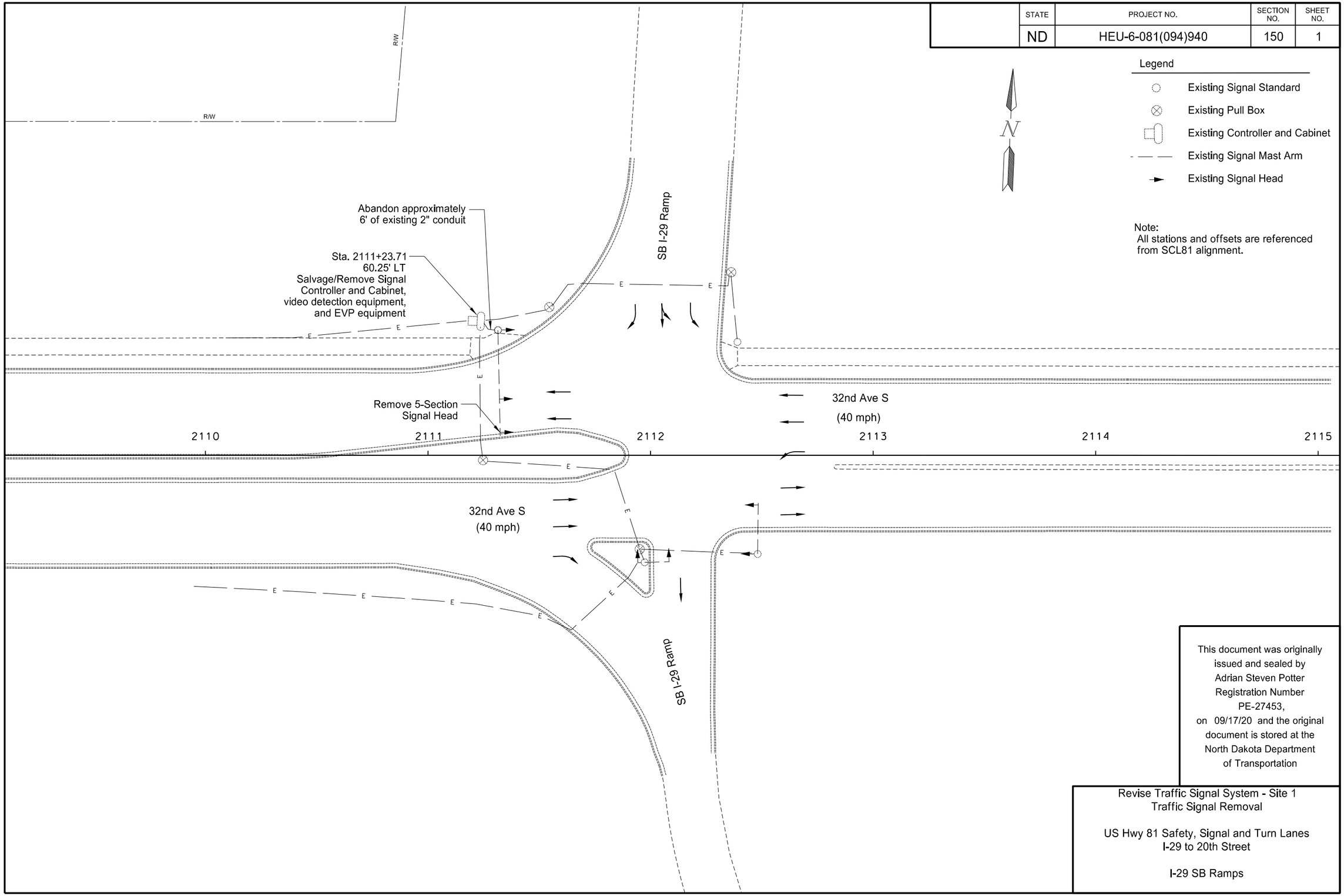
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	1

Legend

- Existing Signal Standard
- Existing Pull Box
- Existing Controller and Cabinet
- Existing Signal Mast Arm
- Existing Signal Head

Note:
All stations and offsets are referenced from SCL81 alignment.



