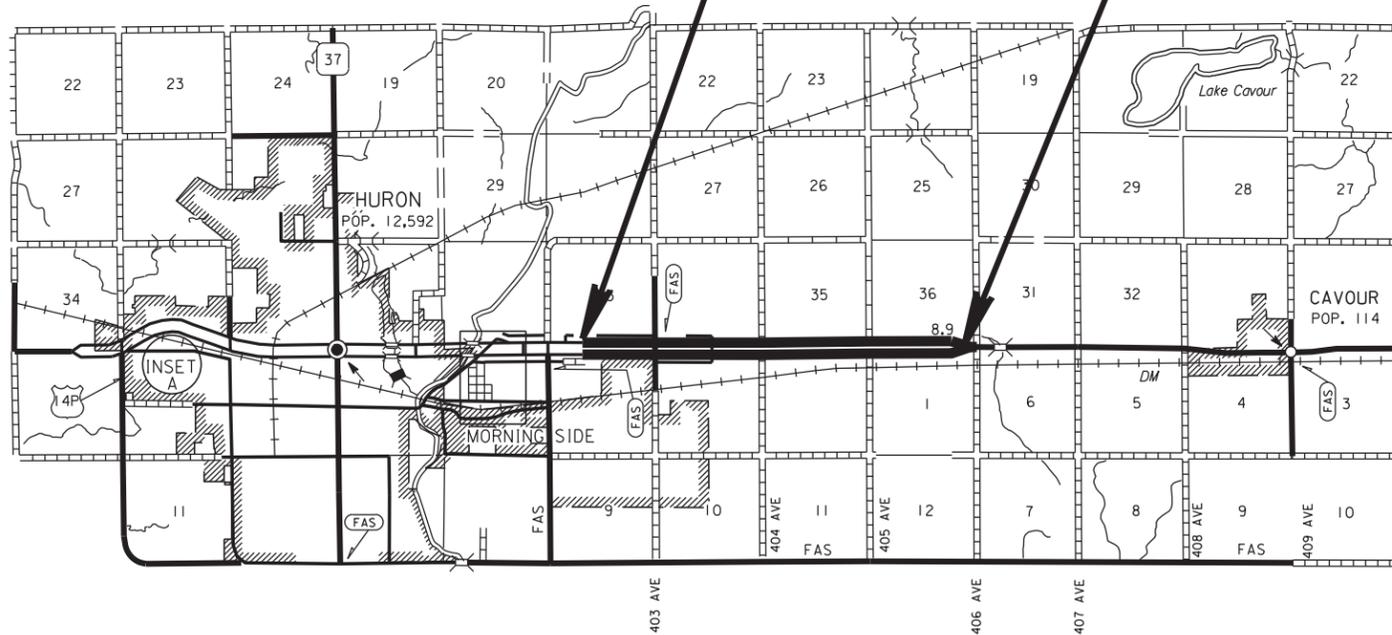
DESIGN DESIGNATION

ADT (2013)	899
ADT (2033)	1176
DHV	113
D	50.0%
T DHV	2.3
T*ADT	9.5%
V	65 MPH



US HWY 14 (EAST & WEST) SEGMENT #3 & #4 BEADLE COUNTY LENGTH: 3.608 MILES & 3.594 MILES

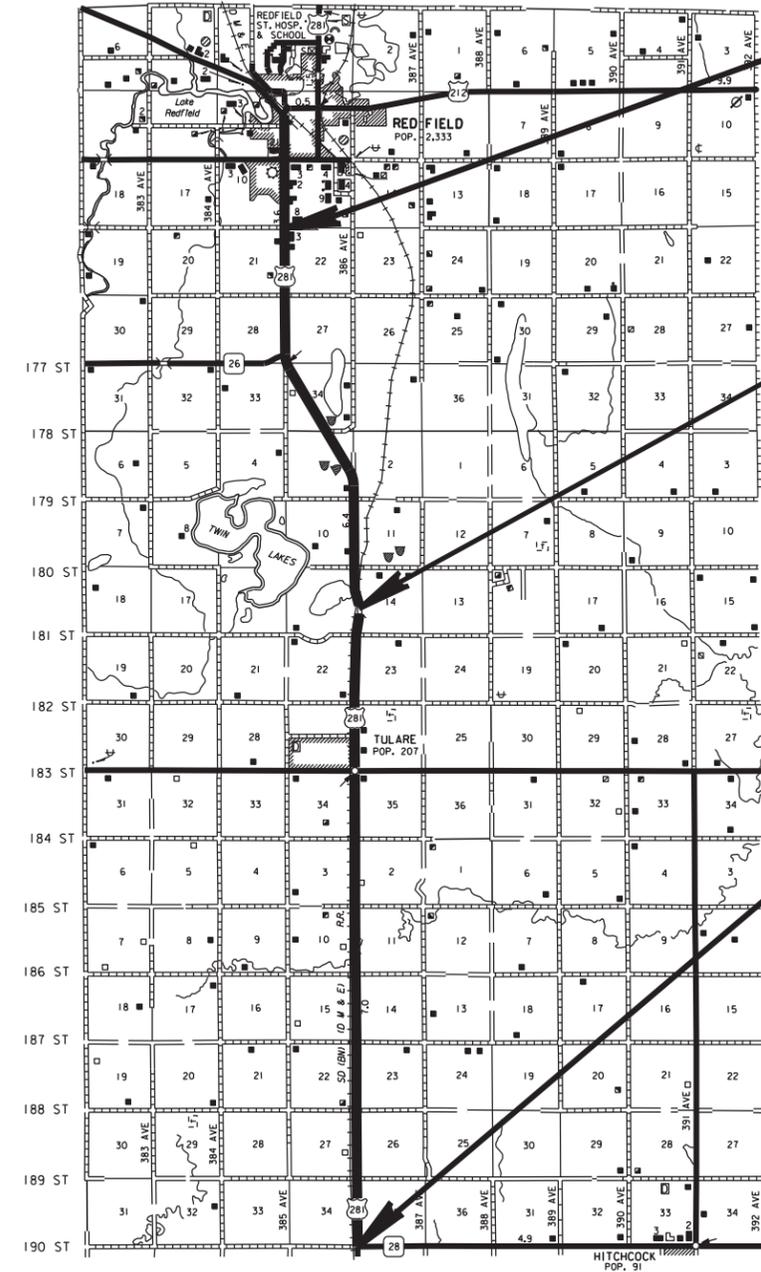
BEGIN SEGMENT 3 EASTBOUND STATION 0 + 00.0 MRM 347.65 + 0.341 MILEAGE: 11.161	END SEGMENT 3 EAST BOUND STATION 189 + 86.88 MRM 351.62 + 0.000 MILEAGE: 14.769
BEGIN SEGMENT 4 WESTBOUND STATION 0 + 0.00 MRM 348.00 + 0.002 MILEAGE: 10.794	END SEGMENT 4 WESTBOUND STATION 189 + 86.88 MRM 351.62 + 0.00 MILEAGE: 14.568



DESIGN DESIGNATION

ADT (2013)	2154
ADT (2033)	2856
DHV	269
D	50.0%
T DHV	2.9
T*ADT	17.8%
V	65 MPH

US HWY 281 SEGMENT #5 SPINK COUNTY LENGTH: 16.138 MILES



END SEGMENT 5
STATION 852.0 + 08.64
MRM 152.00 + 0.675
MILEAGE: 110.593

STR# 58-101-321
245.4' = 0.0465 MILES

APPROACH LENGTH:
2 X 60.5' = 121.0'

TOTAL EXCEPTION = 366.4'
MRM 146.39
STATION 520.00 + 60.8

BEGIN PROJECT
STATION 0 + 00.0
MRM 136.42 + 0.105
MILEAGE: 94.455

DESIGN DESIGNATION

ADT (2013)	2056
ADT (2033)	2430
DHV	257
D	50.0%
T DHV	5.1
T*ADT	24.4%
V	65 MPH

SD HWY 45 SEGMENT #6 HAND COUNTY LENGTH: 7.914 MILES

SD HWY 26 SEGMENT #7 HAND COUNTY LENGTH: 1.000 MILES

SD HWY 45 SEGMENT #8 HAND COUNTY LENGTH: 16.253 MILES

BEGIN SEGMENT 6
SD HWY 45
STATION 0 + 00.0
MRM 129.61 + 0.000
MILEAGE: 95.823

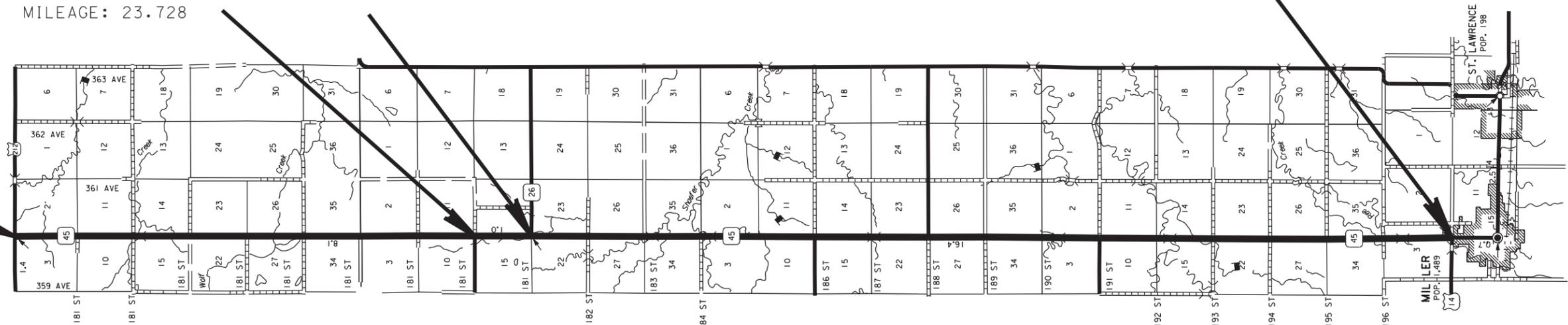
BEGIN SEGMENT 7
SD HWY 26
STATION 52 + 80.0
MRM 252.87 + 0.000
MILEAGE: 23.728

END SEGMENT 7
HWY 26
STATION 52 + 80.0
MRM 253.86 + 0.000
MILEAGE: 22.728

END SEGMENT 8
HWY 45
STATION 858 + 15.84
MRM 128.61 + 0.000
MILEAGE: 95.823

BEGIN SEGMENT 8
STATION 0 + 00.0
MRM 112.35 + 0.000
MILEAGE: 79.57

END SEGMENT 6
STATION 417 + 85.92
MRM 137.574 + 0.000
MILEAGE: 103.737



DESIGN DESIGNATION

ADT (2013)	445
ADT (2033)	489
DHV	56
D	51.0%
T DHV	3.4
T•ADT	25.4%
V	65 MPH

DESIGN DESIGNATION

ADT (2013)	1330
ADT (2033)	1460
DHV	166
D	51.0%
T DHV	3.3
T•ADT	15.9%
V	65 MPH



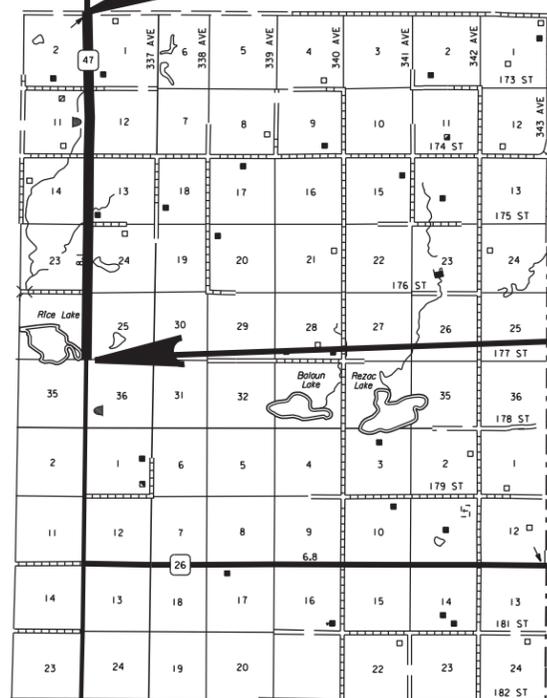
**SD HWY 47
SEGMENT #9
HYDE COUNTY
LENGTH: 5.134 MILES**

**US HWY 14
SEGMENT #10
HUGHES COUNTY
LENGTH: 3.763 MILES**

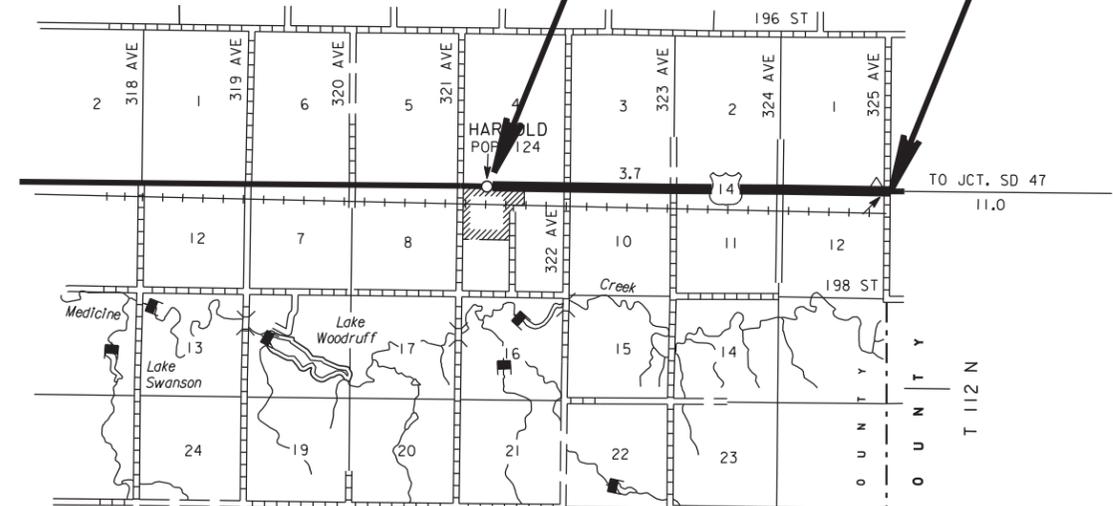
END SEGMENT 9
STATION 271 + 07.52
MRM 162.90 + 0.000
MILEAGE: 127.031

BEGIN SEGMENT 10
STATION 198 + 68.64
MRM 263.29 + 0.000
MILEAGE: 144.079

END SEGMENT 10
STATION 0 + 00.0
MRM 267.05 + 0.000
MILEAGE: 147.842



BEGIN SEGMENT 9
STATION 0 + 00.0
MRM 157.00 + 0.778
MILEAGE: 121.897



DESIGN DESIGNATION

ADT (2013)	267
ADT (2033)	333
DHV	33
D	51.0%
T DHV	3.6
T•ADT	29.7%
V	65 MPH

DESIGN DESIGNATION

ADT (2013)	2328
ADT (2033)	2978
DHV	291
D	51.0%
T DHV	2.0
T•ADT	13.9%
V	65 MPH

ESTIMATE OF QUANTITIES

Bid Item Number	Item	Quantity	Unit
009E0010	Mobilization	Lump Sum	LS
330E0300	SS-1h or CSS-1h Asphalt for Fog Seal	444.0	Ton
330E3000	Sand for Fog Seal	250.0	Ton
360E0042	CRS-2P Asphalt for Surface Treatment	2,388.0	Ton
360E1200	Modified Cover Aggregate	1,189.7	Ton
360E1200	Modified Cover Aggregate	632.8	Ton
360E1200	Modified Cover Aggregate	3,407.5	Ton
360E1200	Modified Cover Aggregate	1,481.1	Ton
360E1200	Modified Cover Aggregate	2,793.0	Ton
360E1200	Modified Cover Aggregate	187.1	Ton
360E1200	Modified Cover Aggregate	2,677.2	Ton
360E1200	Modified Cover Aggregate	960.8	Ton
360E1200	Modified Cover Aggregate	3,041.7	Ton
633E0030	Cold Applied Plastic Pavement Marking, 24"	538	Ft
633E0035	Cold Applied Plastic Pavement Marking, Area	125	SqFt
633E0040	Cold Applied Plastic Pavement Marking, Arrow	15	Each
633E0055	Cold Applied Plastic Pavement Marking, Railroad Crossing	2	Each
633E1300	Pavement Marking Paint, White	3,831.0	Gal
633E1305	Pavement Marking Paint, Yellow	1,036.0	Gal
633E5015	Grooving for Cold Applied Plastic Pavement Marking, 24"	538	Ft
633E5020	Grooving for Cold Applied Plastic Pavement Marking, Area	125	SqFt
633E5025	Grooving for Cold Applied Plastic Pavement Marking, Arrow	15	Each
633E5040	Grooving for Cold Applied Plastic Pavement Marking, Railroad Crossing	2	Each
633E6020	Pavement Marking Masking, 25"	538	Ft
633E6025	Pavement Marking Masking, Area	125	SqFt
633E6030	Pavement Marking Masking, Arrow	15	Each
633E6045	Pavement Marking Masking, Railroad Crossing	2	Each
634E0010	Flagging	1,074	Hour
634E0020	Pilot Car	490	Hour
634E0100	Traffic Control	10,050	Unit
634E0120	Traffic Control, Miscellaneous	Lump Sum	LS
634E0420	Type C Advance Warning Arrow Panel	3	Each
634E0630	Temporary Pavement Marking	175.4	Mile
998E0100	Railroad Protective Insurance	Lump Sum	LS

SPECIFICATIONS

Standard Specifications for Roads and Bridges, 2004 Edition and Required Provisions, Supplemental Specifications and/or Special Provisions as included in the Proposal.

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P 0013(26)	7	36
Plotting Date: 02/03/2014			

ENVIRONMENTAL COMMITMENTS

An Environmental Commitment is a measure that SDDOT commits to implement in order to avoid, minimize, and/or mitigate a real or potential environmental impact. Environmental commitments to various agencies and the public have been made to secure approval of this project. An agency mentioned below with permitting authority can influence a project if perceived environmental impacts have not been adequately addressed. Unless otherwise designated, the Contractor's primary contact regarding matters associated with these commitments will be the Project Engineer. These environmental commitments are not subject to change without prior written approval from the SDDOT Environmental Office. The environmental commitments associated with this project are as follows:

COMMITMENT B: FEDERALLY THREATENED, ENDANGERED, AND PROTECTED SPECIES

COMMITMENT B2: WHOOPING CRANE

The Whooping Crane is a spring and fall migratory bird in South Dakota that is about 5 feet tall and typically stops on wetlands, rivers, and agricultural lands along their migration route. An adult Whooping Crane is white with a red crown and a long, dark, pointed bill. Immature Whooping Cranes are cinnamon brown. While in flight, their long necks are kept straight and their long dark legs trail behind. Adult Whooping Cranes' black wing tips are visible during flight.

Action Taken/Required:

Harassment or other measures to cause the Whooping Crane to leave the site is a violation of the Endangered Species Act. If a Whooping Crane is sighted roosting in the vicinity of the project, borrow pit, or staging site associated with the project, cease construction activities in the affected area until the Whooping Crane departs and contact the Project Engineer. The Project Engineer will contact the Environmental Office so that the sighting can be reported to USFWS.

COMMITMENT C: WATER SOURCE

The Contractor shall not withdraw water with equipment previously used outside the State of South Dakota without prior approval from the SDDOT Environmental Office. Thoroughly wash all construction equipment before entering South Dakota to reduce the risk of invasive species introduction into the project vicinity.

The Contractor shall not withdraw water directly from streams of the James, Big Sioux, and Vermillion watersheds without prior approval from the SDDOT Environmental Office.

Action Taken/Required:

The Contractor shall obtain the necessary permits from the regulatory agencies such as the Department of Environment and Natural Resources (DENR) and the United States Army Corps of Engineers (COE) prior to executing water extraction activities.

COMMITMENT E: STORM WATER

Construction activities constitute less than 1 acre of disturbance.

Action Taken/Required:

At a minimum and regardless of project size, appropriate erosion and sediment control measures must be installed to control the discharge of pollutants from the construction site.