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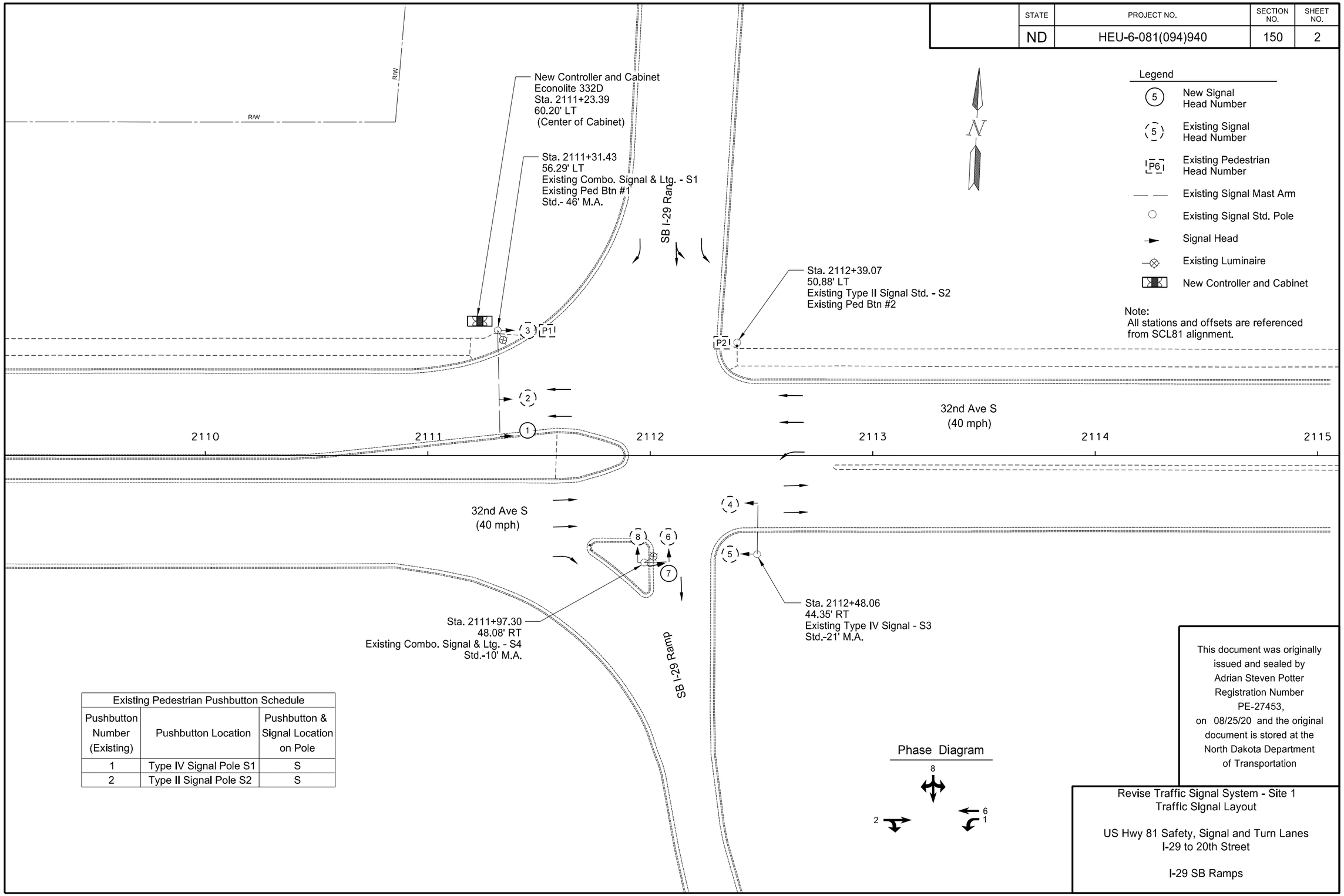
Revise Traffic Signal System - Site 1
Traffic Signal Removal

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	2



Existing Pedestrian Pushbutton Schedule		
Pushbutton Number (Existing)	Pushbutton Location	Pushbutton & Signal Location on Pole
1	Type IV Signal Pole S1	S
2	Type II Signal Pole S2	S

Phase Diagram

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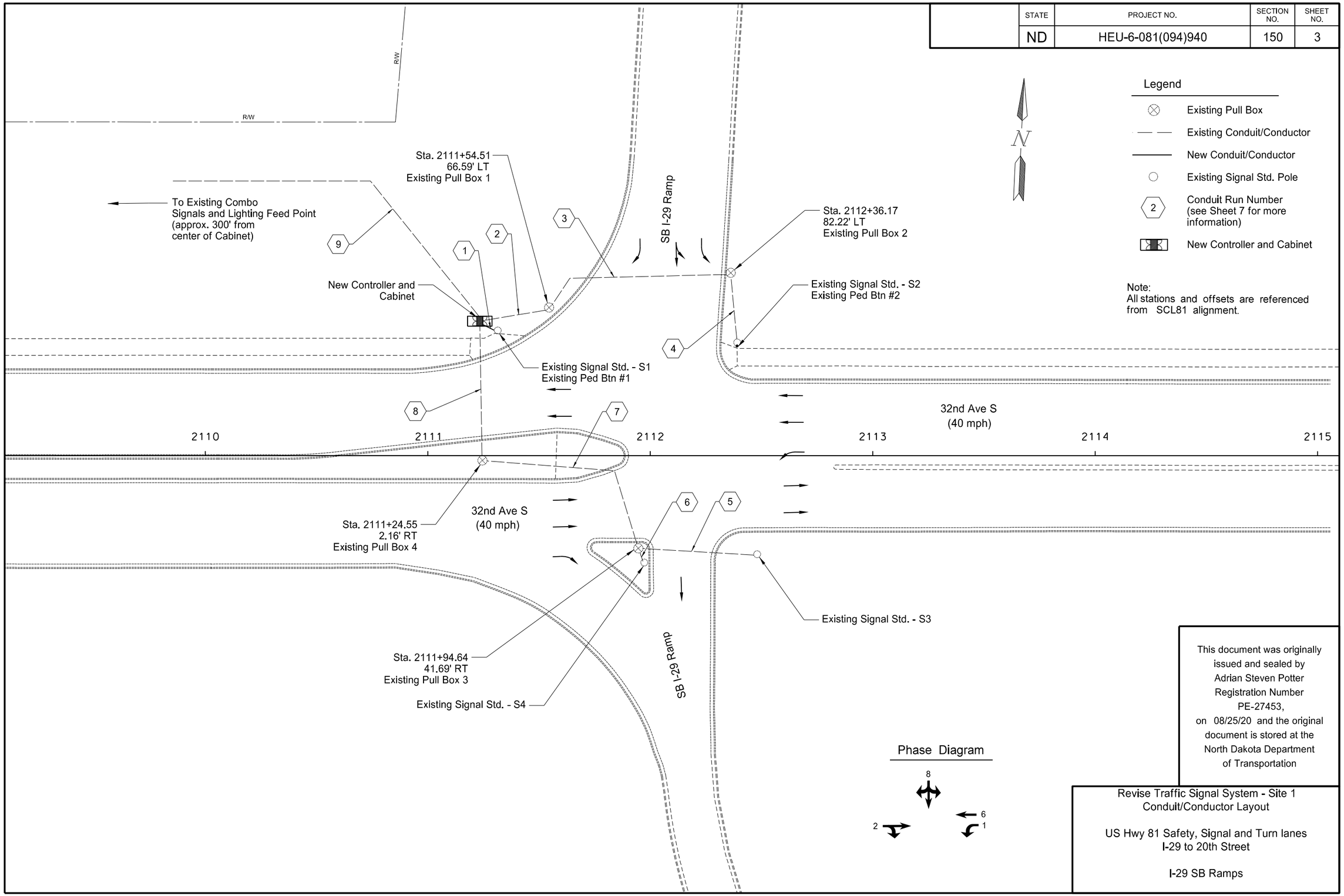
Revise Traffic Signal System - Site 1
Traffic Signal Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	3



N

Legend

- Existing Pull Box
- Existing Conduit/Conductor
- New Conduit/Conductor
- Existing Signal Std. Pole
- Conduit Run Number (see Sheet 7 for more information)
- New Controller and Cabinet

Note:
All stations and offsets are referenced from SCL81 alignment.

Phase Diagram

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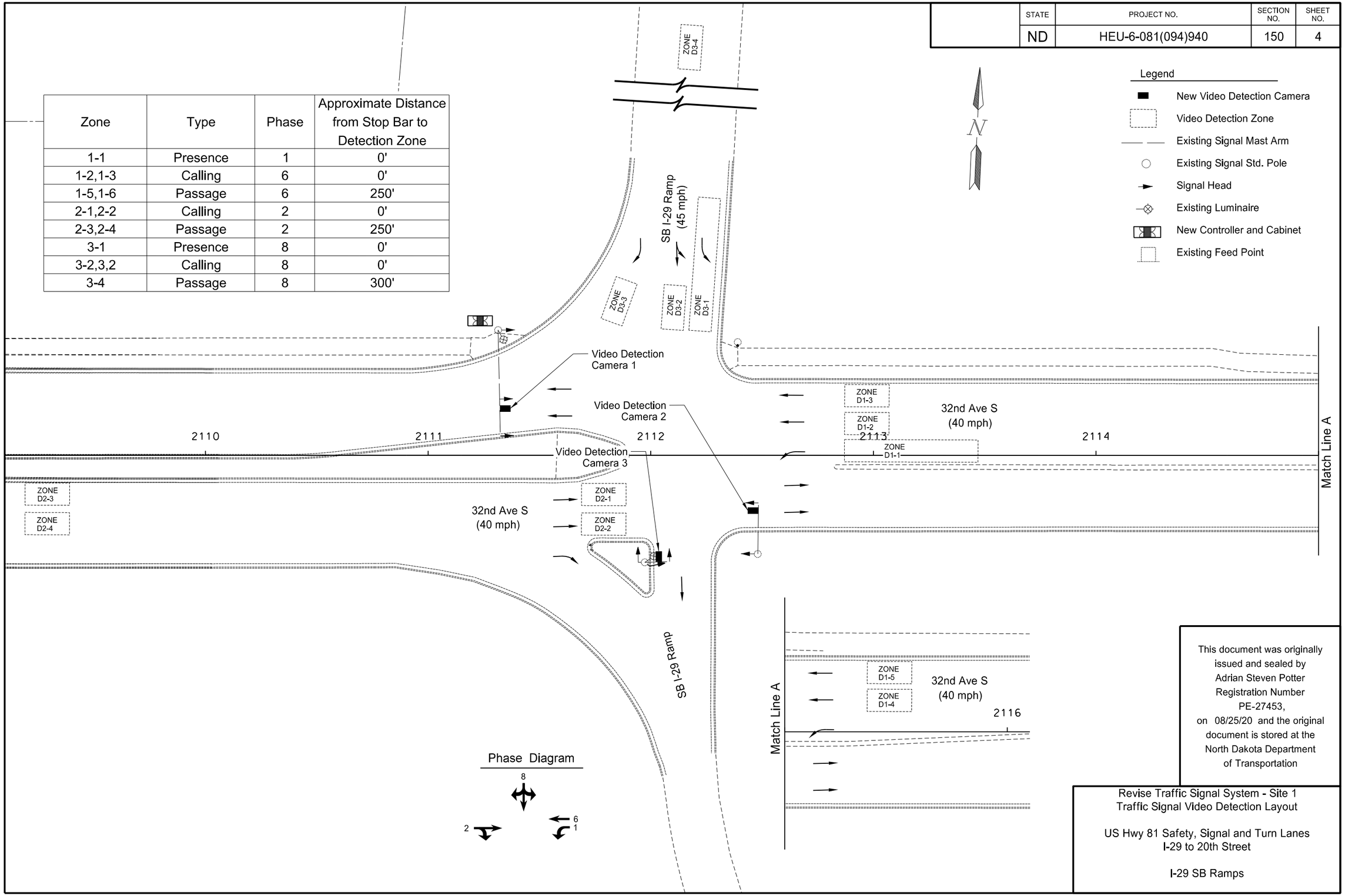
Revise Traffic Signal System - Site 1
Conduit/Conductor Layout