COMMITMENT H: WASTE DISPOSAL SITE

The Contractor shall furnish a site(s) for the disposal of construction and/or demolition debris generated by this project.

Action Taken/Required:

Construction and/or demolition debris may not be disposed of within the State ROW.

The waste disposal site(s) shall be managed and reclaimed in accordance with the following from the General Permit for Highway, Road, and Railway Construction/Demolition Debris Disposal Under the South Dakota Waste Management Program issued by the Department of Environment and Natural Resources.

The waste disposal site(s) shall not be located in a wetland, within 200 feet of surface water, or in an area that adversely affects wildlife, recreation, aesthetic value of an area, or any threatened or endangered species, as approved by the Project Engineer.

If the waste disposal site(s) is located such that it is within view of any ROW, the following additional requirements shall apply:

1. Construction and/or demolition debris consisting of concrete, asphalt concrete, or other similar materials shall be buried in a trench completely separate from wood debris. The final cover over the construction and/or demolition debris shall consist of a minimum of 1 foot of soil capable of supporting vegetation. Waste disposal sites provided outside of the State ROW shall be seeded in accordance with Natural Resources Conservation Service recommendations. The seeding recommendations may be obtained through the appropriate County NRCS Office. The Contractor shall control the access to waste disposal sites not within the State ROW through the use of fences, gates, and placement of a sign or signs at the entrance to the site stating "No Dumping Allowed".

2. Concrete and asphalt concrete debris may be stockpiled within view of the ROW for a period of time not to exceed the duration of the project. Prior to project completion, the waste shall be removed from view of the ROW or buried and the waste disposal site reclaimed as noted above.

The above requirements will not apply to waste disposal sites that are covered by an individual solid waste permit as specified in SDCL 34A-6-58, SDCL 34A-6-1.13, and ARSD 74:27:10:06.

Failure to comply with the requirements stated above may result in civil penalties in accordance with South Dakota Solid Waste Law, SDCL 34A-6-1.31.

All costs associated with furnishing waste disposal site(s), disposing of waste, maintaining control of access (fence, gates, and signs), and reclamation of the waste disposal site(s) shall be incidental to the various contract items.

COMMITMENT I: HISTORICAL PRESERVATION OFFICE CLEARANCES

The SDDOT has obtained concurrence with the State Historical Preservation Office (SHPO or THPO) for all work included within the project limits and all designated option borrow sites provided within the plans.

Action Taken/Required:

All earth disturbing activities not designated within the plans require review of cultural resources impacts. This work includes, but is not limited to: staging areas, borrow sites, waste disposal sites, and all material processing sites.

The Contractor shall arrange and pay for a cultural resource survey and/or records search. The Contractor has the option to contact the state Archaeological Research Center (ARC) at 605-394-1936 or another qualified archaeologist, to obtain either a records search or a cultural resources survey. A record search might be sufficient for review; however, a cultural resources survey may need to be conducted by a qualified archaeologist.

The Contractor shall provide ARC with the following: a topographical map or aerial view on which the site is clearly outlined, site dimensions, project number, and PCN. If applicable, provide evidence that the site has been previously disturbed by farming, mining, or construction activities with a landowner statement that artifacts have not been found on the site.

The Contractor shall submit the records search or cultural resources survey report and if the location of the site is within the current geographical or historic boundaries of any South Dakota reservation to SDDOT Environmental Engineer, 700 East Broadway Avenue, Pierre, SD 57501-2586 (605-773-3180). SDDOT will submit the information to the appropriate SHPO/THPO. Allow **30 Days** from the date this information is submitted to the Environmental Engineer for SHPO/THPO review.

If evidence for cultural resources is uncovered during project construction activities, then such activities shall cease and the Project Engineer shall be immediately notified. The Project Engineer will contact the SDDOT Environmental Engineer in order to determine an appropriate course of action.

SHPO/THPO review does not relieve the Contractor of the responsibility for obtaining any additional permits and clearances for staging areas, borrow sites, waste disposal sites, or material processing sites that affect wetlands, threatened and endangered species, or waterways. The Contractor shall provide the required permits and clearances to the Project Engineer at the preconstruction meeting.

TABLE OF QUANTITIES (FOR INFORMATION ONLY)

ITEM	SEGMENT 1	SEGMENT 2	SEGMENT 3	SEGMENT 4	SEGMENT 5	SEGMENT 6	SEGMENT 7	SEGMENT 8	SEGMENT 9	SEGMENT 10	TOTAL	UNIT
	SD 25	SD 25	US HWY 14, EAST	US HWY 14, WEST	US HWY 281	SD 45	SD 26	SD 45	SD 47	US HWY 14		
Mobilization	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	LS
SS-1H OR CSS-1H FOR FOG SEAL	75.8	92.5	16.0	16.0	72.7	40.2	5.1	82.5	26.1	17.2	444.0	Ton
Sand for Fog Seal	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	250.0	Ton
CRS-2P APSHALT FOR SURFACE TREATMENT	407.6	497.3	86.3	86.0	390.7	216.2	27.3	443.9	140.2	92.4	2388.0	Ton
Modified Cover Aggregate	2793.0	-	-	-	-	-	-	-	-	-	2793.0	Ton
Modified Cover Aggregate	-	3407.5	-	-	-	-	-	-	-	-	3407.5	Ton
Modified Cover Aggregate	-	-	600.6	589.1	-	-	-	-	-	-	1189.7	Ton
Modified Cover Aggregate	-	-	-	-	2677.2	-	-	-	-	-	2677.2	Ton
Modified Cover Aggregate	-	-	-	-	-	1481.1	-	-	-	-	1481.1	Ton
Modified Cover Aggregate	-	-	-	-	-	-	187.1	-	-	-	187.1	Ton
Modified Cover Aggregate	-	-	-	-	-	-	-	3041.7	-	-	3041.7	Ton
Modified Cover Aggregate	-	-	-	-	-	-	-	-	960.8	-	960.8	Ton
Modified Cover Aggregate	-	-	-	-	-	-	-	-	-	632.8	632.8	Ton
Cold Applied Plastic Pavement Marking, 24"	-	-	247	-	291	-	-	-	-	-	538	Ft
Cold Applied Plastic Pavement Marking, Area	-	-	-	-	125.1	-	-	-	-	-	125	SqFt
Cold Applied Plastic Pavement Marking, Arrow	-	-	4	4	7	-	-	-	-	-	15	Each
Cold Applied Plastic Pavement Marking, Rail Road Crossing	-	2	-	-	-	-	-	-	-	-	2	Each
Groove Pavement for Pavement Marking, 24"	-	-	247	-	291	-	-	-	-	-	538	Ft
Groove Pavement for Pavement Marking, Area	-	-	-	-	125.1	-	-	-	-	-	125	SqFt
Groove Pavement for Pavement Marking, Arrow	-	-	4	4	7	-	-	-	-	-	15	Each
Groove Pavement for Pavement Marking, Rail Road Crossing	-	2	-	-	-	-	-	-	-	-	2	Each
Pavement Marking Masking, 25"	-	-	247	-	291	-	-	-	-	-	538	Ft
Pavement Marking Masking, Area	-	-	-	-	125.1	-	-	-	-	-	125.1	SqFt
Pavement Marking Masking, Arrow	-	-	4	4	7	-	-	-	-	-	15	Each
Pavement Marking Masking, Rail Road Crossing	-	2	-	-	-	-	-	-	-	-	2	Each
Pavement Marking Paint, White	590	766	106	105	729	356	45	731	231	171	3831	Gal
Pavement Marking Paint, Yellow	129	284	83	83	182	53	9	116	67	31	1036	Gal
Flagging	161	209	45	45	197	97	12	199	63	46	1074	Hour
Pilot Car	80	104	-	-	98	48	6	100	31	23	490	Hour
Traffic Control	1196	1340	747	747	1539	785	620	1200	942	934	10050	Unit
Traffic Control, Miscellaneous	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	LS
Temporary Pavement Marking	26.2	34.1	7.4	7.4	32.1	15.8	2.0	32.5	10.3	7.5	175.4	Mile
Type C Advance Warning Arrow Panel	-	-	1	1	-	-	-	-	-	1	3	Each
Rail Road Protective Insurance	-	Lump Sum	-	-	-	-	-	-	-	-	Lump Sum	LS

RATES OF MATERIALS

The Estimate of Quantities is based on the following quantities of materials per mile.

ASPHALT SURFACE TREATMENT:

Segment	ROUTE	Station		Station
1	HWY 25	0+00	to	692+47.2

CRS-2P Asphalt for Surface Treatment at the rate of 31.1 tons applied 33 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 213.0 tons applied 33 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 5.8 tons applied 33 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
2	SD HWY 25	0+00	to	899+28.96

CRS-2P Asphalt for Surface Treatment at the rate of 29.2 tons applied 31 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 200.1 tons applied 31 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 5.4 tons applied 31 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
3	US HWY 14	0+00	to	189+86.88

CRS-2P Asphalt for Surface Treatment at the rate of 23.5 tons applied 25 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 161.3 tons applied 25 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 4.4 tons applied 25 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
4	US HWY 14	0+00	to	189+86.88

CRS-2P Asphalt for Surface Treatment at the rate of 23.5 tons applied 25 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 161.3 tons applied 25 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 4.4 tons applied 25 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
5	US HWY 281	0+00	to	852+8.64

CRS-2P Asphalt for Surface Treatment at the rate of 23.5 tons applied 25 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 161.3 tons applied 25 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 4.4 tons applied 25 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
6	SD HWY 45	0+00	to	417+85.92

CRS-2P Asphalt for Surface Treatment at the rate of 27.3 tons applied 29 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 187.1 tons applied 29 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 5.1 tons applied 29 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
7	SD HWY 26	0+00	to	52+80.0

CRS-2P Asphalt for Surface Treatment at the rate of 27.3 tons applied 29 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 187.1 tons applied 29 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 5.1 tons applied 29 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
8	SD HWY 45	0+00	to	858+15.84

CRS-2P Asphalt for Surface Treatment at the rate of 27.3 tons applied 29 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 187.1 tons applied 29 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 5.1 tons applied 29 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
9	SD HWY 47	0+00	to	271+7.52

CRS-2P Asphalt for Surface Treatment at the rate of 27.3 tons applied 29 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 187.1 tons applied 29 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 5.1 tons applied 29 feet wide.
(Rate = 0.07 Gal./S.Y.)

RATES OF MATERIALS (CONTINUED):

Segment	ROUTE	Station		Station
10	US HWY 14	0+00	to	189+14.8

CRS-2P Asphalt for Surface Treatment at the rate of 23.5 tons applied 25 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 161.3 tons applied 25 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 4.4 tons applied 25 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
10	US HWY 14	189+14.8	to	193+26.8

CRS-2P Asphalt for Surface Treatment at the rate of 34.9 tons applied 37 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 238.8 tons applied 37 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 6.5 tons applied 37 feet wide.
(Rate = 0.07 Gal./S.Y.)

Segment	ROUTE	Station		Station
10	US HWY 14	193+26.8	to	198+68.64

CRS-2P Asphalt for Surface Treatment at the rate of 47.1 tons applied 50 feet wide.
(Rate = 0.38 Gal./S.Y.).

Modified Cover Aggregate at the rate of 322.7 tons applied 50 feet wide.
(Rate= 22 Lbs./S.Y.).

CSS-1H or SS-1H for Fog Seal at the rate of 8.8 tons applied 50 feet wide.
(Rate = 0.07 Gal./S.Y.)

Table: Additional Asphalt and Aggregate Quantities

Segment	Route	Location	CRS-2P (Tons)	Aggregate (Tons)	CSS-1H (Tons)
3	US HWY 14	US HWY 14	1.35	9.26	0.25
4	US HWY 14	US HWY 14	1.35	9.26	0.25
5	US HWY 281	Turn Lane 175 th St. Intersection	2.07	14.15	0.38
5	US HWY 281	Turn Lane 177 th /HWY 22 Intersection	1.45	9.94	0.27
5	US HWY 281	Turn Lane SD HWY 26 Intersection	0.94	6.43	0.17
5	US HWY 281	Turn Lane at Tulare, SD	1.73	11.87	0.32
10	US HWY 14	Harrold, SD East Transitions	0.33	2.23	0.06
10	US HWY 14	Harrold, SD West Transitions	0.47	3.20	0.09

SEQUENCE OF OPERATIONS

The following Sequence of Operations shall be used for this project. The Contractor may submit an alternate Sequence of Operations, which shall be submitted to the Area Engineer a minimum of 2 weeks prior to the preconstruction meeting.

1. Install Construction Signing
2. Install Cold Applied Plastic Pavement Markings
3. Install Pavement Marking Masking
4. Install Temporary Pavement Markings
5. Apply Asphalt Surface Treatment
6. Apply Fog Seal
7. Apply Permanent Pavement Markings
8. Project Cleanup and Removal of Construction Signing

TRAFFIC CONTROL

Removing, relocating, covering, salvaging and resetting of existing traffic control devices, including delineation, shall be the responsibility of the Contractor. Cost for this work shall be incidental to the contract unit prices for the various items unless otherwise specified in the plans. Any delineators and signs damaged or lost shall be replaced by the Contractor at no cost to the State.

Storage of vehicles and equipment shall be as near as possible to the right-of-way line. Contractor's employees should mobilize at a location off the right-of-way and arrive at the work sites in a minimum number of vehicles necessary to perform the work.

Indiscriminate driving and parking of vehicles within the right-of-way will not be permitted. Any damage to the vegetation, surfacing, embankment, delineators and existing signs resulting from such indiscriminate use shall be repaired and/or restored by the Contractor, at no expense to the State, and to the satisfaction of the Engineer.

The Contractor shall provide documentation that all breakaway sign supports comply with FHWA NCHRP Report 350 or MASH crash-worthy requirements. The Contractor shall provide installation details at the preconstruction meeting for all breakaway sign support assemblies.

Work activities during non-daylight hours are subject to prior approval.

Traffic approaching the project from intersecting roadways, streets, and approaches must be adequately accommodated. Major intersections or large commercial entrances may require additional signing, flaggers, and channelizing devices on a temporary basis until work activities pass these areas.

"ROAD WORK NEXT ___ MILES", "LOOSE GRAVEL", and "END ROAD WORK" signs are the only signs that need to be mounted on Fixed Location Breakaway Sign Supports. "ROAD WORK AHEAD", "FLAGGER", "ONE LANE ROAD AHEAD" and any other signs may be mounted on portable supports. The bottom of signs on portable or temporary supports shall not be less than seven feet above the pavement in urban areas, and one foot above the pavement in rural areas. The signs mounted on portable supports shall be moved as necessary to keep current with the work activities.

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TRAFFIC CONTROL (CONTINUED)

Traffic Control units, as shown in the Estimate of Quantities, are estimates. Contractor's operation may require adjustments in quantities, either more or less. Payment will be for those signs actually ordered by the Engineer and used. Traffic Control units will be paid for separately for each project.

The Contractor shall furnish, install and maintain "LOOSE GRAVEL" signs with "40 MPH" advisory speed plate signs upon start of surface treatment operations at each end of the project. In addition, "LOOSE GRAVEL" signs with "40 MPH" advisory speed plates shall be installed at 3 mile intervals throughout each project and at other location(s) determined in the field by the Engineer. The aforementioned signs shall be removed after the final brooming has been completed.

Until initial brooming, additional flagger(s) and FLAGGER symbol sign(s) shall be provided to alert the traveling public entering completed portions of the project to the potential of airborne chips.

The flagger(s) shall provide each motorist with a printed notice on the Contractor's letterhead similar to the one shown. Cost of the notice shall be incidental to other contract bid items.

"CONTRACTORS LETTERHEAD"

THIS HIGHWAY IS BEING RESURFACED WITH A CHIP SEAL COAT.

THIS TYPE OF CONSTRUCTION HAS THE POTENTIAL OF CAUSING VEHICLE DAMAGE SUCH AS CHIPPED WINDSHIELDS AND BROKEN HEADLIGHTS DUE TO ROCKS BEING THROWN BY HIGH SPEED ONCOMING OR PASSING TRAFFIC.

YOU MAY WISH TO CONSIDER TAKING AN ALTERNATE ROUTE. IF YOU PROCEED, KEEP TO THE RIGHT AND DRIVE 40 MPH OR LESS. ANOTHER FLAGGER AND A PILOT CAR WILL BE ESCORTING YOU AROUND THE SEAL COAT APPLICATION AREA.

THANK YOU.

The Contractor shall have enough printed notices on hand to allow one for every vehicle (Current ADT).

PROJECT BROOMING

All material shall be broomed off of bridges and curb & gutter areas adjacent to the bridges. No material shall be broomed under the guardrail, including the 3 cable guardrail or into the drop inlets. This material from the curb & gutter areas of the bridges, the guardrail areas of the bridges and the drop inlets shall be disposed of in a manner satisfactory to the Engineer.

No material shall be broomed into the ditches or on the boulevards in residential and commercial areas where the adjacent landowner conducts the mowing of the right-of-way. This material shall be disposed of in a manner satisfactory to the Engineer.

Material that is broomed onto the roadway inslopes shall not be left in piles or windrows. The material shall be evenly distributed at a height that will not hinder mowing operations or cause dispersion of the material into the traveled roadway when passed over with a mower.

In lieu of the requirements of Sec. 360.3H, paragraph 5 of the Standard Specifications, loose material at the following locations in the table below shall be removed by the Contractor by means of a pickup broom having integral mounted self-contained storage using water to control dust and shall be removed during the cool period of early morning of the day following application or as directed by the Engineer. Removed material shall be disposed of at sites provided by the Contractor and approved by the Engineer.

Segment	Route	Description
5	US 281	City Limits of Tulare
8	SD 45	City Limits of Miller
10	US 14	City Limits of Harold

This list may not be complete. Additional areas may need attention as directed by the Engineer.

At no time before, during, or after placement of Asphalt Surface Treatment will a broom without working integral mounted self-contained storage using water (in working condition) be used.

Brooming will be incidental to the contract for Asphalt Surface Treatment.

MODIFIED COVER AGGREGATE (SEGMENT 1 THRU 10)

A minimum of 14 days prior to construction the Contractor shall submit aggregate samples from each aggregate source used for the project to be tested by the Area Office along with the Contractor's production sample test results. Project operations may not begin until production test results are received and informational samples are tested. The samples must be collected from the stockpile location. A passing sample is required prior to use on the project from each source.

Quality tests on the Cover Aggregate are required by specification. The Contractor shall notify the Area Office prior to sampling and a representative from the Area Office shall witness all sampling of aggregates to be submitted to the Central Testing Laboratory.

MODIFIED COVER AGGREGATE (SEGMENT 1 THRU 10) (CONTINUED)

Cover Aggregate shall be screened over a 1-inch screen prior to immediate application.

Cover Aggregate shall conform to the following gradation requirements:

Sieve Size	Percent Passing
3/8 inch	100
¼ inch	25-70
No. 4	0 - 25
No. 8	0 - 5
No. 200	0 - 1.3

The Flakiness Index shall not exceed 30%. Non-processed natural aggregate shall be subject to flakiness testing at a frequency of one test minimum per aggregate source.

Application of the Modified Cover Aggregate shall be maintained within 500 feet or have a time limit of 1 minute between the application of the CRS-2P for Asphalt Surface Treatment and the application of the cover aggregate, whichever amounts to the shorter period of time.

The Contractor shall continue chip spreader progress, forward, thru the asphalt application at any end where work will be temporarily shut down for a time greater than 5 minutes, to allow for satisfactory uniform rolling of the placed aggregate. The Contractor shall not allow the chip spreader, trucks, or other equipment to lie dormant on the aggregate while transitioning between asphalt distributor loads and or any other temporary shutdown of production, before uniform rolling is complete.

All passes of the rollers shall be completed within 8 minutes of application of the CRS-2P Asphalt for Surface Treatment.

All other requirements for Type 1B Cover Aggregate shall apply.

A failure on the #200 sieve will cause all operations to cease immediately and the Engineer will determine correction, if necessary, needed prior to restarting operations.