US Hwy 81 Safety, Signal and Turn lanes
I-29 to 20th Street

I-29 SB Ramps

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	4

Zone	Type	Phase	Approximate Distance from Stop Bar to Detection Zone
1-1	Presence	1	0'
1-2,1-3	Calling	6	0'
1-5,1-6	Passage	6	250'
2-1,2-2	Calling	2	0'
2-3,2-4	Passage	2	250'
3-1	Presence	8	0'
3-2,3,2	Calling	8	0'
3-4	Passage	8	300'



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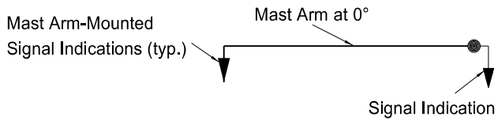
Revise Traffic Signal System - Site 1
Traffic Signal Video Detection Layout

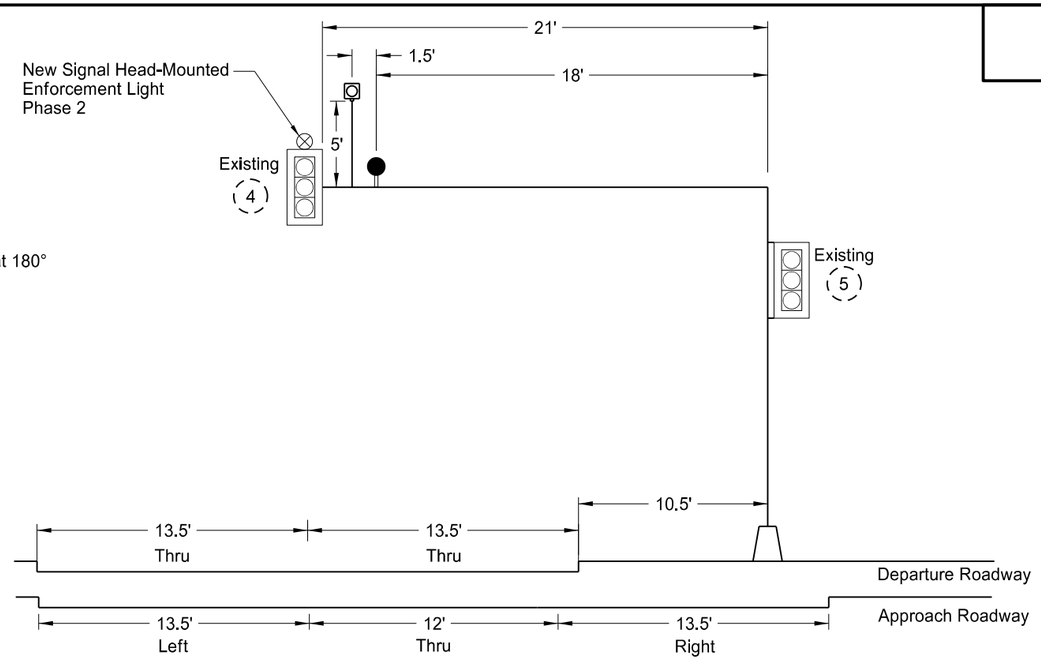
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	5

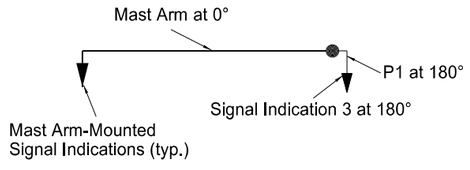
Pole-Mounted Signal
Indication Orientation Detail
Not to Scale

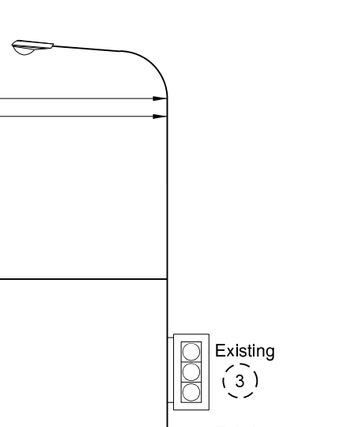




Eastbound 32nd Avenue South
(S3)

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Westbound 32nd Avenue South
(S1)

Notes:

1. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
2. See Section 110 for sign details.

Legend

- Transformer Base
- New Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- PX Pedestrian Head Number
- New Emergency Vehicle Preemption Indicator Light
- New Emergency Vechicle Preemption GPS Detector and Light
- Enforcement Light

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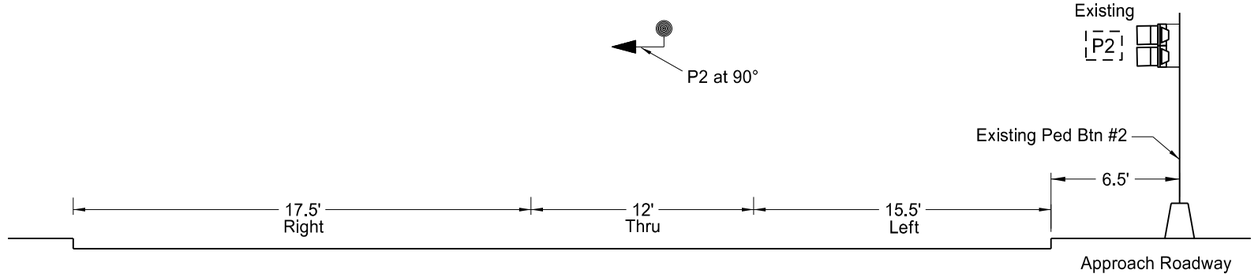
Revise Traffic Signal System - Site 1
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	6