FOG SEAL

The fog seal shall be placed following the completion of the chip seal and prior to the placement of the permanent pavement marking. Application of the fog seal shall begin no earlier than the morning following application of the chip seal but no later than three days after the application of each day's chip seal.

The application of the fog seal will be permitted only when the ambient air and surface temperature on the project are both at least 60° F in the shade and conditions are dry.

Immediately prior to the application of the fog seal the Contractor will be required to broom the entire width of the chip seal. A CSS-1h or SS-1h emulsion shall be used for the fog seal application. A water-to-emulsion rate of 1:1 should be used for the binder application.

Bill of Laidings showing both the CSS-1h or SS-1h and water will be required.

The Contractor shall avoid placing the Fog Seal over the newly placed Cold Applied Permanent Pavement Markings. The Contractor shall be responsible for removing any CSS-1h or SS-1h that is on the markings. All costs associated with cleaning the pavement markings shall be incidental to the contract unit price per ton for CSS-1h or SS-1h.

Blotting Sand for Fog Seal shall conform to the Standard Specifications Section 879.1.B except for the following requirements:

Passing a 3/8 Inch Sieve	100%
Passing a No. 4 Sieve	85-100%
Passing a No. 8 Sieve	60-95%
Passing a No. 40 Sieve	5-45%
Passing a No. 200 Sieve	0-10.0%

The Plasticity Index shall not exceed three (3).

The shale content or other particles of low specific gravity (less than 1.95) passing the No. 4 sieve shall not exceed 4.5%

Prior to hauling, Blotting Sand shall be screened to minimize segregation, eliminate oversize and effectively breakup or discard material bonded into chunks.

The Contractor shall maintain traffic control on the fog sealing area until the fog seal is cured enough to prevent pickup on vehicles. Any areas where vehicles are allowed to drive and pickup will be considered unacceptable and the quantities will be deducted. Sand shall be applied at intersections or other locations as directed by the Engineer.

BRIDGES, APPROACH SLABS, SLEEPER SLABS, STRIP SEALS, RAILROAD CROSSINGS, MANHOLES, WATER VALVES AND CONCRETE

Asphalt Surface Treatment shall not be placed on any of the bridges, approach slabs, sleeper slabs, strip seals, railroad crossings, manholes, water valves or any type of concrete on these projects.

All areas listed shall be protected with proper masking prior to application of the Asphalt Surface Treatment. Any areas not properly protected shall be cleaned to the satisfaction of the Engineer at the Contractor's expense.

HAUL ROAD

The Contractor shall be responsible for any haul roads used to transport material to the project site. The State will not participate in the cost of restoration of any haul roads used by the Contractor.

TEMPORARY PAVEMENT MARKINGS

Paint will not be allowed for Temporary Pavement Marking. Temporary road markers shall be used to mark dashed centerline and applicable lane lines.

The temporary road markers shall have secure covers. The Contractor will be required to remove the covers manually and properly dispose the covers. Any markers that are non-reflective will be cleaned. Cleaning of road markers will be incidental to the contract unit price per mile for TEMPORARY PAVEMENT MARKINGS. Petroleum products shall not be used to clean markers.

All costs associated with furnishing, installing, removing covers and cleaning of the Temporary Road Markers used on this project will be incidental to the contract unit price per mile for TEMPORARY PAVEMENT MARKINGS.

The Contractor is allowed to use DO NOT PASS and PASS WITH CARE signs for a period of 2 weeks to mark no passing zones on roads with an average daily traffic of 2500 vehicles or less. It is estimated that the following amounts of DO NOT PASS and PASS WITH CARE signs will be required to mark the no passing zones, should the Contractor elect to use these signs.

Table: Estimated DO NOT PASS and PASS WITH CARE signs per segment

Segment	Location	DO NOT PASS	PASS WITH CARE
1	SD HWY 25	14	13
2	SD HWY 25	49	47
3	US HWY 14	0	0
4	US HWY 14	0	0
5	US HWY 281	14	13
6	SD HWY 45	2	1
7	SD HWY 26	4	4
8	SD HWY 45	6	5
9	SD HWY 47	10	9
10	US HWY 14	6	5

TEMPORARY PAVEMENT MARKINGS (CONTINUED)

Cost for furnishing, installing and removing the DO NOT PASS and PASS WITH CARE signs shall be incidental to the contract unit price per mile for Temporary Pavement Marking.

Flagger symbol signs (W20-7) and flaggers, or a shadow vehicle with rotating yellow lights or strobe lights, shall be positioned on the roadway shoulder in advance of workers for both directions of traffic during the installation of temporary road markers. The traffic control device used shall be moved to provide proper warning of the work operation. A ROAD WORK AHEAD (W20-1) sign, a Workers symbol sign (W21-1), or a BE PREPARED TO STOP (W3-4) warning sign shall be mounted on the rear of the shadow vehicle. The method of traffic control used by the Contractor for this work shall be approved by the Engineer.

The total length of no passing zone on this project is estimated to be 15.58 miles.

Table: Estimated Total No Pass Zones per Segment

Segment	Location	Miles
1	SD HWY 25	1.99
2	SD HWY 25	7.55
5	US HWY 281	2.84
6	SD HWY 45	0.16
7	SD HWY 26	0.65
8	SD HWY 45	0.67
9	SD HWY 47	1.53
10	US HWY 14	0.19

Quantities of Temporary Pavement Markings consist of:
One pass on top of the Seal Coat and one pass on Fog Seal.

PERMANENT PAVEMENT MARKINGS

Traffic Control shall be incidental to the cost of application. The striper and advance or trailing warning vehicle shall be equipped with flashing amber lights with an optional advance warning arrow panel.

All materials shall be applied as per manufacturer's recommendations.

The Contractor shall advise the Engineer a minimum of 2 weeks prior to the application of the permanent pavement marking to allow the State to check and mark the location of no passing zones. All materials shall be applied as per manufacturer's recommendations.

The Contractor will be required to repaint all existing pavement marking including centerline, edge line, lane lines, word messages, turn arrows, stop bars, railroad crossings, pedestrian crossings, etc. This list is approximate. The Contractor will be required to inventory and mark, with appropriate colored tabs, the extent and location of the existing word messages, turn arrows, stop bars, railroad crossings, pedestrian crossings, etc. before the markings are obliterated. The Engineer will be provided a copy of the pavement marking inventory. Additional quantities are included in the estimate of quantities to paint the additional pavement marking. The cost of the tabs shall be incidental to the contract unit prices for the various items.

Permanent pavement markings shall be furnished and applied by the Contractor in accordance with Section 633 of the Standard Specifications and the details in these plans. **The rate of application of glass beads shall be 8 lbs per gallon of paint.**

The application of permanent pavement marking paint shall not begin until 7 calendar days following completion of final surfacing and shall be completed within 21 calendar days following completion of final surfacing when temporary road markers are used to mark No Passing Zones.

The application of permanent pavement marking paint shall not begin until 7 calendar days following completion of final surfacing and shall be completed within 14 calendar days following completion of final surfacing when DO NOT PASS and PASS WITH CARE signs are used to mark No Passing Zones.

For each working day the application of permanent pavement marking paint remains uncompleted after the previously stated time requirements, the Contractor will be assessed liquidated damages at the rate of \$250.00 per day.

The liquidated damages shall apply up to the Contract Completion Date, as extended. After the completion date, liquidated damages will be assessed in accordance with section 8.7 of the Standard Specifications, until the Permanent Pavement Marking is completed, even though the project may be open to traffic.

COLD APPLIED PLASTIC PAVEMENT MARKING

Cold Applied Plastic Pavement Marking shall be placed prior to asphalt surface treatment on all projects as noted in the plans and as directed by the Engineer.

Cold Plastic Pavement Marking shall be placed in the same location as existing markings, unless otherwise directed by the Engineer. Existing pavement markings shall be completely removed by grinding prior to installing the new Cold Plastic Pavement Marking.

It shall be the Contractor's responsibility to visit the project site to determine what type of material(s) are present and the extent of the work required to remove the existing pavement markings. Cost for removing existing pavement marking shall be incidental to the various contract unit prices for pavement marking.

Once work starts on this portion of the project it shall be pursued in a continuous manner until the project is completed. Cold Plastic Pavement Markings shall be installed as follows:

Table: Estimated Cold Applied Plastic Pavement Markings per segment

Segment	ITEM	LOCATION	QUANTITY
2	RAILROAD CROSSING	SD 25	2
3	GORE AREAS, 24" YELLOW	US HWY 14	247'
3	RIGHT-TURN ARROWS	US HWY 14, EBL	4
4	LEFT-TURN ARROWS	US HWY 14, WBL	4
5	RIGHT-TURN ARROWS	US HWY 281 & 180 TH ST JUNCTION	3
5	LEFT-TURN ARROWS	US HWY 281 & 180 TH ST JUNCTION	2
5	GORE AREAS, 24" YELLOW	US HWY 281 & 180 TH ST JUNCTION	68'
5	BULLET NOSE AREA	US HWY 281 & MAIN ST. JUNCTION; TULARE, SD	38.7 SqFt
5	LEFT-TURN ARROWS	US HWY 281 & MAIN ST. JUNCTION; TULARE, SD	2
5	GORE AREAS, 24" YELLOW	US HWY 281 & MAIN ST. JUNCTION; TULARE, SD	223'
5	BULLET NOSE AREA	US HWY 281 & MAIN ST. JUNCTION; TULARE, SD	86.4 SqFt

New pavement markings shall be provided and applied by the Contractor.

PAVEMENT MARKING MASKING

Immediately prior to sealing, durable markings shall be covered with an approved pavement marking masking. All cost for furnishing, installing, removing, and disposing of masking shall be incidental to the various contract unit prices for Pavement Marking Masking.

The following items shall be masked:

Table: Estimated pavement marking Masking per segment

Segment	ITEM	LOCATION	QUANTITY
2	RAILROAD CROSSING	SD 25	2
3	GORE AREAS, 24" YELLOW	US HWY 14	247'
3	RIGHT-TURN ARROWS	US HWY 14, EBL	4
4	LEFT-TURN ARROWS	US HWY 14, WBL	4
5	RIGHT-TURN ARROWS	US HWY 281 & 180 TH ST JUNCTION	3
5	LEFT-TURN ARROWS	US HWY 281 & 180 TH ST JUNCTION	2
5	GORE AREAS, 24" YELLOW	US HWY 281 & 180 TH ST JUNCTION	68'
5	BULLET NOSE AREA	US HWY 281 & MAIN ST. JUNCTION; TULARE, SD	38.7 SqFt
5	LEFT-TURN ARROWS	US HWY 281 & MAIN ST. JUNCTION; TULARE, SD	2
5	GORE AREAS, 24" YELLOW	US HWY 281 & MAIN ST. JUNCTION; TULARE, SD	223'
5	BULLET NOSE AREA	US HWY 281 & MAIN ST. JUNCTION; TULARE, SD	86.4 SqFt

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EXISTING PAVEMENT CONDITIONS & TRAFFIC VOLUMES

The existing pavement conditions have been checked for each project and factored into the rates of materials. Actual rates will be adjusted in the field during construction by the Engineer.

The descriptions used were from the McLeod procedure for seal coat design.

The traffic volumes are shown on the title sheets.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN

After the aggregate stockpiles have been produced, the Contractor shall submit samples of the aggregates to the asphalt supplier, prior to construction, to determine a mix design and verify compatibility of the aggregate and asphalt.

The asphalt surface treatment will be designed in accordance with the Modified McLeod Design Procedure found in Volume II of Appendix C of the Preventive Maintenance Surface Treatments Report. The asphalt surface treatment design will be prepared by qualified personnel experienced in asphalt surface treatment design.

The surface design will be based on the traffic volume(s) and pavement conditions contained in the plans. The final application rate for the asphalt binder and cover aggregate will be determined after the source of the material is known and field adjustments are made. The design will include the following information:

- 1) Aggregate gradation.
- 2) Bulk specific gravity of the aggregate.
- 3) Loose unit weight of the aggregate.
- 4) Asphalt type and rate of application.
- 5) Aggregate rate of application.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

In addition to the above data, the Contractor will submit with the design of the asphalt surface treatment a sample of each aggregate and emulsion for use by the Engineer for verifying the test results. The design may be verified by the Department.

The mix design shall be submitted to the Engineer at least one week prior to the start of construction.

Appendix C Volume II. Guidelines for Design of Chip Seals are reproduced below:

Volume II. Guidelines for Design of Chip Seals

Introduction

This volume presents the guidelines for the design of chip seals. The guidelines first cover some general information regarding the aggregate chips and the asphalt emulsion. The guidelines then address the specific material properties that are used in the recommended design procedure. Finally, the design equations for the aggregate and emulsion application rates are presented. An example design problem, illustrating the design procedure in a step-by-step manner, is also presented.

Aggregate Chips

Aggregate Type

Three aggregate types—quartzite, limestone and natural aggregates— are commonly used throughout the state. Quartzite is more common in the eastern part of the state, whereas limestone is more common in the western part of the state. Natural aggregates are found in the central as well as the northeast portion of the state. Other aggregate types, such as river gravel and granite, have been used for chip seals but are not common.

The selection of the aggregate type should be based on the availability and cost of aggregates in the area. The performance of chip seals with specific aggregate types should also be considered in the selection. On specialized applications, such as for high-volume roadways, additional considerations may need to be taken into account. For example, crushed aggregate can provide improved retention and durability characteristics.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Aggregate Shape

The ideal shape for aggregate chips is cubical and angular, as opposed to flat and rounded. Flat particles tend to orient on their flattest side under traffic loadings and can become completely covered with emulsion and create a bleeding problem. In addition, these completely embedded chips prevent proper embedment of chips that lie on top of the embedded chips, resulting in continued chip loss. With cubical aggregates, the chip height is essentially the same regardless of its orientation, resulting in more uniform chip embedment.

Angular or crushed aggregate particles are preferred over rounded particles. Rounded aggregates are more susceptible to rolling and displacement under traffic, especially in locations of stopping or turning traffic. Angular particles tend to lock together and provide better long-term retention and stability.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Aggregate Gradation

The aggregate gradation plays a key role in the design, construction and performance of chip seals. The gradation requirements shown in this Design Procedure are for information only and Modified Cover Aggregate is specified in the plans. The ideal gradation comprises the following characteristics:

- The aggregate chips should be similarly sized. A one-size aggregate provides a more uniform thickness and a more
- consistent and proper embedment of the chips, which improves the retention and performance of the chip seal. Similarly sized chips also help improve the surface friction and drainage capabilities of the chip seal.
- The aggregate bands should not be too wide. Allowing a wide range of aggregate retained on a particular sieve will result in widely varying gradations and differing performance. A tight gradation band ensures consistency and uniformity of the chip seal.
- The gradation should limit the amount of fines (material passing the 0.075 mm [No. 200] sieve). Fine materials create dust and can be a safety hazard for passing vehicles. Furthermore, fine materials absorb emulsion and can affect the bonding characteristics and performance of the chip seal.

To better account for these ideal properties, the aggregate gradations in Table II-1 are recommended for all roadways. The maximum aggregate size is 9.52 mm (3/8 in). The gradation also forces the majority of the aggregate to a small range to create a more uniform chip seal. The gradation also addresses the amount of fines by limiting the material passing the 0.075 mm (No. 200) sieve to one percent. The recommended gradation for sections using a second choke stone layer is also provided in the table.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Table II-1. Aggregate gradations for chip seal designs.

Sieve Size	Percent Passing	
	Aggregate Chips	Choke Stone
12.7 mm (1/2 in)	100	100
9.52 mm (3/8 in)	90 – 100	100
6.35 mm (1/4 in)	40 – 70	100
4.75 mm (No. 4)	0 – 25	85 – 100
2.36 mm (No. 8)	0 – 5	10 – 40
1.18 mm (No. 16)	–	0 – 10
0.300 mm (No. 50)	–	0 – 5
0.075 mm (No. 200)	0 – 1	0 – 1

Flat and Elongated Particles (Flakiness Index)

Like small particles, flat and elongated particles can become completely embedded in the emulsion and thus prevent larger aggregate particles from achieving proper embedment. The flakiness index – determined in accordance with the Central Federal Lands Highway Division (CFLHD) DFT-508, *Standard Method of Determining the Flakiness Index and Average Least Dimension of Aggregates* – should be performed to limit the amount of flat and elongated particles. The Flakiness Index is a measure of the percentage, by weight, of flat particles. For most applications, the Flakiness Index should be limited to 30 percent (i.e., the weight of flat and elongated particles should not exceed 30 percent of the total aggregate weight). For special applications such as high-volume roadways, the limit should be tightened to 20 or 25 percent.

Asphalt Emulsion

Emulsification is a process in which two otherwise incompatible materials are blended together. In the case of asphalt emulsion, the two incompatible materials are asphalt and water. An asphalt emulsion consists of asphalt particles dispersed in water, which is stabilized using a chemical solution (also known as an emulsifier). Upon application, the water and asphalt separate, a process referred to as "breaking" of the emulsion. The water then evaporates leaving the asphalt as the bonding agent.

Emulsion Classification

Asphalt emulsions are classified into three categories – anionic, cationic and nonionic – referring to the electrical charge of the emulsifier surrounding the asphalt particles. Anionic emulsions have a negative electrical charge surrounding the asphalt particles, and cationic emulsions have a positive charge.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Because opposite electrical charges attract, anionic emulsions should be used with aggregates that have a positive charge (such as limestone and natural aggregates). Likewise, cationic emulsions should be used with aggregates that have a negative charge (such as quartzite).

Emulsions are further identified based on how quickly they revert back to asphalt cement. The following terms are used to classify the emulsion grades:

- Rapid-setting (RS)
- Medium-setting (MS)
- Slow-setting (SS)
- Quick-setting (QS)

The grades indicate the speed at which the emulsion will become unstable and "break" coming into contact with the aggregate. An RS emulsion breaks very quickly and has little or no ability to mix with an aggregate. An MS emulsion will mix with coarse aggregate but not fine aggregate. SS and QS emulsions are designed to mix with fine aggregates.

High-float emulsions (designated as HF) allow a thicker film of asphalt material on the aggregate, which enhances the bonding and retention. They are designated as such because they pass the Float Test (ASTM D139 or AASHTO T50). High-float emulsions are recommended for use with dusty aggregates (greater than 2 percent fines).

Numbers are used in the classification to indicate the relative viscosity of the emulsion. Lower numbers indicate a lower viscosity or more fluid material (i.e., an MS-2 is more viscous than an MS-1). Letters are also sometimes used following the designation: "h" indicates a harder base asphalt, "s" indicates a softer base asphalt and "p" indicates a polymer-modified asphalt.

Table II-2 shows the classifications for asphalt emulsion. Standard specifications are available for anionic asphalt emulsions (ASTM D977 or AASHTO M140) and for cationic asphalt emulsions (ASTM D2397 or AASHTO M208).

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Table II-2. Classifications of asphalt emulsions.

Anionic Asphalt Emulsions	Cationic Asphalt Emulsions
RS-1	CRS-1
RS-2	CRS-2
HFRS-2	—
MS-1	—
MS-2	CMS-2
MS-2h	CMS-2h
HFMS-1	—
HFMS-2	—
HFMS-2h	—
HFMS-2s	—
SS-1	CSS-1
SS-1h	CSS-1h

Chip Seal Design

Chip seals should be designed so that the proposed materials are of sufficient quality and have the desired properties to provide the expected performance. Proper design also ensures that the proper application rates are being used. The design procedure presented herein is a modified version of the McLeod design procedure (McLeod 1969) and is currently being used by the Minnesota Department of Transportation (Janisch and Gaillard 1998).

The procedure is based on two basic principles:

- The aggregate application rate is designed to provide a chip seal that is one stone thick (i.e., there should be a single layer of uniformly sized chips) with minimal excess.
- The voids in the aggregate are designed to be 70 percent filled with asphalt cement for good performance (i.e., the chips should be 70 percent embedded).

Emulsion Properties

Residual Asphalt Content

A portion of an asphalt emulsion consists of water, which evaporates as the binder breaks. The amount of asphalt cement that remains after breaking is referred to as the residual asphalt content. It is important to consider the residual asphalt content because it represents the amount of material that is available for bonding to the aggregate. In general, the residual asphalt content is about 65 to 70 percent (i.e., 65 to 70 percent of an asphalt emulsion consists of asphalt cement).

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

As mentioned, the objective of this design procedure is to achieve 70 percent embedment of the average-sized aggregate. To accomplish this, the emulsion must be at the top of the average-sized aggregate before curing. If only 70 percent of the aggregate is covered initially, the asphalt height will be about 30 percent too low after curing.

Aggregate Properties

Median Particle Size

The median particle size is the theoretical size through which 50 percent of the material passes. It is determined from the gradation chart using the following sieve sizes: 25.0 mm (1 in), 19.0 mm (¾ in), 12.5 mm (½ in), 9.5 mm (⅜ in), 6.3 mm (¼ in), 4.75 mm (No. 4), 2.36 mm (No. 8), 1.18 mm (No. 16), 0.300 mm (No. 50) and 0.075 mm (No. 200).

Flakiness Index

The Flakiness Index is a measure of the percentage, by weight, of flat particles. It is determined by testing a sample of aggregate particles for their ability to fit through a slotted plate. The test is conducted in accordance with the Central Federal Lands Highway Division (CFLHD) DFT-508, *Standard Method of Determining the Flakiness Index and Average Least Dimension of Aggregates*. The weight of the material passing the slots is divided by the total weight of the aggregate sample to determine the percent of flat particles or Flakiness Index.

Average Least Dimension

The average least dimension represents a reduction of the median particle size after accounting for the amount of flat particles. It represents the chip seal thickness in the wheel path after traffic has reoriented the chips on their flattest side. It is determined from the median particle size and flakiness index using the following equation:

$$H = \frac{M}{1.139285 + 0.011506FI} \quad (\text{Eq. II-1})$$

where:

- H = Average Least dimension, in.
- M = Median particle size, in.
- FI = Flakiness index, percent.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Loose Unit Weight

The loose unit weight is required in order to determine the voids in the aggregate in a loose condition. The voids represent the available space for the asphalt binder after placement and rolling. The loose unit weight is a function of the gradation, shape and specific gravity of the aggregate. It should be determined in accordance with ASTM C29.

Bulk Specific Gravity

Bulk specific gravity represents the weight of aggregate as compared to the weight of water. Different aggregate types have different unit weights or specific gravities. This factor affects the application rate of the aggregate chips because a heavier aggregate will require more weight of chips (or a higher application rate) than a lighter aggregate to cover the same area. Bulk specific gravities for aggregates typically range from 2.40 to 3.00. Natural aggregates are generally about 2.40 and quartzite and limestone aggregates are generally around 2.60.

Voids in Loose Aggregate

The voids in the loose aggregate represent the voids after the aggregate chips are placed on the pavement. It is based on the loose unit weight and can be determined using the following equation:

$$V = 1 - \frac{W}{62.4G} \quad (\text{Eq. II-2})$$

where:

- V = Voids in the loose aggregate.
- W = Loose unit weight of the aggregate chips, lb/ft³.
- G = Bulk specific gravity of the aggregate.

For one-sized chips, this factor will typically be around 50 percent. Rolling will reduce the amount of voids, typically to around 30 percent. Traffic will further reduce the amount of voids to around 20 percent.

Aggregate Absorption

Aggregates, especially porous aggregates, will absorb a portion of the asphalt emulsion. This will affect the amount of asphalt binder that is available for bonding with the aggregate chips. To ensure that enough binder remains, this factor must be taken into account when designing the emulsion application rate. An absorption correction factor of 0.09 l/m² (0.02 gal/yd²) is recommended for aggregates with absorption greater than 1.5 percent. Quartzite is generally not too absorptive and will not require an adjustment. Some limestone and natural aggregates, however, may require an adjustment to the emulsion application rate.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Other Design Properties

Traffic Volume

The traffic volume will influence the amount of asphalt binder that is required to provide sufficient embedment of the aggregate chips. All other factors equal, roadways with higher traffic volumes will require less asphalt binder. This may appear to be the opposite of what is typically expected. However, consider that traffic causes a reorientation of the chips until they eventually lie on their flattest side.

More traffic thus results in a greater probability that the chips will be laying on their flattest side and will result in a thinner chip seal. Less traffic will result in a thicker chip seal and will thus require more asphalt binder to achieve sufficient embedment. Table II-3 provides the recommended traffic correction factor to be used in determining the emulsion application rate. Failure to account for this factor will result in bleeding in the wheel paths.

Table II-3. Recommended traffic correction factor.

Traffic (ADT)	Traffic Factor
< 100	0.85
100 – 500	0.75
500 – 1000	0.70
1000 – 2000	0.65
> 2000	0.60

Traffic Whip-Off

A portion of the aggregate chips will get thrown off the roadway before final curing and embedment under traffic has occurred. This is accounted for in the procedure using a traffic whip-off factor. The factor is based on the traffic volume and traffic speed of the roadway. Low-volume, residential streets will have about a 5 percent loss, whereas the loss on high-volume, high-speed roadways will be around 10 percent. The factor can be computed using the following equation:

$$E = 1 + \frac{P}{100} \quad (\text{Eq. II-3})$$

where:

- E = Traffic whip-off factor.
- P = Expected loss of aggregate chips, percent.

Thus, an expected loss of 10 percent results in a traffic whip-off factor of 1.10.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Existing Pavement Condition

The surface condition of the existing pavement will greatly influence the amount of asphalt emulsion that is required. A dry, porous pavement will absorb a tremendous amount of asphalt binder and thus affect the emulsion application rate. Conversely, a new pavement (or a pavement with bleeding on the surface) will absorb much less binder. The varying condition is accounted for in the design procedure by the surface correction factor. The recommended value, based on the pavement surface texture, is provided in Table II-4.

The same application rate cannot be used for all roadways with varying conditions. Similarly, the surface condition should be monitored during placement, and the application rate adjusted as needed to address areas of differing condition.

Table II-4. Recommended surface correction factors.

Existing Pavement Surface Texture	Surface Correction Factor, gal/yd ²
Black, flushed asphalt	-0.01 to -0.06
Smooth, non-porous	0.00
Slightly porous and oxidized	+0.03
Slightly pocked, porous and oxidized	+0.06
Badly pocked, porous and oxidized	+0.09

Design Equations

Once the inputs are determined, the application rates can be calculated using the McLeod design equations. The equations for aggregate and emulsion application rates are presented below.

Aggregate Application Rate

The following equation is used to determine the aggregate application rate:

$$C = 46.8(1 - 0.4V) \times H \times G \times E \quad (\text{Eq. II-4})$$

where:

- C = Chip application rate, lbs/yd².
- V = Voids in loose aggregate.
- H = Average Least dimension, in.
- G = Bulk specific gravity.
- E = Traffic whip-off factor.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Emulsion Application Rate

The emulsion application rate is determined using the following equation:

$$B = \frac{2.244 \times H \times T \times V + S + A}{R} \quad (\text{Eq. II-5})$$

where:

- B = Binder application rate, gal/yd².
- H = Average Least dimension, in.
- T = Traffic correction factor.
- V = Voids in loose aggregate.
- S = Surface correction factor.
- A = Aggregate absorption factor, gal/yd².
- R = Residual asphalt content of binder.

Minnesota performs an additional calculation of the emulsion application rate to account for snowplow damage (Janisch and Gaillard 1998). The emulsion application rate is recalculated using the median particle size instead of the average least dimension. This new emulsion rate provides the required rate if the chips are not reoriented, and thus is more representative of the rate required outside the wheel path. The average of the two rates is then used as the starting point in the field. Minnesota has found that if this additional calculation is not performed, insufficient binder is applied in non-traffic areas, and snow plows shave off the chips (Janisch and Gaillard 1998).

Example Design Problem

A 68 kg (150 lb) sample of quartzite aggregate has been submitted for design. The roadway has traffic levels of 2,125 vehicles per day. The pavement surface is slightly pocked, porous and oxidized. A CRS-2 emulsion with a residual asphalt content of 66.5 percent will be used as the binder. Determine the emulsion and aggregate application rates for this project.

Step 1. Determine the aggregate gradation, bulk specific gravity and percent absorption.

Laboratory testing of the aggregate revealed the gradation as shown in Table II-5. Testing in accordance with AASHTO T 84-94 indicates a bulk specific gravity of the aggregate of 2.61. The aggregate absorption based on AASHTO T 84-94 is 0.55 percent, so no correction is needed.

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Table II-5. Gradation results for design project.

Sieve Size	Percent Passing
12.7 mm (½ in)	100
9.52 mm (¾ in)	95
6.35 mm (¼ in)	62
4.75 mm (No. 4)	12
2.36 mm (No. 8)	3.2
0.075 mm (No. 200)	1.3

Step 2. Determine the mean particle size.

The median particle size (M) is determined by plotting the gradation results and reading off the size at which 50 percent of the particles pass. The median particle size represents the theoretical size at which half the stones are larger and half are smaller. For the given gradation, the median particle size is determined to be 5.8 mm (0.23 in).

Step 3. Determine the flakiness index.

To determine the flakiness index, the aggregate particles are fitted through slots. The results of this testing is shown in Table II-6.

Table II-6. Results of flakiness index test.

Size Fraction	Weight Retained on Slot, grams	Weight Passing Slot, grams
12.5 to 9.5 mm (½ to ¾ in)	54.2	12.3
9.5 to 6.3 mm (¾ to ¼ in)	123.3	43.5
6.3 to 4.75 mm (¼ in to No. 4)	184.4	89.5
Total	361.9	145.3

Using these results, the flakiness index (FI) is determined as follows:

$$FI = \frac{\text{Weight of Flat Chips}}{\text{Weight of Sample}} = \frac{145.3}{361.9 + 145.3} = 0.286 = 28.6 \text{ percent}$$

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Step 4. Determine the average least dimension.

The average least dimension (H) is the expected thickness of the chip seal after the chips have been reoriented on their flattest side from traffic. It is determined using Equation II-2 as follows:

$$H = \frac{M}{1.139285 + 0.011506FI} = \frac{0.23 \text{ in}}{1.139285 + (0.011506 \times 28.6)} = 0.157 \text{ in}$$

Step 5. Determine the loose weight of the aggregate.

A metal cylinder with a volume of 0.014 m³ (0.50 ft³) was loosely filled with aggregate and weighed. This process was repeated three times, the results of which are shown in Table II-7.

Table II-7. Results of loose unit weight testing.

Test Number	Weight of Aggregate, kg (lbs)
1	20.57 (45.25)
2	20.60 (45.32)
3	20.59 (45.29)
Average	20.59 (45.29)

The loose unit weight (W) is then determined as follows:

$$W = \frac{\text{Weight of Aggregate}}{\text{Weight of Cylinder}} = \frac{45.29 \text{ lbs}}{0.50 \text{ ft}^3} = 90.58 \text{ lbs / ft}^3$$

Step 6. Determine the voids in the loose aggregate.

The voids in the loose aggregate (V) is determined using Equation II-2 as follows:

$$V = 1 - \frac{W}{62.4 G} = 1 - \frac{90.58 \text{ lbs / ft}^3}{62.4 \text{ lbs / ft}^3 \times 2.61} = 0.44$$

Step 7. Determine the aggregate application rate.

With the inputs determined above, Equation II-4 is used to determine the aggregate application rate (C):

$$C = 46.8(1 - (0.4V)) \times H \times G \times E$$

$$= 46.8(1 - (0.4 \times 0.44)) \times 0.157 \times 2.61 \times 1.10 = 17.3 \text{ lbs / yd}^2$$

ASPHALT FOR SURFACE TREATMENT MIX DESIGN (CONTINUED)

Step 8. Determine the emulsion application rate.

The emulsion application rate is determined using Equation II-5. The calculation is performed twice – once for the wheel path areas (using the average least dimension) and again for the non-wheel path areas (using the median particle size). These calculations are shown below:

$$B = \frac{2.244 \times H \times T \times V + S + A}{R}$$

$$= \frac{2.244 \times 0.157 \times 0.60 \times 0.44 + 0.06 + 0.00}{0.665} = 0.23 \text{ gal.yd}^2$$

$$B = \frac{2.244 \times M \times T \times V + S + A}{R}$$

$$= \frac{2.244 \times 0.23 \times 0.60 \times 0.44 + 0.06 + 0.00}{0.665} = 0.30 \text{ gal.yd}^2$$

The average of the two results (0.27 gal/yd²) is used as the starting point in the field.

FIXED LOCATION SIGNS GROUND MOUNTED BREAKAWAY SUPPORT

SD HWY 25 SEGMENT #2 CLARK COUNTY

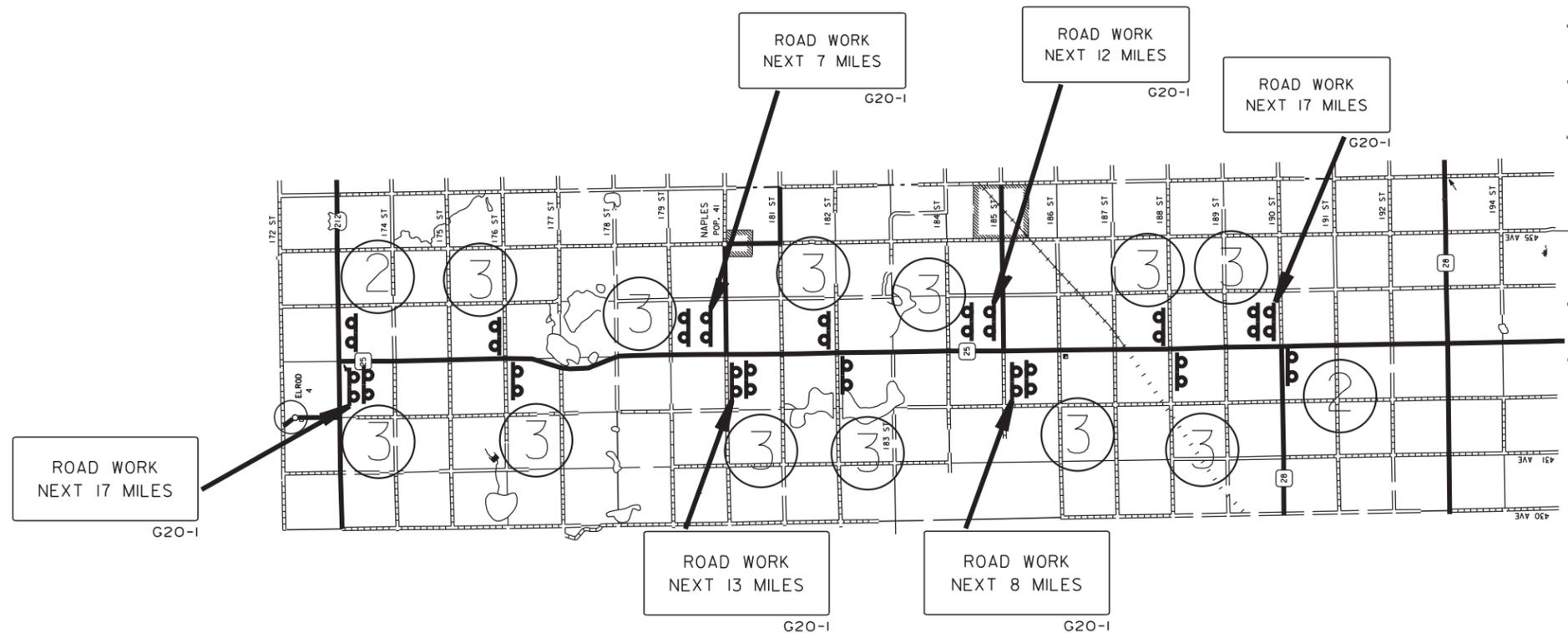
NOTES:

All Fixed Location signs shall remain in place until the permanent pavement marking is complete.

Signs shall be placed 200' to 300' from intersection. Exact location to be approved by the Engineer.

Construction signs shall not obscure existing signs and must be installed a minimum of 200' from an existing sign.

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (FEET)
0 - 30	200
35 - 40	350
45 - 50	500
55	750
60 - 65	1000
75	1000



G20-2



W8-7



W13-1P



W20-1

W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

FIXED LOCATION SIGNS GROUND MOUNTED BREAKAWAY SUPPORT

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P 0013(26)	21	36
Plotting Date: 02/19/2014			

NOTES:

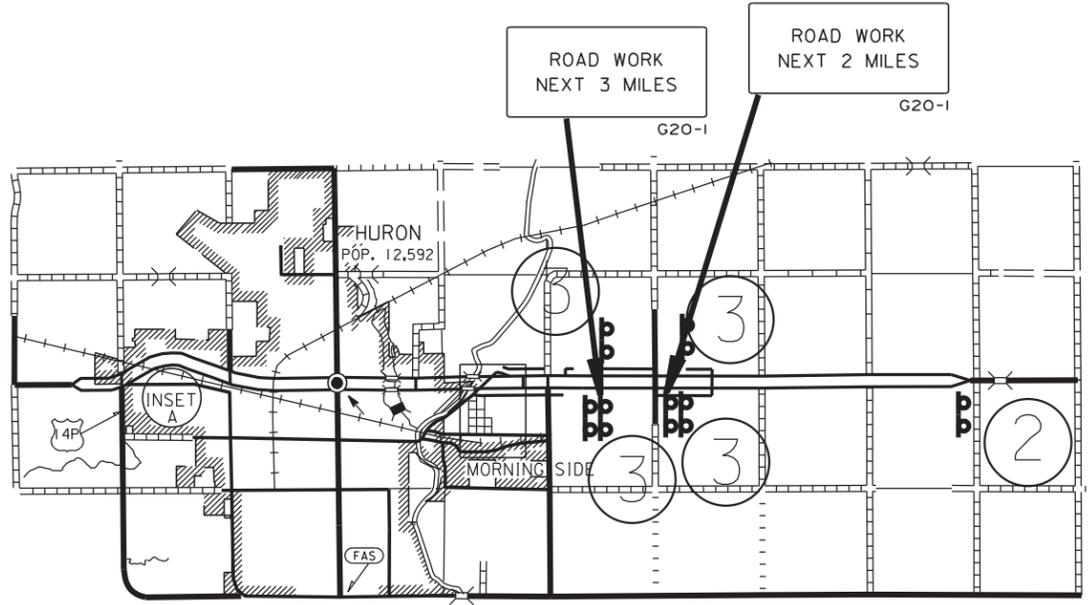
All Fixed Location signs shall remain in place until the permanent pavement marking is complete.

Signs shall be placed 200' to 300' from intersection. Exact location to be approved by the Engineer.