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale

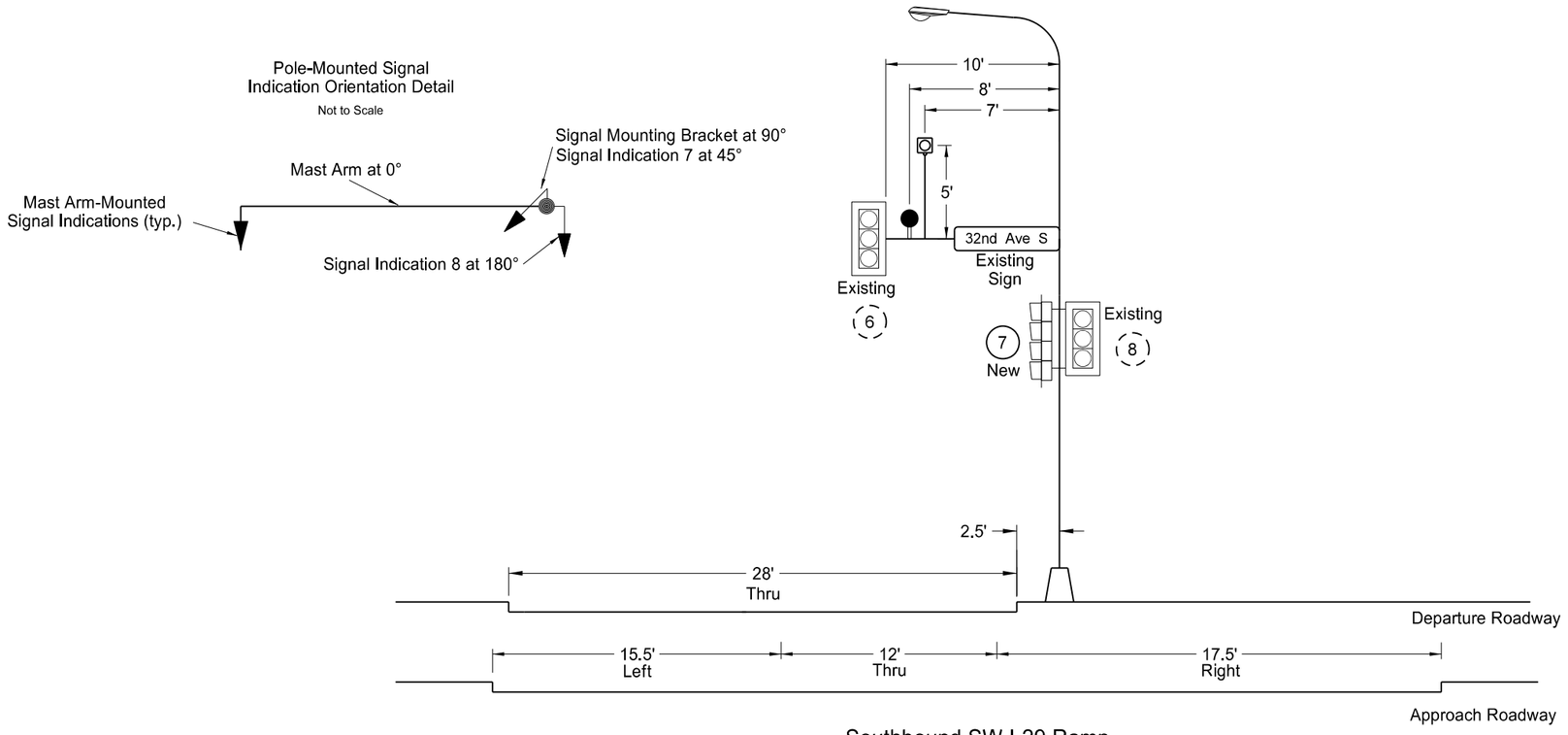


Southbound NW I-29 Ramp
(S2)

Notes:

1. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
2. See Section 110 for sign details.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale



Southbound SW I-29 Ramp
(S4)

Legend

- Transformer Base
- New Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- PX Pedestrian Head Number
- New Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Revise Traffic Signal System - Site 1
Signal Standard & Head Locations

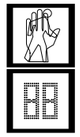
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

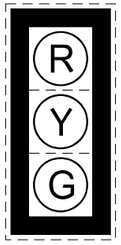
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	7

Conductor			Existing Cable 1 (12 No.12 AWG)			Existing Cable 2 (12 No.12 AWG)			Existing Cable 3 (12 No.12 AWG)			Existing Cable 4 (12 No.5 AWG)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black				Spare			Spare			Spare			Spare
2	White				Neutral			Neutral			Neutral			Neutral
3	Red		6,8	8	Red	2,3	6	Red	4,5	2	Red	P2	2	Walk
4	Green				Ground			Ground			Ground			Ground
5	Orange		6,8	8	Yellow	2,3	6	Yellow	4,5	2	Yellow	P2	2	Don't Walk
6	Blue		6,8	8	Green	2,3	6	Green	4,5	2	Green			
7	White	Black			Spare			Spare			Spare			
8	Red	Black	7	1	Red Left Arrow			Spare			Spare			
9	Green	Black			Spare			Spare			Spare			
10	Orange	Black	7	1	Flashing Yellow Left Arrow			Spare			Spare			
11	Blue	Black	7	1	Green Left Arrow	P1	6	Walk			Spare			
12	Black	White	7	1	Yellow Left Arrow	P1	6	Don't Walk			Spare			

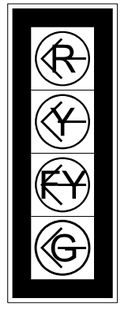
Conductor			New Cable 5 (14 No.7 AWG)		
Run	Base	Tracer	Head	Phase	Indication
1	Black				Spare
2	White				Neutral
3	Red		1	1	Red Left Arrow
4	Green				Ground
5	Orange		1	1	Flashing Yellow Left Arrow
6	Blue		1	1	Green Left Arrow
7	White	Black	1	1	Yellow Left Arrow



(12" Lenses)
Existing Heads P1, P2



(12" Lenses)
Existing Heads 2, 3, 4, 5
6, 8



(12" Lenses)
New Heads 1, 7

Notes:

1. Use LED indications on new 4-section Flashing Yellow Arrow heads.
2. Use 5" Louvered Black Plate on new 4-section Flashing Yellow Arrow heads.

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Revise Traffic Signal System - Site 1
Signal Heads & Conductor Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	8