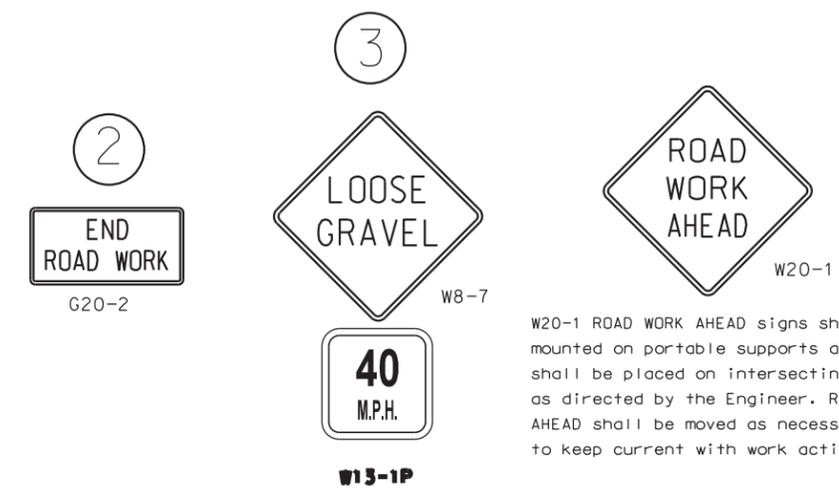
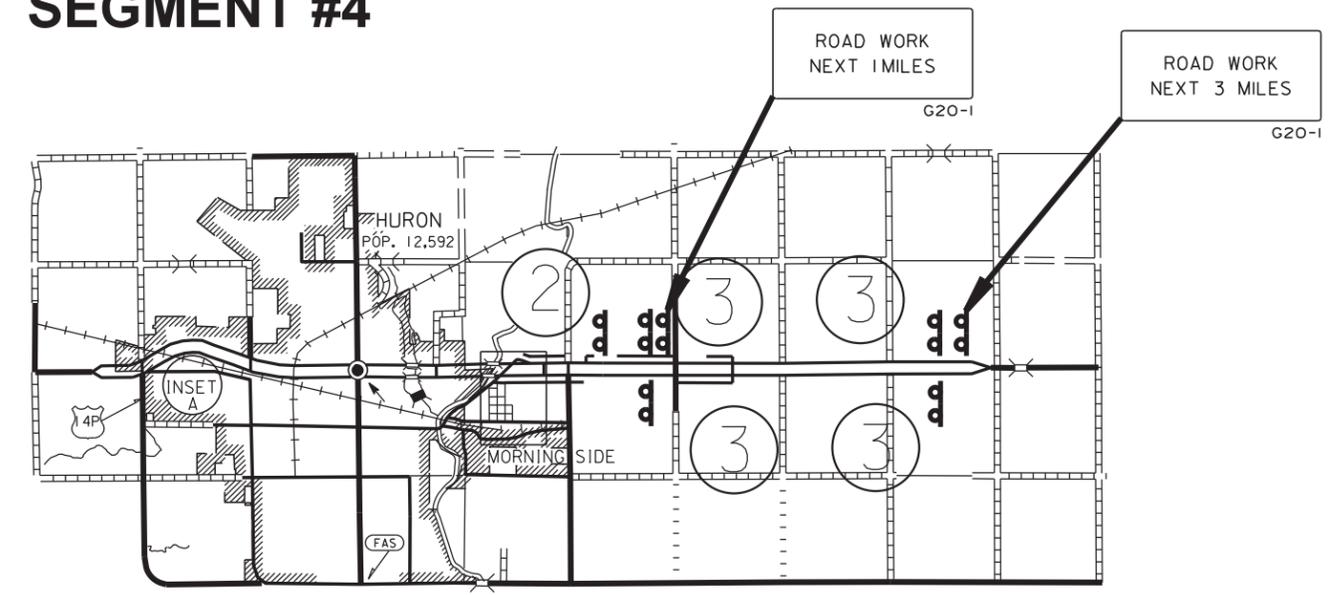
Construction signs shall not obscure existing signs and must be installed a minimum of 200' from an existing sign.

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (FEET)
0 - 30	200
35 - 40	350
45 - 50	500
55	750
60 - 65	1000
75	1000

US HWY 14 - DIVIDED HWY (EASTBOUND) SEGMENT #3



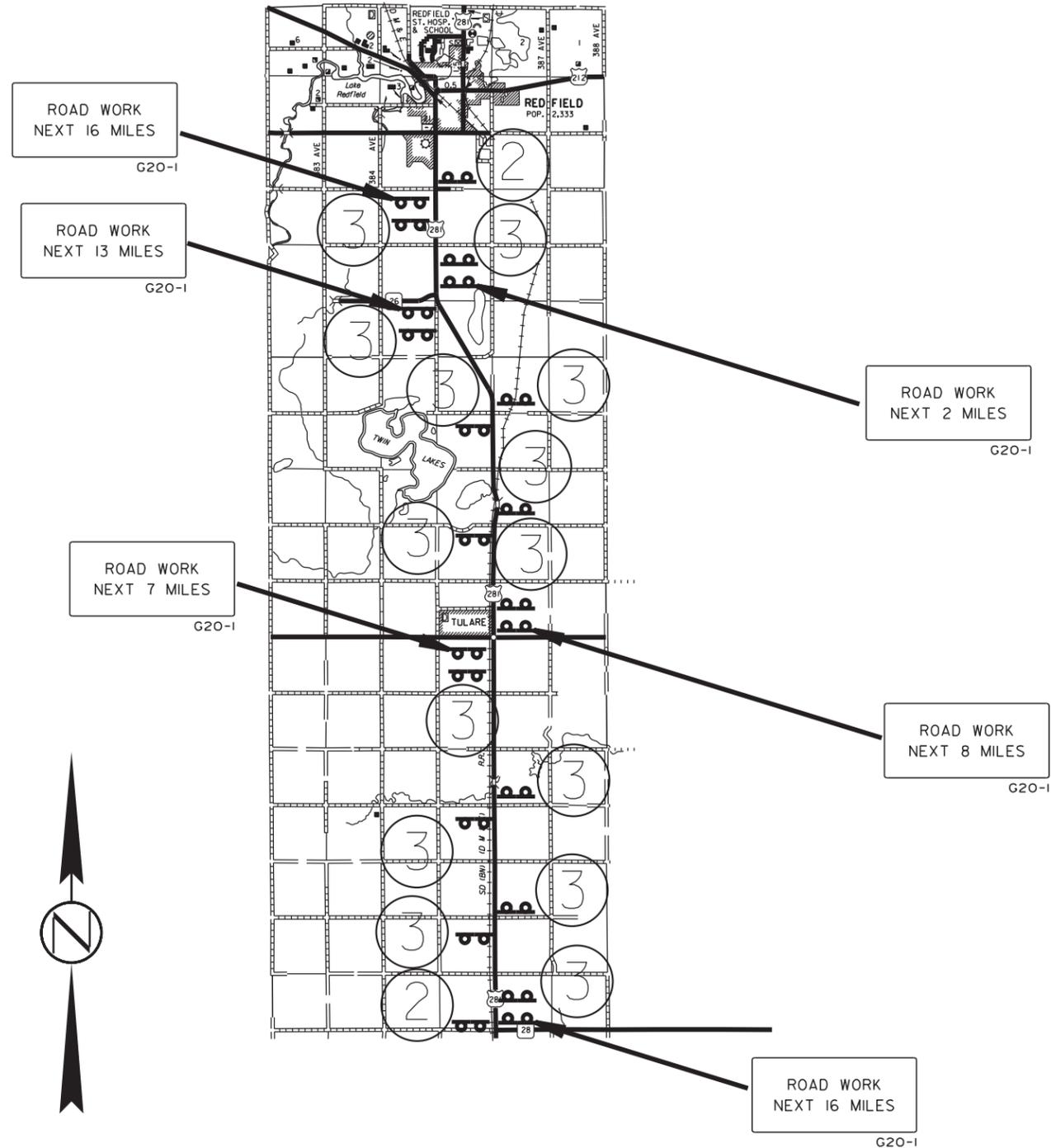
US HWY 14 - DIVIDED HWY (WESTBOUND) SEGMENT #4



W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

FIXED LOCATION SIGNS GROUND MOUNTED BREAKAWAY SUPPORT

US HWY 281 SEGMENT #5 SPINK COUNTY



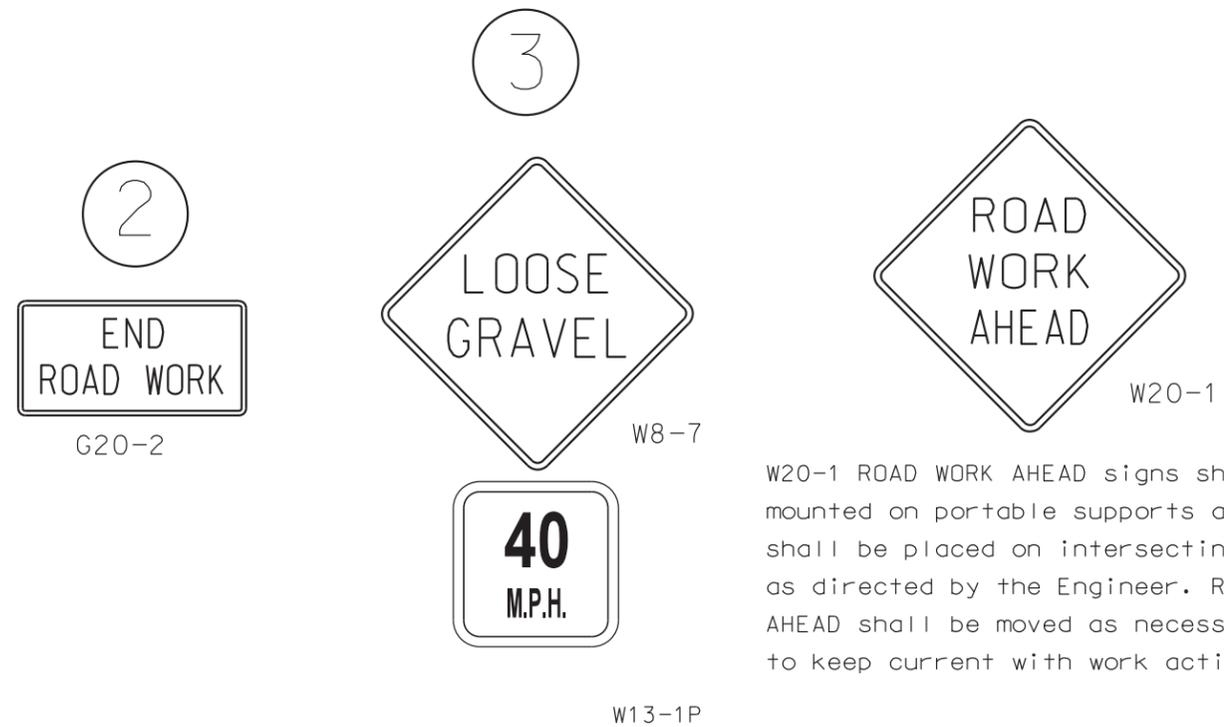
NOTES:

All Fixed Location signs shall remain in place until the permanent pavement marking is complete.

Signs shall be placed 200' to 300' from intersection. Exact location to be approved by the Engineer.

Construction signs shall not obscure existing signs and must be installed a minimum of 200' from an existing sign.

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (FEET)
0 - 30	200
35 - 40	350
45 - 50	500
55	750
60 - 65	1000
75	1000



W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

FIXED LOCATION SIGNS GROUND MOUNTED BREAKAWAY SUPPORT

NOTES:

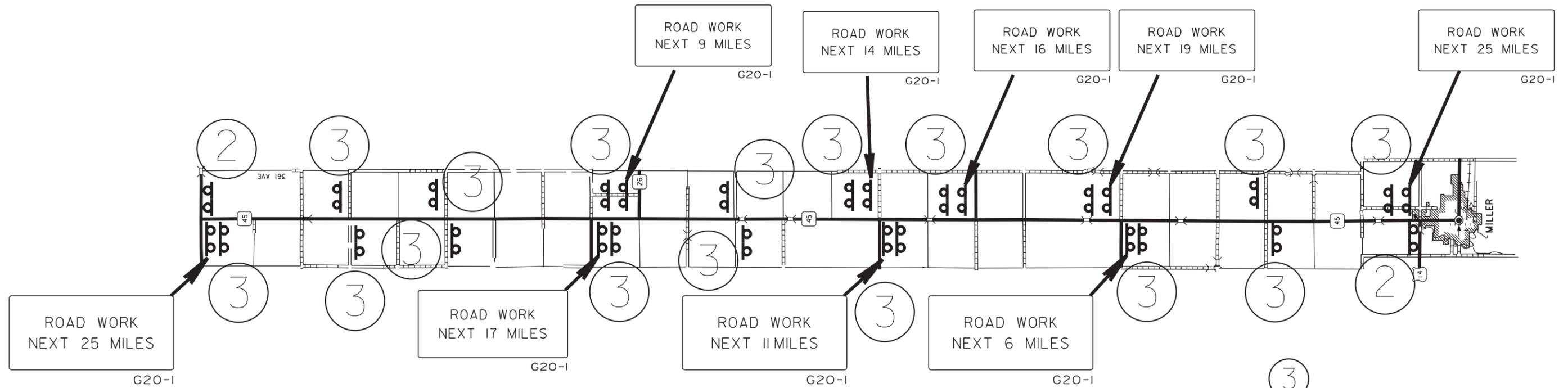
All Fixed Location signs shall remain in place until the permanent pavement marking is complete.

Signs shall be placed 200' to 300' from intersection. Exact location to be approved by the Engineer.

Construction signs shall not obscure existing signs and must be installed a minimum of 200' from an existing sign.

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (FEET)
0 - 30	200
35 - 40	350
45 - 50	500
55	750
60 - 65	1000
75	1000

SD HWY 45 & 26 SEGMENT #6-8 HAND COUNTY



W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

FIXED LOCATION SIGNS GROUND MOUNTED BREAKAWAY SUPPORT

SD HWY 47 SEGMENT #9 HYDE COUNTY

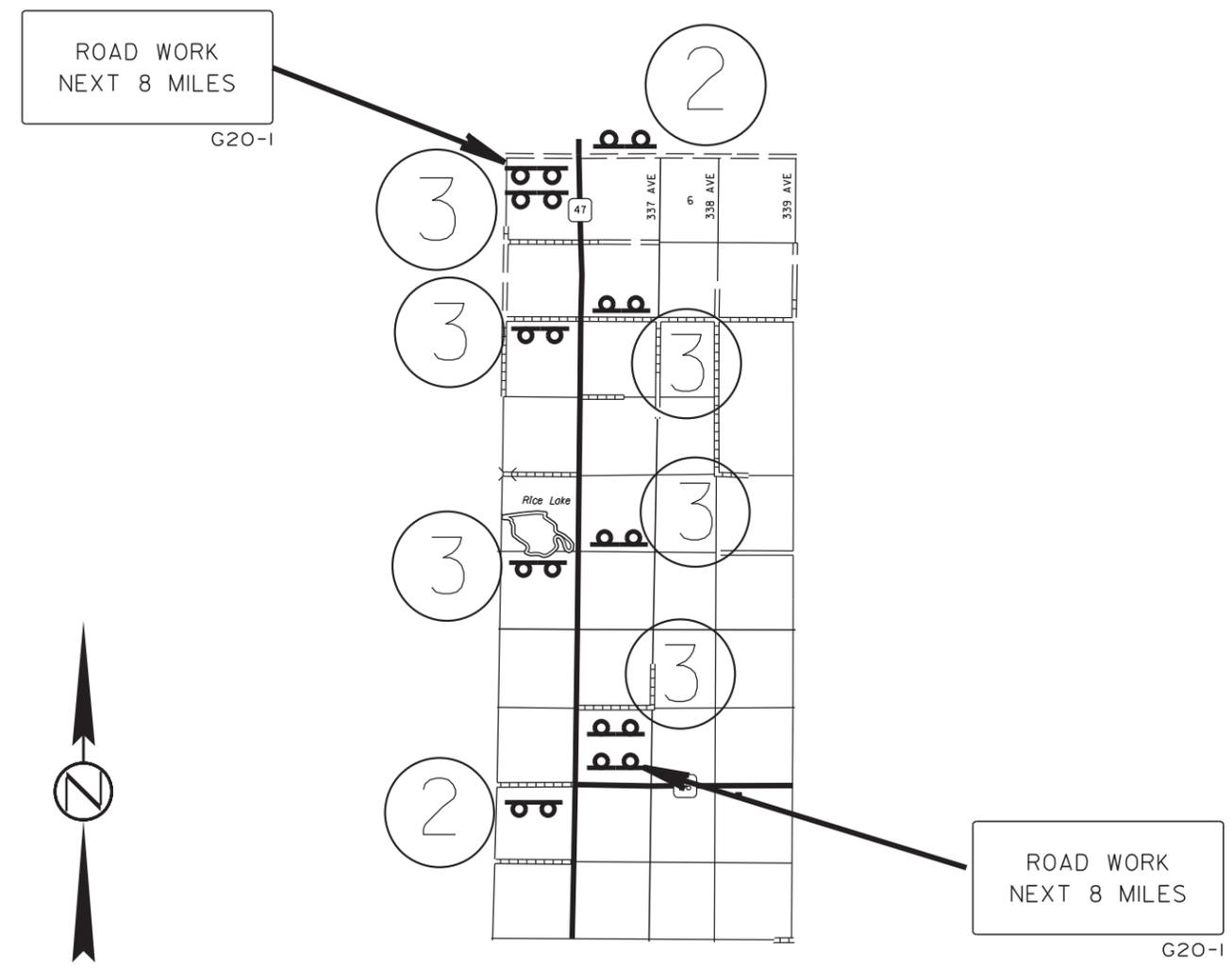
NOTES:

All Fixed Location signs shall remain in place until the permanent pavement marking is complete.

Signs shall be placed 200' to 300' from intersection. Exact location to be approved by the Engineer.

Construction signs shall not obscure existing signs and must be installed a minimum of 200' from an existing sign.

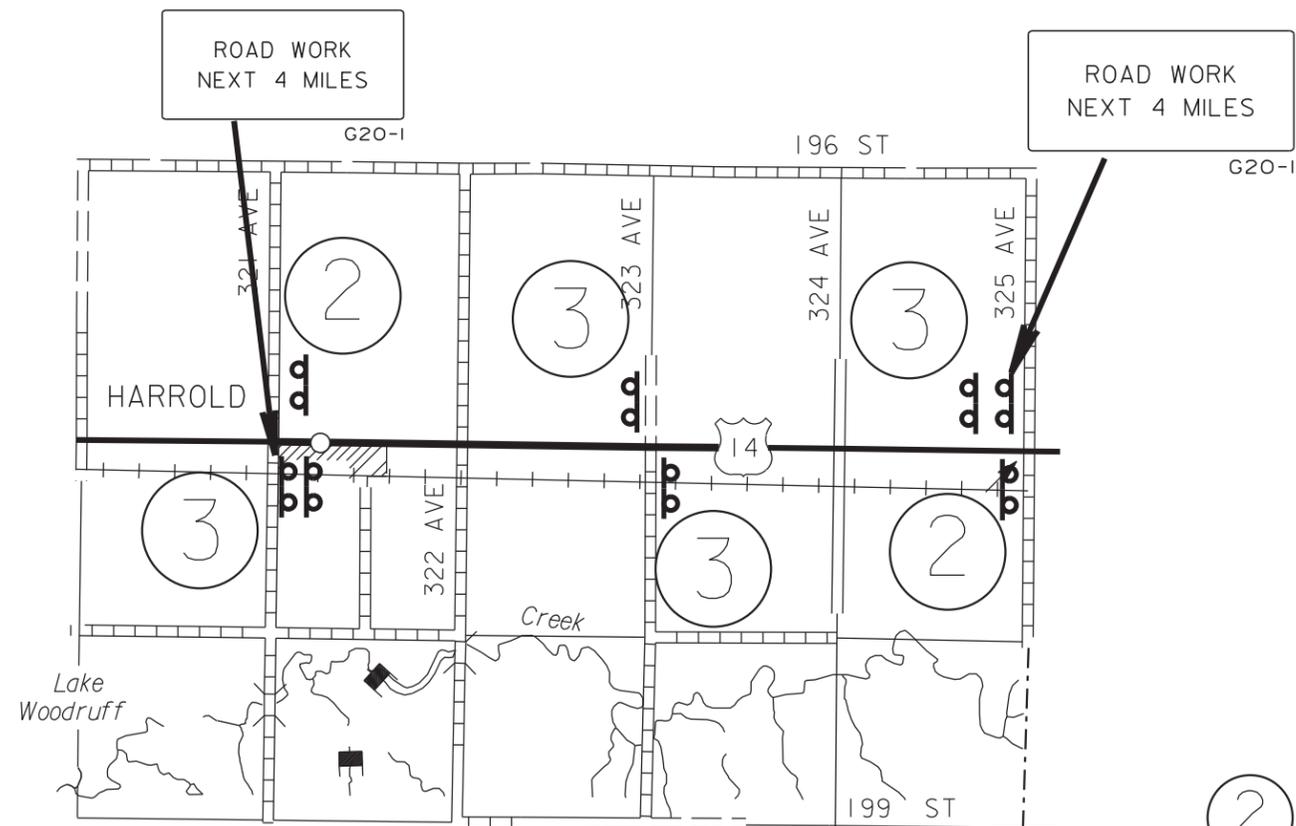
Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (FEET)
0 - 30	200
35 - 40	350
45 - 50	500
55	750
60 - 65	1000
75	1000



W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

FIXED LOCATION SIGNS GROUND MOUNTED BREAKAWAY SUPPORT

**US HWY 14
SEGMENT #10
HUGHES COUNTY**



NOTES:

All Fixed Location signs shall remain in place until the permanent pavement marking is complete.

Signs shall be placed 200' to 300' from intersection. Exact location to be approved by the Engineer.

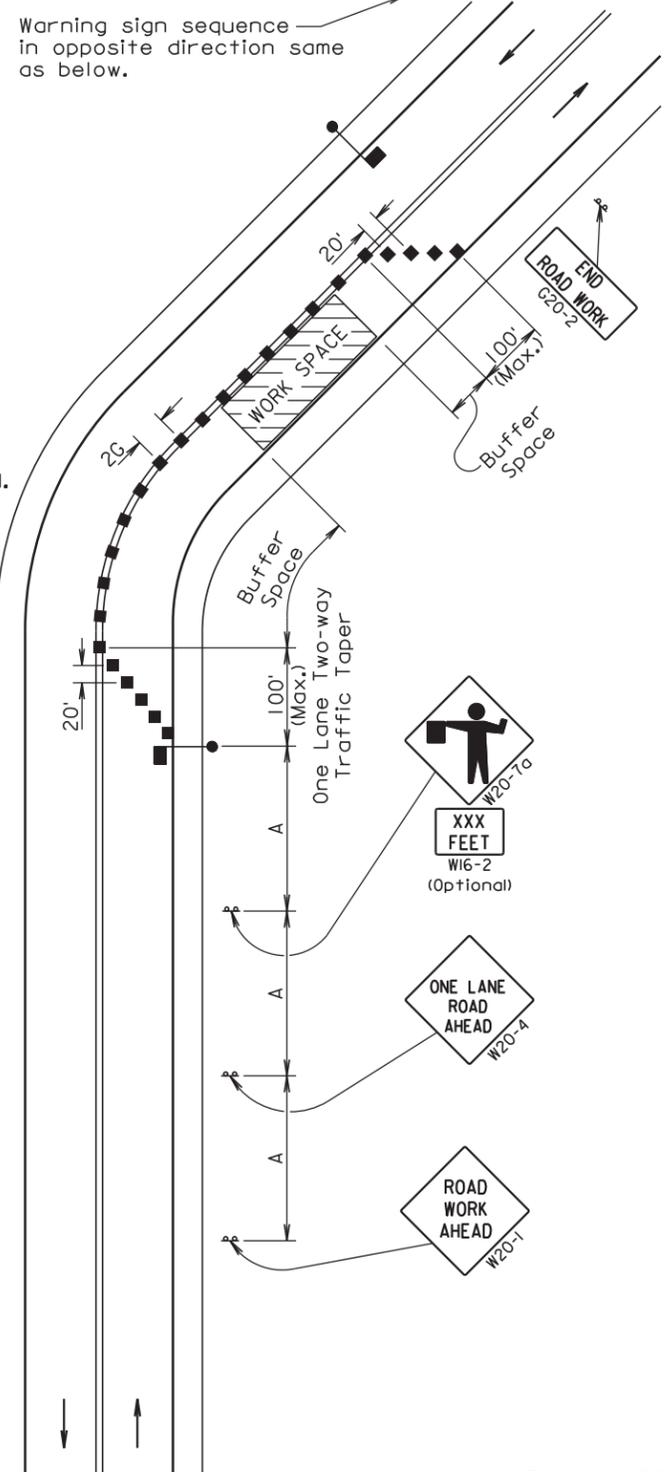
Construction signs shall not obscure existing signs and must be installed a minimum of 200' from an existing sign.

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (FEET)
0 - 30	200
35 - 40	350
45 - 50	500
55	750
60 - 65	1000
75	1000



W20-1 ROAD WORK AHEAD signs shall be mounted on portable supports and shall be placed on intersecting roadways as directed by the Engineer. ROAD WORK AHEAD shall be moved as necessary to keep current with work activities.

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (Feet) (A)	Spacing of Channelizing Devices (Feet) (G)
0 - 30	200	25
35 - 40	350	25
45 - 50	500	50
55	750	50
60 - 65	1000	50



● Flagger
 ■ Channelizing Device

For low-volume traffic situations with short work zones on straight roadways where the flagger is visible to road users approaching from both directions, a single flagger may be used.

The ROAD WORK AHEAD and the END ROAD WORK signs may be omitted for short duration operations (1 hour or less).

For tack and/or flush seal operations, when flaggers are not being used, the FRESH OIL sign (W21-2) shall be displayed in advance of the liquid asphalt areas.

Flashing warning lights and/or flags may be used to call attention to the advance warning signs.

The channelizing devices shall be drums or 42" cones.

Channelizing devices are not required along the centerline adjacent to work area when pilot cars are utilized for escorting traffic through the work area.

Channelizing devices and flaggers shall be used at intersecting roads to control intersecting road traffic as required.

The buffer space should be extended so that the two-way traffic taper is placed before a horizontal or vertical curve to provide adequate sight distance for the flagger and queue of stopped vehicles.

February 14, 2011

Published Date: 1st Qtr. 2014	S D D O T	GUIDES FOR TRAFFIC CONTROL DEVICES	PLATE NUMBER
		LANE CLOSURE WITH FLAGGER PROVIDED	634.23
		Sheet 1 of 1	

Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (Feet) (A) (B) (C)	Taper Length (Feet) (L)	Spacing of Channelizing Devices (Feet) (G)
0 - 30	200	180	25
35 - 40	350	320	25
45 - 50	500	600	50 *
55	750	660	50 *
60 - 65	1000	780	50 *

* Spacing to be every 40' for 42" cones.

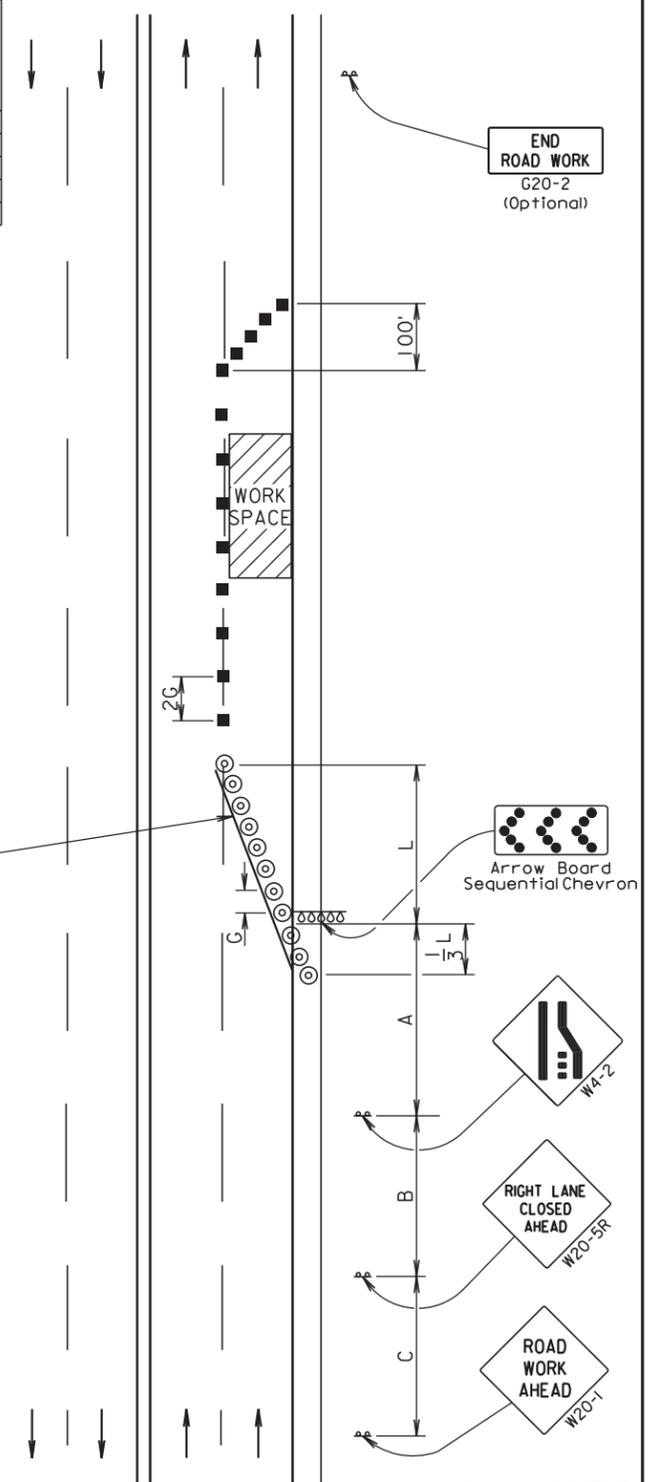
⊙ Reflectorized Drum

■ Channelizing Device shall be 42" cones or drums

42" cones may be used in place of the drums shown in the taper if setup will not be used during any night time hours.

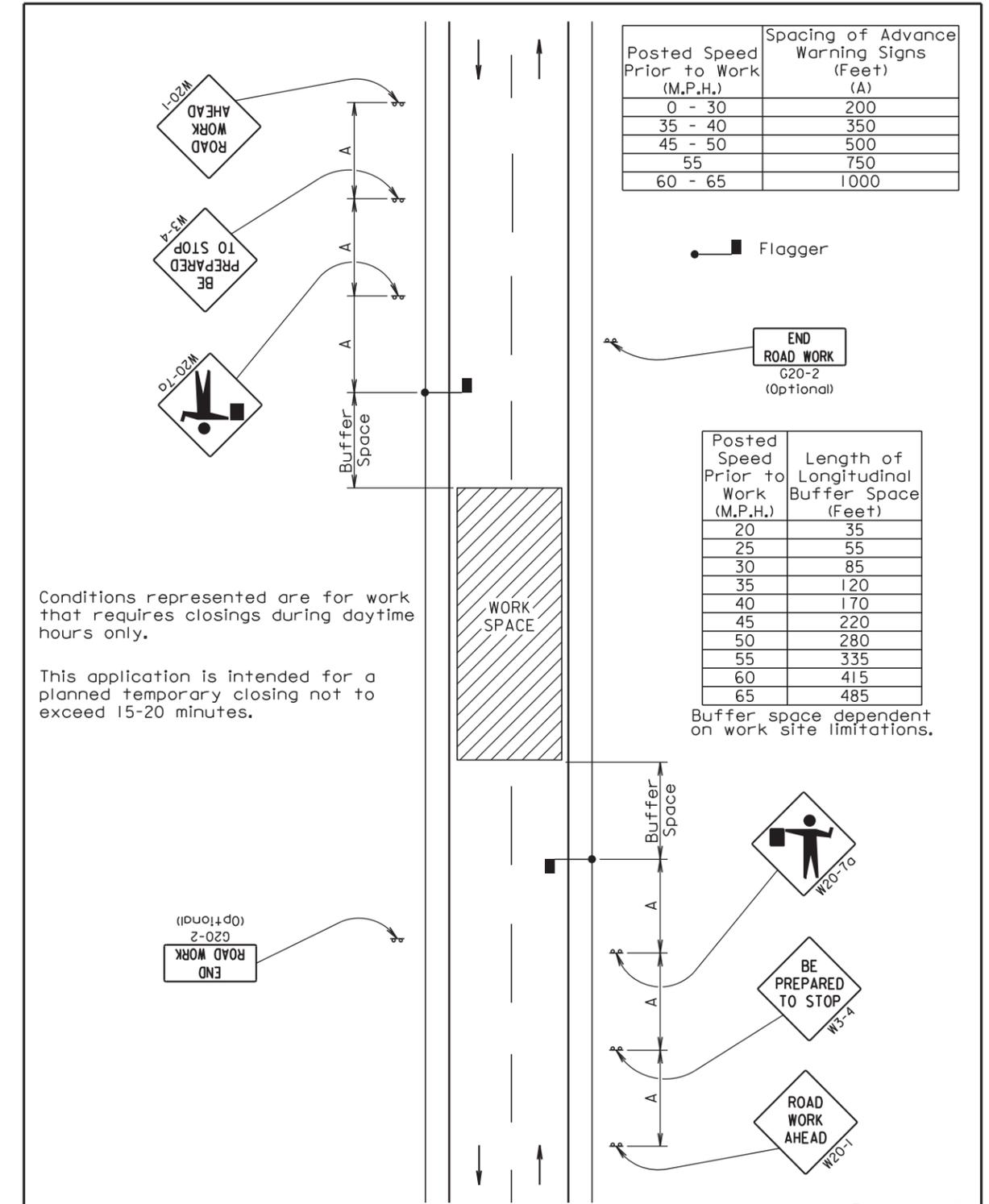
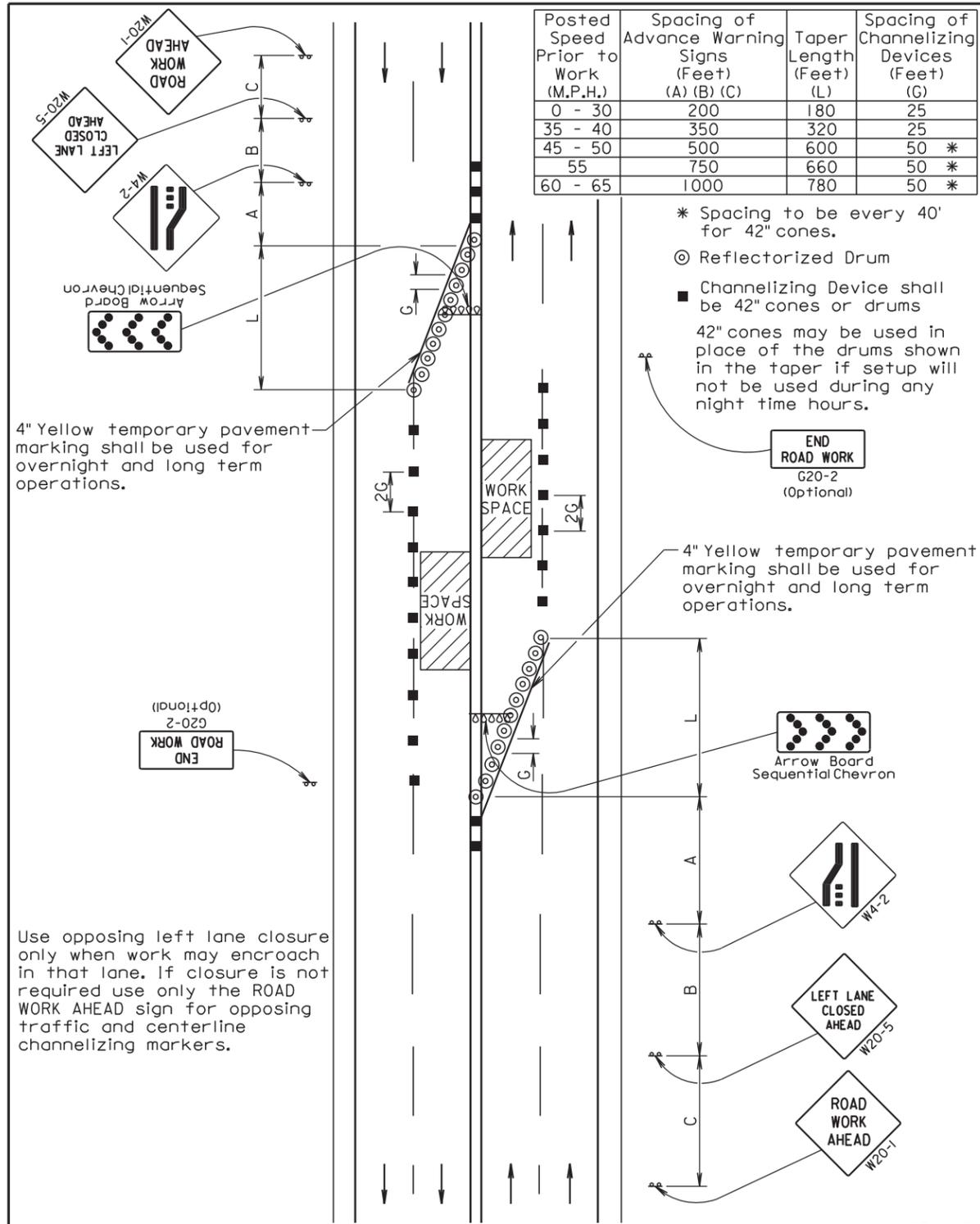
4" white temporary pavement marking shall be used for overnight and long term operations.

Longitudinal dimensions may be adjusted to fit project conditions such as horizontal curves, vertical curves, and other site restrictions.



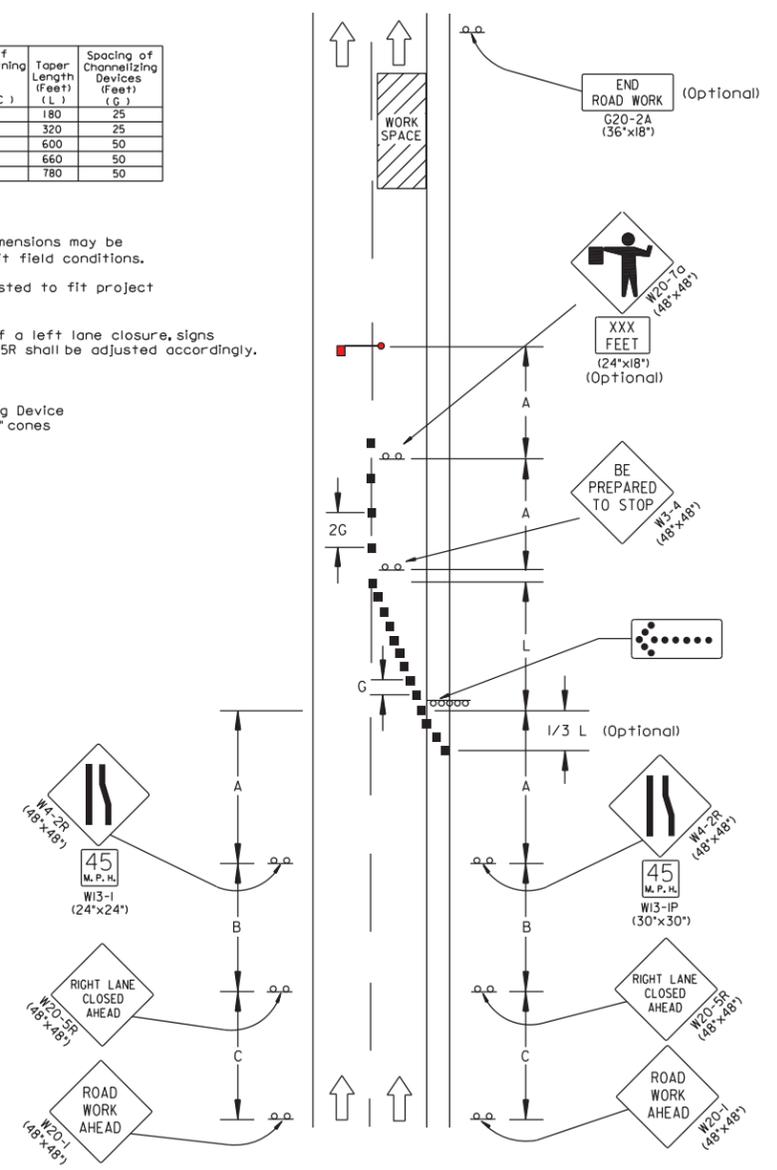
December 23, 2012

Published Date: 1st Qtr. 2014	S D D O T	GUIDES FOR TRAFFIC CONTROL DEVICES	PLATE NUMBER
		4-LANE UNDIVIDED, RIGHT LANE CLOSED	634.47
		Sheet 1 of 1	