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Cable Run Code	Cable Run QTY	Cable Run Type
1	Controller to Existing Signal Std. - S1	6	3"	76	A	1	No. 14 AWG 3 Conductor Cable
				76	B	1	Emergency Detector Cable
				16	C	1	Existing Cable 2
				89	C	1	New Cable 5
				16	C	1	Push Button (EX)
				76	D	1	Video Detector Cable
				168	F	2	No. 14 AWG 3 Conductor Cable
2	Controller to Existing Pull Box 1	24 (EX)	2.5" (EX)	34	C	1	Existing Cable 4
				34	C	1	Push Button (EX)
3	Existing Pull Box 1 to Existing Pull Box 2	92 (EX)	2" (EX)	93	C	1	Existing Cable 4
				93	C	1	Push Button (EX)
4	Existing Pull Box 2 to Existing Signal Std. - S2	24 (EX)	2" (EX)	30	C	1	Existing Cable 4
				30	C	1	Push Button (EX)
5	Existing Pull Box 3 to Existing Signal Std. - S3	53 (EX)	2" (EX)	97	A	1	No. 14 AWG 3 Conductor Cable
				97	B	1	Emergency Detector Cable
				59	C	1	Existing Cable 3
				96	D	1	Video Detector Cable
				97	F	1	No. 14 AWG 3 Conductor Cable
6	Existing Pull Box 3 to Existing Signal Std. - S4	8 (EX)	2" (EX)	39	A	1	No. 14 AWG 3 Conductor Cable
				39	B	1	Emergency Detector Cable
				14	C	1	Existing Cable 1
				38	D	1	Video Detector Cable
7	Existing Pull Box 4 to Existing Pull Box 3	112 (EX)	2.5" (EX)	226	A	2	No. 14 AWG 3 Conductor Cable
				226	B	2	Emergency Detector Cable
				113	C	1	Existing Cable 1
				113	C	1	Existing Cable 3
				226	D	2	Video Detector Cable
				118	F	1	No. 14 AWG 3 Conductor Cable
8	Controller to Existing Pull Box 4	61 (EX)	3" (EX)	140	A	2	No. 14 AWG 3 Conductor Cable
				140	B	2	Emergency Detector Cable
				70	C	1	Existing Cable 1
				70	C	1	Existing Cable 3
				140	D	2	Video Detector Cable
				70	F	1	No. 14 AWG 3 Conductor Cable
9	Existing Feed Point to Controller	328 (EX)	2" (EX)	698	E	2	No. 6 RHW (EX)
				349	E	1	No. 6 THW (EX)

Cable Code

(EX) = Existing Conductor/Cable Runs
A = Emergency Vehicle Indicator Lamp
B = Emergency Vehicle Detector Cable
C = Signal Control Cable
D = Video Detection Cable
E = Power Cable
F = Enforcement Light Cable

Note:
All conduit and cable lengths are in feet.

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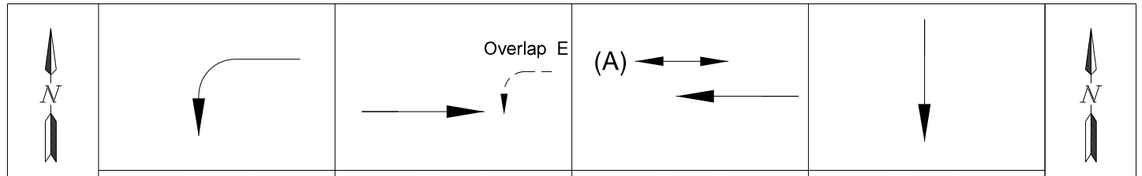
Revise Traffic Signal System - Site 1
Conduit Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	9



Head #	Phase 1 R/W	Phase 1 Clear to Phase 2	3	4	5	6	7	8	Phase 2 R/W	Phase 2 Clear to Phase 3	4	5	6	7	8	1	Phase 6 R/W	Phase 6 Clear to Phase 7	8	1	2	3	4	5	Phase 8 R/W	Phase 8 Clear to Phase 1	2	3	4	5	6	7	Head #
1	~~G~~	~~Y~~				(B)		~~Y~~	(C)				(B)		(D)	(C)																	1
2																	G		Y	(B)	(B)												2
3																	G		Y	(B)	(B)												3
4									G				(B)		Y	Y																	4
5									G				(B)		Y	Y																	5
6																									G	Y	Y				Y		6
7	~~G~~	~~Y~~				(B)		~~Y~~	(C)				(B)		(D)	(C)																	7
8																									G	Y	Y				Y		8

Blank Squares Denote Red Indication

(A) = Pedestrian movements, upon activation.

(B) = When one phase is on alone a nonconflicting phase may start timing concurrently without a clearance interval (See Chart A).

(C) = Flashing yellow left turn arrow (protected/permissive mode and permissive only mode).

(D) = Solid yellow left turn arrow (protected/permissive mode and permissive only mode).

Protected Movement

Permitted Movement

Pedestrian Actuated Movement

Chart A

Non-Conflicting Phases

On Phase	Non-Conflicting Phase Allowed to Time Concurrently
1	6
2	6
6	1 or 2
8	-

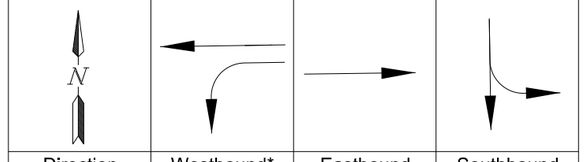
Chart B

Special Overlaps

(Flashing Yellow Left Turn Arrows)

Overlap	Protected Phase	Permissive Phase
E	1	2
F	-	-
G	-	-
H	-	-

Emergency Vehicle Preemption Phasing



Direction	Westbound*	Eastbound	Southbound
Dwell Phases	1,6	2	8
Dwell Overlaps	-	-	-

*Note:

Utilize Phase 1 and 6 EVP for Northbound I-29 Ramp queue flush phase at Southbound I-29 Ramps.