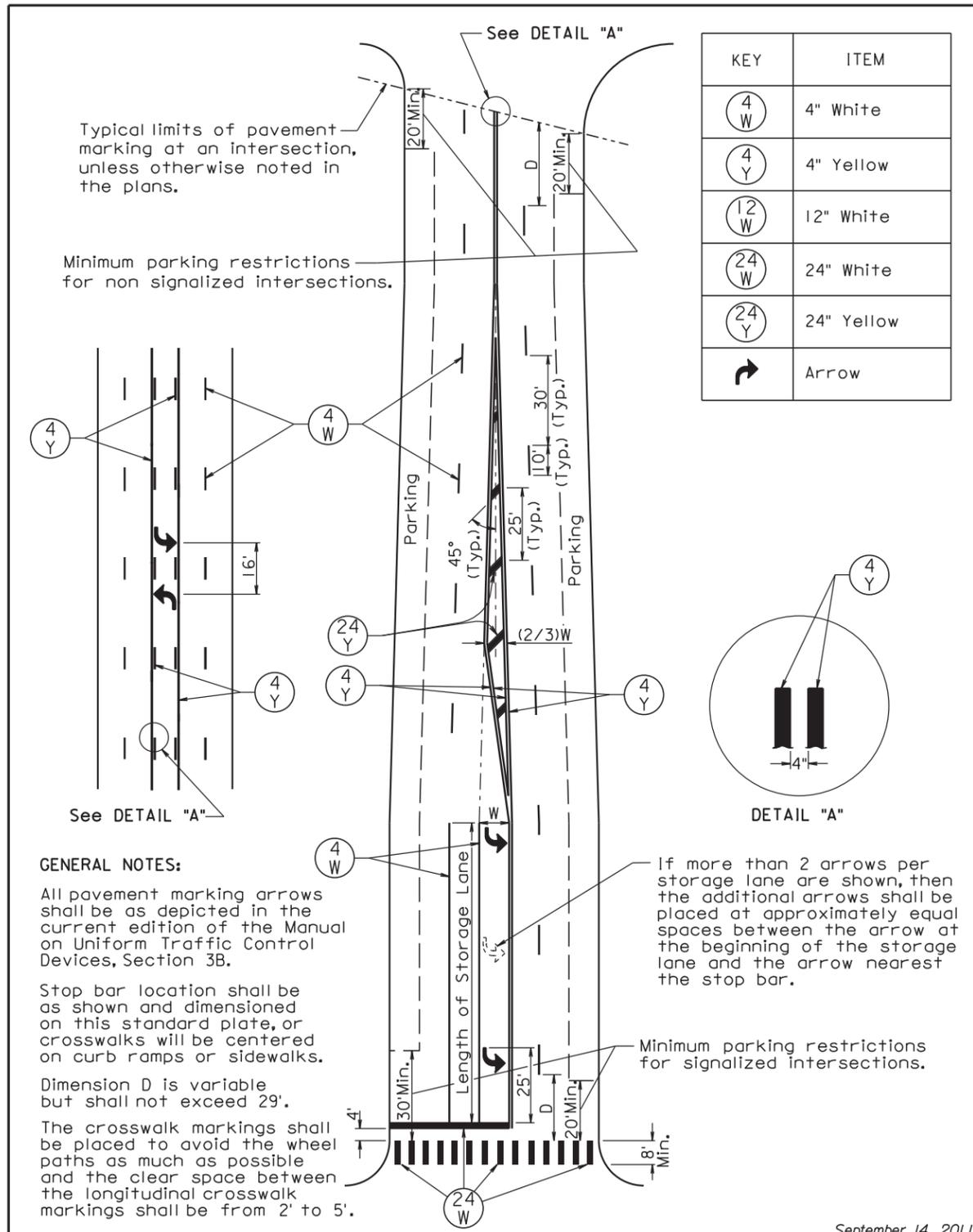


Posted Speed Prior to Work (M.P.H.)	Spacing of Advance Warning Signs (Feet) (A) (B) (C)	Taper Length (Feet) (L)	Spacing of Channelizing Devices (Feet) (G)
0 - 30	200	180	25
35 - 40	350	320	25
45 - 50	500	600	50
55	750	660	50
60 - 65	1000	780	50

- NOTES:
1. Longitudinal dimensions may be adjusted to fit field conditions.
 2. L may be adjusted to fit project conditions.
 3. In the case of a left lane closure, signs W4-2R and W20-5R shall be adjusted accordingly.
- Channelizing Device shall be 42" cones or drums



GUIDES FOR TRAFFIC CONTROL DEVICES 4-LANE DIVIDED, RIGHT LANE CLOSED



GENERAL NOTES:

All pavement marking arrows shall be as depicted in the current edition of the Manual on Uniform Traffic Control Devices, Section 3B.

Stop bar location shall be as shown and dimensioned on this standard plate, or crosswalks will be centered on curb ramps or sidewalks.

Dimension D is variable but shall not exceed 29'.

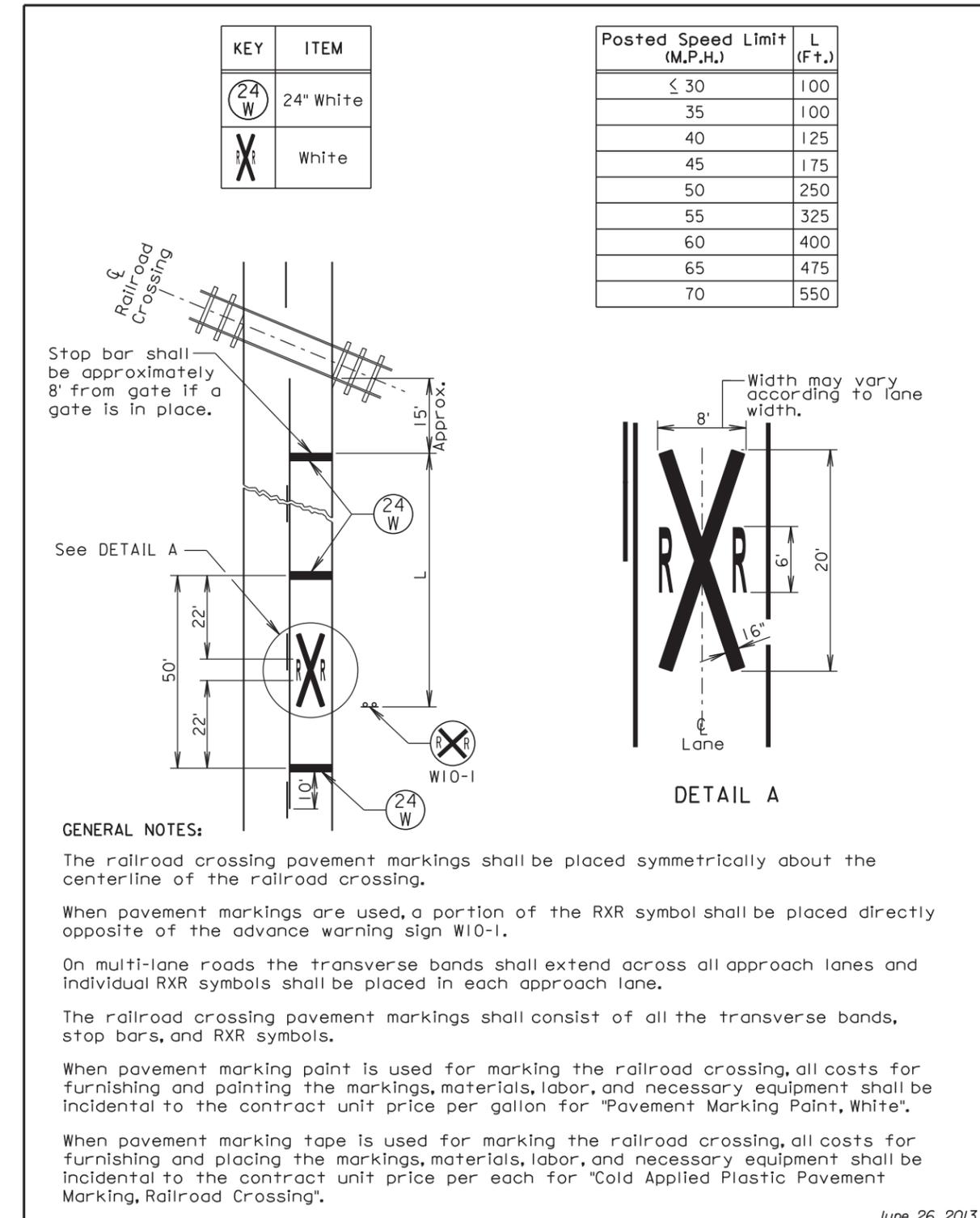
The crosswalk markings shall be placed to avoid the wheel paths as much as possible and the clear space between the longitudinal crosswalk markings shall be from 2' to 5'.

If more than 2 arrows per storage lane are shown, then the additional arrows shall be placed at approximately equal spaces between the arrow at the beginning of the storage lane and the arrow nearest the stop bar.

Minimum parking restrictions for signalized intersections.

September 14, 2011

S D D O T	PAVEMENT MARKINGS FOR ADJACENT INTERSECTIONS AND CENTER TURN LANE	PLATE NUMBER 633.01
	Published Date: 1st Qtr. 2014	Sheet 1 of 1



GENERAL NOTES:

The railroad crossing pavement markings shall be placed symmetrically about the centerline of the railroad crossing.

When pavement markings are used, a portion of the RXR symbol shall be placed directly opposite of the advance warning sign W10-1.

On multi-lane roads the transverse bands shall extend across all approach lanes and individual RXR symbols shall be placed in each approach lane.

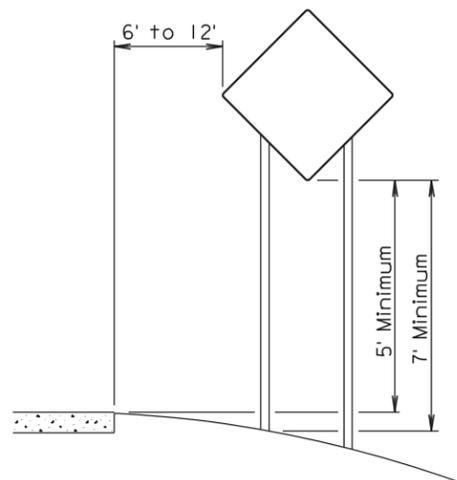
The railroad crossing pavement markings shall consist of all the transverse bands, stop bars, and RXR symbols.

When pavement marking paint is used for marking the railroad crossing, all costs for furnishing and painting the markings, materials, labor, and necessary equipment shall be incidental to the contract unit price per gallon for "Pavement Marking Paint, White".

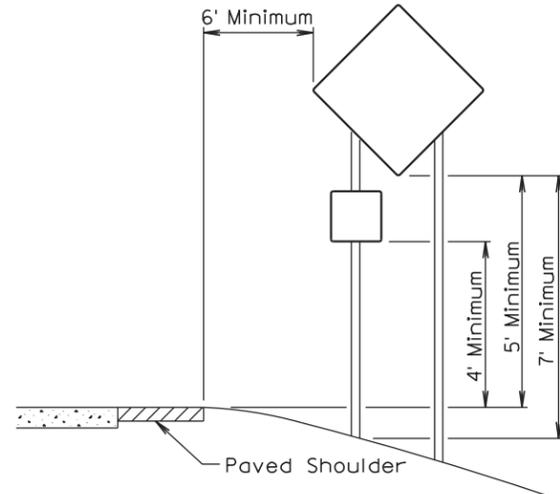
When pavement marking tape is used for marking the railroad crossing, all costs for furnishing and placing the markings, materials, labor, and necessary equipment shall be incidental to the contract unit price per each for "Cold Applied Plastic Pavement Marking, Railroad Crossing".

June 26, 2013

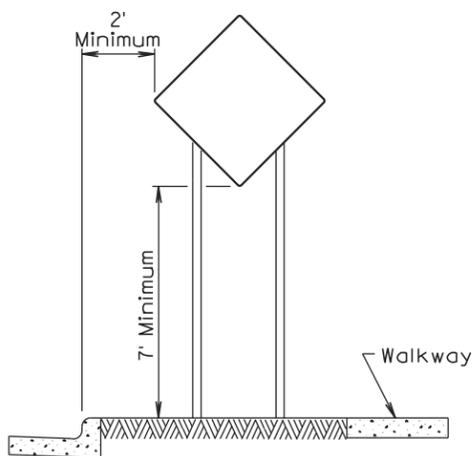
S D D O T	PAVEMENT MARKINGS AT RAILROAD CROSSING	PLATE NUMBER 633.10
	Published Date: 1st Qtr. 2014	Sheet 1 of 1



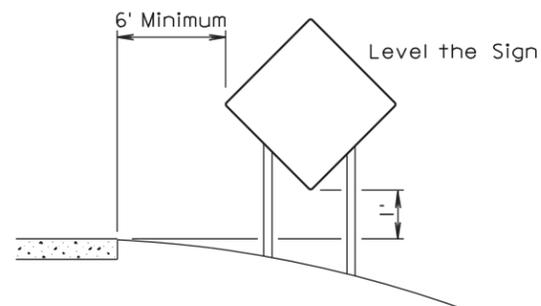
RURAL DISTRICT



RURAL DISTRICT WITH
SUPPLEMENTAL PLATE



URBAN DISTRICT



RURAL DISTRICT
3 DAY MAXIMUM

February 14, 2011

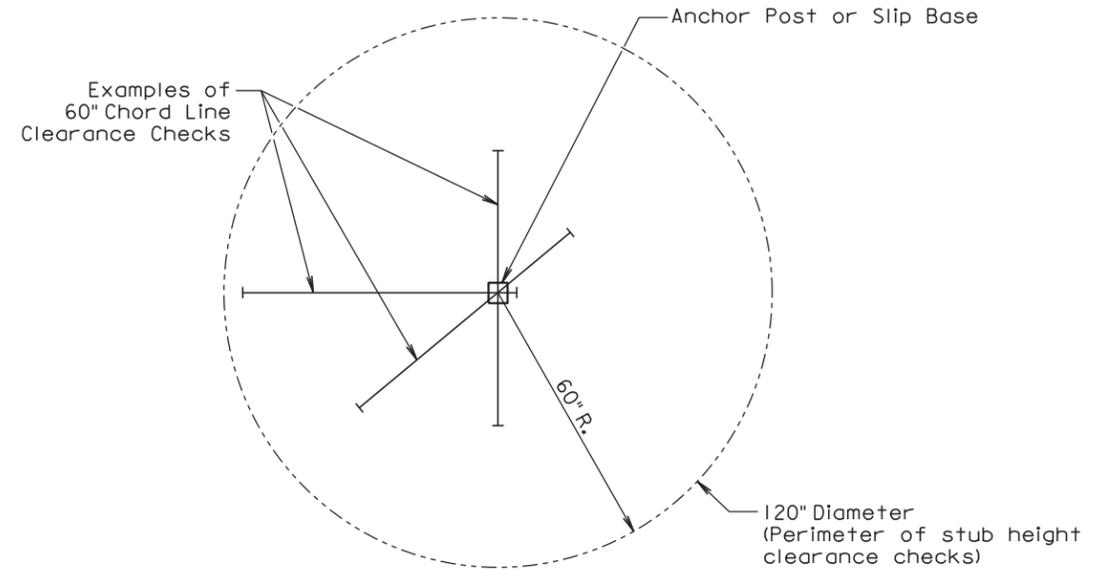
Published Date: 1st Qtr. 2014

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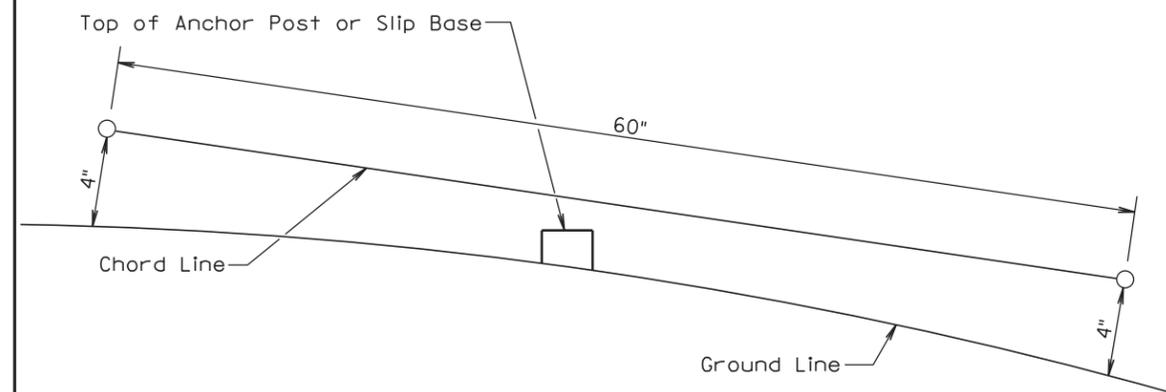
CRASHWORTHY SIGN SUPPORTS
(Typical Construction Signing)

PLATE NUMBER
634.85

Sheet 1 of 1



PLAN VIEW
(Examples of stub height clearance checks)



ELEVATION VIEW

GENERAL NOTES:

The top of anchor posts and slip bases SHALL NOT extend above a 60" chord line within a 120" diameter circle around the post with ends 4" above the ground.

At locations where there is curb and gutter adjacent to the breakaway sign support, the stub height shall be a maximum of 4" above the ground line at the localized area adjacent to the breakaway support stub.

The 4" stub height clearance is not necessary for U-channel lap splices where the support is designed to yield (bend) at the base.

July 1, 2005

Published Date: 1st Qtr. 2014

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BREAKAWAY SUPPORT STUB CLEARANCE

PLATE NUMBER
634.99

Sheet 1 of 1

ITEMIZED TRAFFIC CONTROL (SEGMENTS 1 THRU 10):

If a sign is required on a project and not listed in the below inventory, the units per sign will be determined as follows:
 Signs 36" x 36" will be measured at 27 units each and signs 48" x 48" will be measured at 34 units each, otherwise:
 If a sign measures less than 25" high and 25" wide the units per sign will be computed as sign size (sq ft) x 3.
 If a sign measures between 23H" and 37H" the units per sign will be computed as sign size (sq ft) x 1.2 +15.

ITEMIZED LIST FOR TRAFFIC CONTROL SD 25 (Segment 1)

SIGN CODE	SIGN SIZE	DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36" x 18"	ROAD WORK NEXT ## MILES	4	17	68
G20-2	36" x 18"	END ROAD WORK	2	17	34
W3-4	48" x 48"	BE PREPARED TO STOP	2	34	68
W8-7	48" x 48"	LOOSE GRAVEL	10	34	340
W13-1P	30" x 30"	ADVISORY SPEED PLATE	10	21	210
W20-1	48" x 48"	ROAD WORK #### FT. OR AHEAD	6	34	204
W20-4	48" x 48"	ONE LANE ROAD #### FT. OR AHEAD	4	34	136
W20-7	48" x 48"	FLAGGER (SYMBOL)	4	34	136
TOTAL UNITS					1196

ITEMIZED LIST FOR TRAFFIC CONTROL US 14 (Segment 3)

SIGN CODE	SIGN SIZE	DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36" x 18"	ROAD WORK NEXT ## MILES	2	17	34
G20-2	36" x 18"	END ROAD WORK	1	17	17
W3-4	48" x 48"	BE PREPARED TO STOP	2	34	68
W4-2	48" x 48"	LEFT OR RIGHT LANE ENDS (SYMBOL)	2	34	68
W8-7	48" x 48"	LOOSE GRAVEL	4	34	136
W13-1P	30" x 30"	ADVISORY SPEED PLATE	4	21	84
W20-1	48" x 48"	ROAD WORK #### FT. OR AHEAD	6	34	204
W20-5	48" x 48"	LT. OR RT. LANE CLOSED #### FT. OR AHEAD	2	34	68
W20-7	48" x 48"	FLAGGER (SYMBOL)	2	34	68
TOTAL UNITS					747

ITEMIZED LIST FOR TRAFFIC CONTROL SD 25 (Segment 2)

SIGN CODE	SIGN SIZE	DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36" x 18"	ROAD WORK NEXT ## MILES	6	17	102
G20-2	36" x 18"	END ROAD WORK	2	17	34
W3-4	48" x 48"	BE PREPARED TO STOP	2	34	68
W8-7	48" x 48"	LOOSE GRAVEL	12	34	408
W13-1P	30" x 30"	ADVISORY SPEED PLATE	12	21	252
W20-1	48" x 48"	ROAD WORK #### FT. OR AHEAD	6	34	204
W20-4	48" x 48"	ONE LANE ROAD #### FT. OR AHEAD	4	34	136
W20-7	48" x 48"	FLAGGER (SYMBOL)	4	34	136
TOTAL UNITS					1340

ITEMIZED LIST FOR TRAFFIC CONTROL US 14 (Segment 4)

SIGN CODE	SIGN SIZE	DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36" x 18"	ROAD WORK NEXT ## MILES	2	17	34
G20-2	36" x 18"	END ROAD WORK	1	17	17
W3-4	48" x 48"	BE PREPARED TO STOP	2	34	68
W4-2	48" x 48"	LEFT OR RIGHT LANE ENDS (SYMBOL)	2	34	68
W8-7	48" x 48"	LOOSE GRAVEL	4	34	136
W13-1P	30" x 30"	ADVISORY SPEED PLATE	4	21	84
W20-1	48" x 48"	ROAD WORK #### FT. OR AHEAD	6	34	204
W20-5	48" x 48"	LT. OR RT. LANE CLOSED #### FT. OR AHEAD	2	34	68
W20-7	48" x 48"	FLAGGER (SYMBOL)	2	34	68
TOTAL UNITS					747

ITEMIZED LIST FOR TRAFFIC CONTROL US 281 (Segment 5)

SIGN CODE	SIGN SIZE	DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36" x 18"	ROAD WORK NEXT ## MILES	6	17	102
G20-2	36" x 18"	END ROAD WORK	2	17	34
W3-4	48" x 48"	BE PREPARED TO STOP	3	34	102
W8-7	48" x 48"	LOOSE GRAVEL	15	34	510
W13-1P	30" x 30"	ADVISORY SPEED PLATE	15	21	315
W20-1	48" x 48"	ROAD WORK ##### FT. OR AHEAD	6	34	204
W20-4	48" x 48"	ONE LANE ROAD ##### FT. OR AHEAD	2	34	68
W20-7	48" x 48"	FLAGGER (SYMBOL)	6	34	204
TOTAL UNITS					1539

ITEMIZED LIST FOR TRAFFIC CONTROL SD 26 (Segment 7)

SIGN CODE	SIGN SIZE	DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36" x 18"	ROAD WORK NEXT ## MILES	2	17	34
W3-4	48" x 48"	BE PREPARED TO STOP	2	34	68
W8-7	48" x 48"	LOOSE GRAVEL	2	34	68
W13-1P	30" x 30"	ADVISORY SPEED PLATE	2	21	42
W20-1	48" x 48"	ROAD WORK ##### FT. OR AHEAD	6	34	204
W20-4	48" x 48"	ONE LANE ROAD ##### FT. OR AHEAD	2	34	68
W20-7	48" x 48"	FLAGGER (SYMBOL)	4	34	136
TOTAL UNITS					620

ITEMIZED LIST FOR TRAFFIC CONTROL SD 45 (Segment 6)

SIGN CODE	SIGN SIZE	DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36" x 18"	ROAD WORK NEXT ## MILES	1	17	17
G20-2	36" x 18"	END ROAD WORK	1	17	17
W3-4	48" x 48"	BE PREPARED TO STOP	2	34	68
W8-7	48" x 48"	LOOSE GRAVEL	5	34	170
W13-1P	30" x 30"	ADVISORY SPEED PLATE	5	21	105
W20-1	48" x 48"	ROAD WORK ##### FT. OR AHEAD	6	34	204
W20-4	48" x 48"	ONE LANE ROAD ##### FT. OR AHEAD	2	34	68
W20-7	48" x 48"	FLAGGER (SYMBOL)	4	34	136
TOTAL UNITS					785

ITEMIZED LIST FOR TRAFFIC CONTROL SD 45 (Segment 8)

SIGN CODE	SIGN SIZE	DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36" x 18"	ROAD WORK NEXT ## MILES	6	17	102
G20-2	36" x 18"	END ROAD WORK	1	17	17
W3-4	48" x 48"	BE PREPARED TO STOP	2	34	68
W8-7	48" x 48"	LOOSE GRAVEL	11	34	374
W13-1P	30" x 30"	ADVISORY SPEED PLATE	11	21	231
W20-1	48" x 48"	ROAD WORK ##### FT. OR AHEAD	6	34	204
W20-4	48" x 48"	ONE LANE ROAD ##### FT. OR AHEAD	2	34	68
W20-7	48" x 48"	FLAGGER (SYMBOL)	4	34	136
TOTAL UNITS					1200

ITEMIZED LIST FOR TRAFFIC CONTROL SD 47 (Segment 9)

SIGN CODE	SIGN SIZE			DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36"	x	18"	ROAD WORK NEXT ## MILES	2	17	34
G20-2	36"	x	18"	END ROAD WORK	2	17	34
W3-4	48"	x	48"	BE PREPARED TO STOP	2	34	68
W8-7	48"	x	48"	LOOSE GRAVEL	6	34	204
W13-1P	30"	x	30"	ADVISORY SPEED PLATE	6	21	126
W20-1	48"	x	48"	ROAD WORK #### FT. OR AHEAD	6	34	204
W20-4	48"	x	48"	ONE LANE ROAD #### FT. OR AHEAD	4	34	136
W20-7	48"	x	48"	FLAGGER (SYMBOL)	4	34	136
TOTAL UNITS							942

ITEMIZED LIST FOR TRAFFIC CONTROL SD 14 (Segment 10)

SIGN CODE	SIGN SIZE			DESCRIPTION	NUMBER REQUIRED	UNITS PER SIGN	UNITS
G20-1	36"	x	18"	ROAD WORK NEXT ## MILES	2	17	34
G20-2	36"	x	18"	END ROAD WORK	2	17	34
W3-4	48"	x	48"	BE PREPARED TO STOP	2	34	68
W4-2	48"	x	48"	LEFT OR RIGHT LANE ENDS (SYMBOL)	2	34	68
W8-7	48"	x	48"	LOOSE GRAVEL	4	34	136
W13-1P	30"	x	30"	ADVISORY SPEED PLATE	4	21	84
W20-1	48"	x	48"	ROAD WORK #### FT. OR AHEAD	5	34	170
W20-4	48"	x	48"	ONE LANE ROAD #### FT. OR AHEAD	4	34	136
W20-5	48"	x	48"	LT. OR RT. LANE CLOSED #### FT. OR AHEAD	2	34	68
W20-7	48"	x	48"	FLAGGER (SYMBOL)	4	34	136
TOTAL UNITS							934

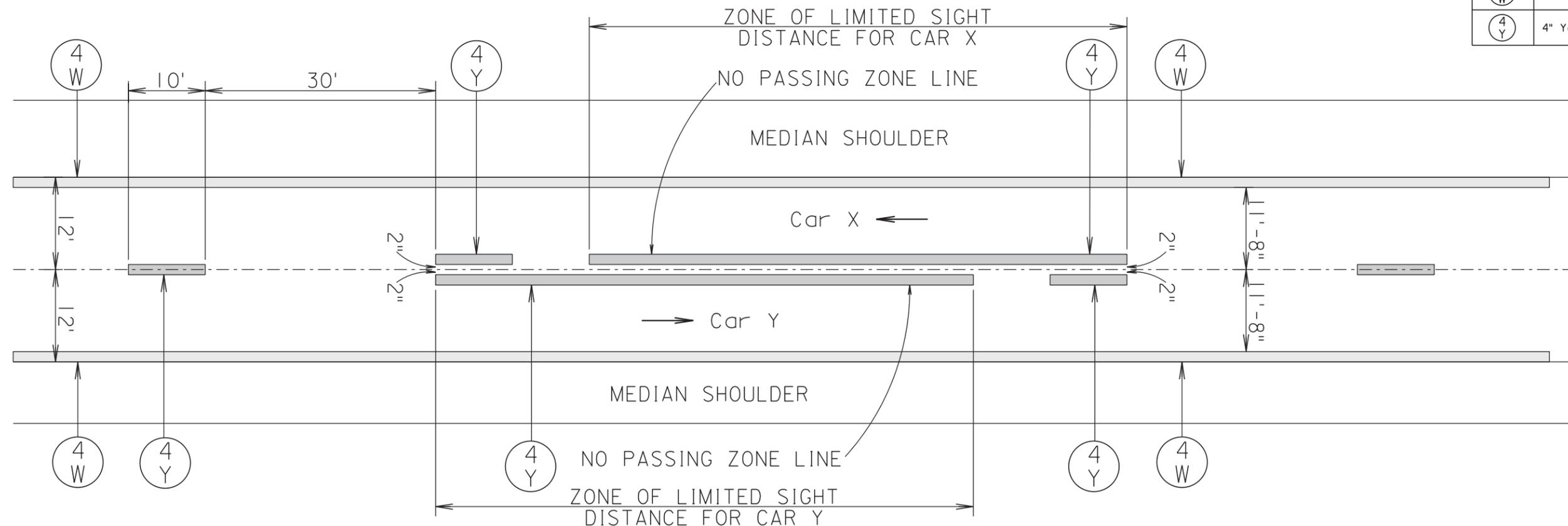
FURNISHING AND APPLYING PAVEMENT MARKING PAINT (4" WHITE LINE)

Approximate Paint Application Rates Shall Be as Follows:

<u>Two Lane Roadway</u> (Rates for One line)
<u>Dashed Yellow Centerline</u> Rate = 6.2 Gals/Pass-Mile
<u>Solid Yellow Centerline</u> Rate = 22.5 Gals/Pass-Mile
<u>Solid White Edgeline</u> Rate = 22.5 Gals/Pass-Mile
Glass Beads = 8 Lbs/Gal

TWO LANE UNDIVIDED ROADWAY

KEY	ITEM
(4 W)	4" White
(4 Y)	4" Yellow



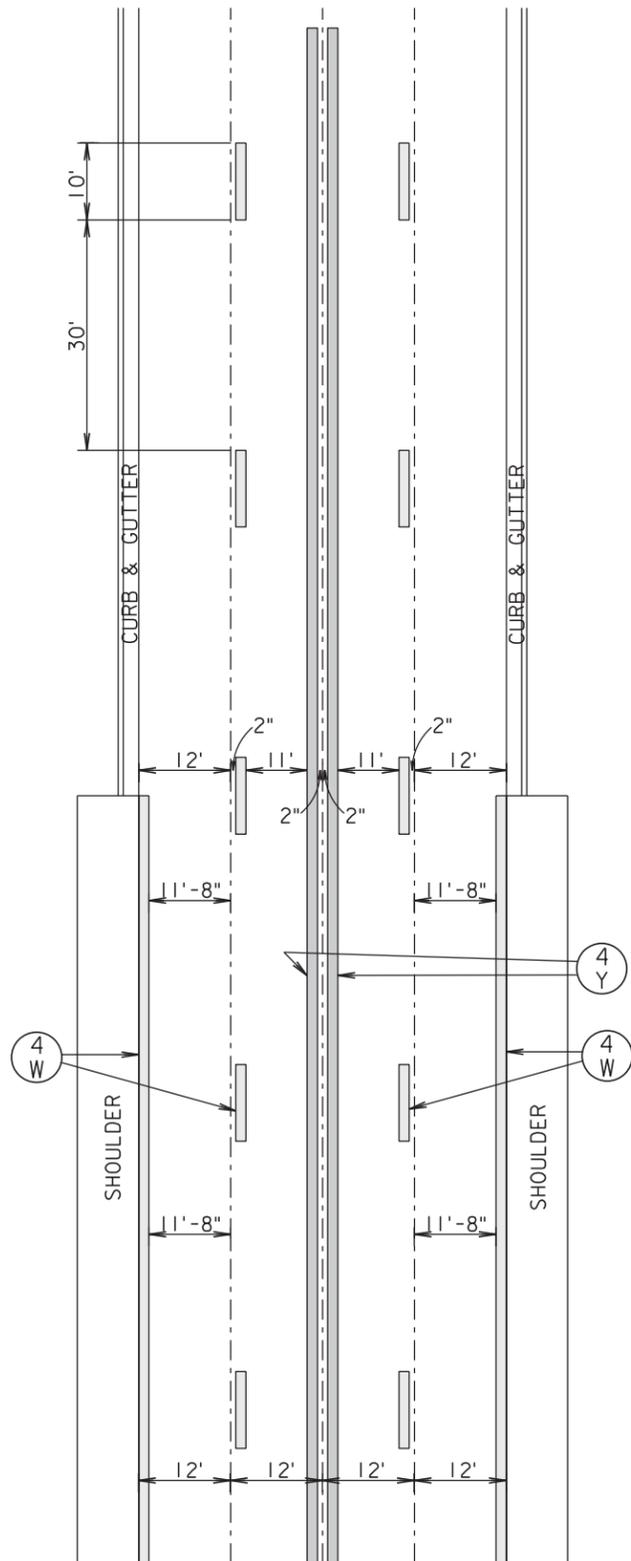
Typical pavement marking as shown on this sheet shall be applied throughout the entire length of undivided roadway.

Traffic Control shall be incidental to the cost of application. The striping and advance or trailing warning vehicle shall be equipped with flashing amber lights or advance warning arrow panel.

FURNISHING AND APPLYING PAVEMENT MARKING PAINT

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	NH-P 0013(26)	35	36
Plotting Date: 02/19/2014			

FOUR LANE UNDIVIDED ROADWAY

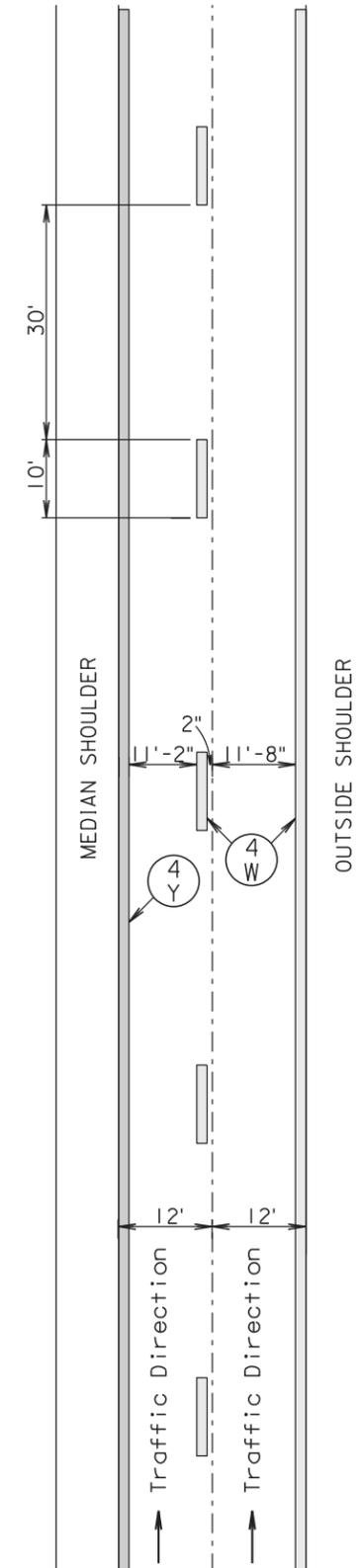


KEY	ITEM
(4 W)	4" White
(4 Y)	4" Yellow

Typical pavement marking as shown on this sheet shall be applied throughout the entire length of undivided roadway.

Traffic Control shall be incidental to the cost of application. The striping and advance or trailing warning vehicle shall be equipped with flashing amber lights or advance warning arrow panel.

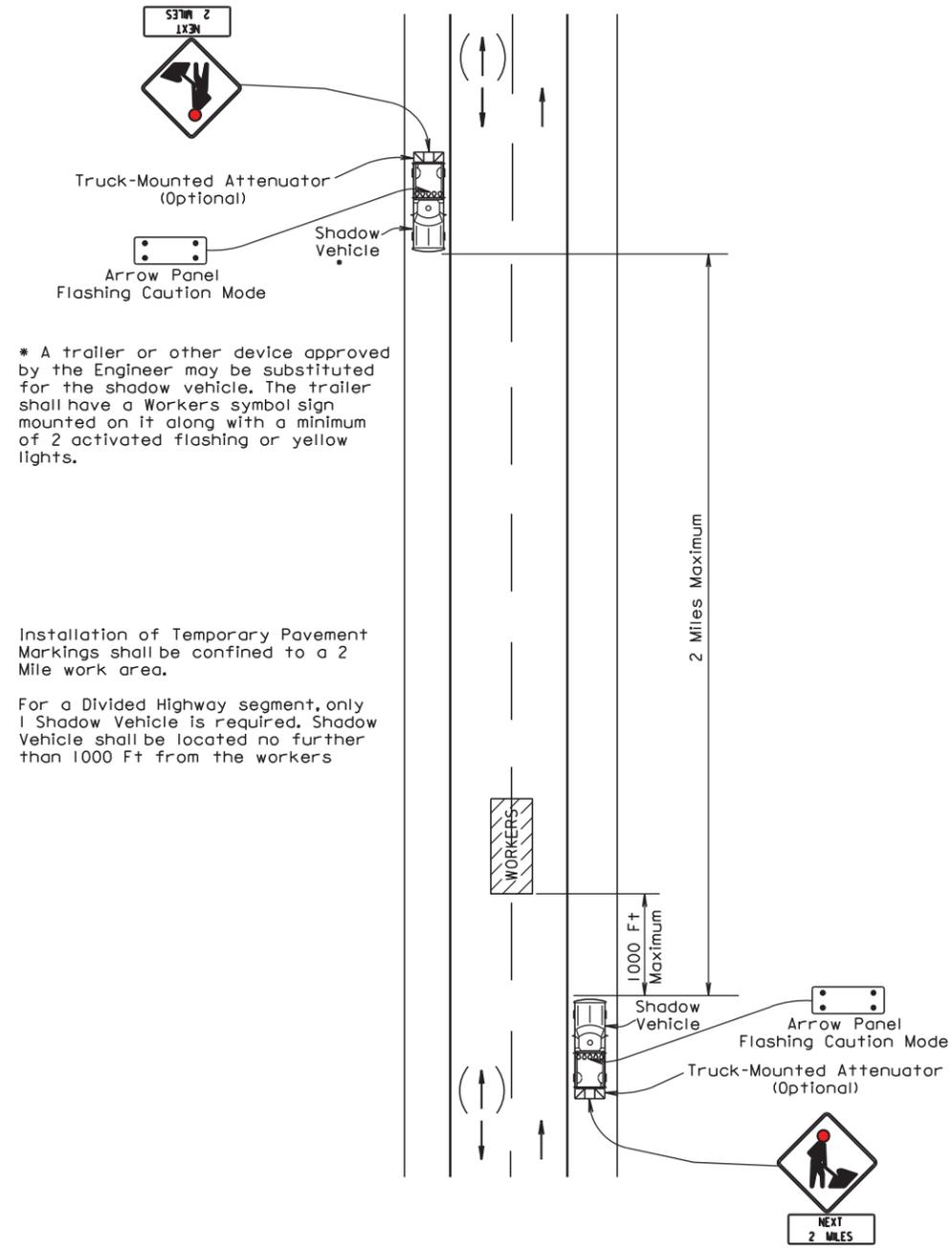
FOUR LANE PAVEMENT MARKING ONLY ONE DIRECTION SHOWN



Approximate Paint Application Rates Shall Be as Follows:

Two Lane Roadway (Rates for One line)	
Dashed Yellow Centerline	Rate = 6.2 Gals/Pass-Mile
Solid Yellow Centerline	Rate = 22.5 Gals/Pass-Mile
Solid White Edgeline	Rate = 45 Gals/Pass-Mile
Glass Beads	= 8 Lbs/Gal

**GUIDES FOR TRAFFIC CONTROL DEVICES
APPLICATION OF TEMPORARY PAVEMENT MARKING TABS**



* A trailer or other device approved by the Engineer may be substituted for the shadow vehicle. The trailer shall have a Workers symbol sign mounted on it along with a minimum of 2 activated flashing or yellow lights.

Installation of Temporary Pavement Markings shall be confined to a 2 Mile work area.

For a Divided Highway segment, only 1 Shadow Vehicle is required. Shadow Vehicle shall be located no further than 1000 Ft from the workers

**GUIDES FOR TRAFFIC CONTROL DEVICES
TEMPORARY ROAD MARKER INSTALLATION**