See Section 6 for timing settings.

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Revise Traffic Signal System - Site 1
Signal Controller Phasing

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	10

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
	WBL	EB				WB		SB
BASIC INTERVALS (OR FUNCTIONS)								
Minimum Initial	5.0	15.0	-	-	-	15.0	-	7.0
Vehicle Extension	1.5	5.0	-	-	-	5.0	-	5.0
Maximum Green (Max 1)	40.0	40.0	-	-	-	40.0	-	40.0
Yellow Change	3.5	4.0	-	-	-	4.0	-	4.0
Red Clearance	1.5	1.0	-	-	-	1.0	-	1.0
Walk	-	-	-	-	-	7.0	-	-
Pedestrian Clearance	-	-	-	-	-	25.0	-	-
Delayed Green (Leading Pedestrian Interval)	-	-	-	-	-	-	-	-
VOLUME DENSITY TIMING FUNCTIONS								
VARIABLE INITIAL TIMING OPTIONS								
Actuations Before Added Initial	-	-	-	-	-	-	-	-
Added Initial per Actuation	-	-	-	-	-	-	-	-
Maximum Initial	-	-	-	-	-	-	-	-
GAP REDUCTION OPTIONS								
Time Before Reduction	-	20.0	-	-	-	20.0	-	-
Time to Reduce to Minimum Gap	-	20.0	-	-	-	20.0	-	-
Minimum Gap	-	2.5	-	-	-	2.5	-	-
OTHER CONTROLLER FUNCTIONS								
Locking Memory	-	x	-	-	-	x	-	
Non-Locking Memory	x	-	-	-	-	-	-	x
Phase recall	-	-	-	-	-	-	-	-
Red Revert	2.0	2.0	-	-	-	2.0	-	2.0
Backup Prevent Phases	-	-	-	-	-	-	-	-
No Serve Phases	-	-	-	-	-	-	-	-
Flashing-Normal & Conflict Monitor	R	R	-	-	-	R	-	R

Notes:
1. Operate all left turn phases as either leading or lagging phases.
2. Operate all left turn phases either in protected, protected/permissive, or permissive mode.

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Revise Traffic Signal System - Site 1
Signal Timing Settings

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	11

SPEC	CODE	ITEM DESCRIPTION	UNIT	TOTAL
772	0270	3IN DIAMETER RIGID CONDUIT	LF	20
772	0375	EMERGENCY VEHICLE DETECTOR CABLE	LF	580
772	0433	NO14 AWG 3 CONDUCTOR CABLE	LF	1040
772	0437	NO14 AWG 7 CONDUCTOR CABLE	LF	90
772	1820	1-WAY 4 SEC HEAD W/12IN LENS-POST MTD	EA	1
772	1822	1-WAY 4 SEC HEAD W/12IN LENS-MA MTD	EA	1
772	2070	LAW ENFORCEMENT CONFIRMATION LIGHT	EA	3
772	2260	VIDEO DETECTION CABLE	LF	580
772	2265	VIDEO DETECTION SYSTEM	EA	1
772	2554	ARTERIAL SYSTEM MASTER CONTROLLER	EA	1
772	2556	BATTERY BACKUP SYSTEM	EA	1
772	2610	EMERGENCY VEHICLE PREEMPTION UNIT	EA	4
772	2621	EMERGENCY VEHICLE PRE-EMPTION PHASE SELECTOR	EA	1
772	3122	REMOVE CONTROLLER & CABINET	EA	1
772	3140	REMOVE VEHICULAR HEADS	EA	1
		ABANDON CONDUIT	LF	10
		NEW CONTROLLER AND CABINET	EA	1
772	2906	REVISE TRAFFIC SIGNAL SYSTEM - SITE 1	EA	1
		The items appear above for informational purposes; provide all labor and equipment necessary for the signal system to be fully operational as shown in the Plans. Include items in the corresponding price bid for "REVISE TRAFFIC SIGNAL SYSTEM - SITE 1"		

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Revise Traffic Signal System - Site 1
Estimated Traffic Signal Quantities

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 SB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	12

Legend

- Existing Signal Standard
- Existing Pull Box
- Existing Controller and Cabinet
- Existing Signal Mast Arm
- Existing Signal Head
- Existing Feed Point

Note:
All stations and offsets are referenced from SCL81 alignment.

N

R/W

R/W

NB I-29 Ramp

Abandon approximately
82' of existing 2.5" conduit

Sta. 2120+44.39
54.51' LT
Salvage/Remove Signal
Controller and Cabinet,
video detection equipment,
and EVP equipment

Abandon approximately
3' of existing 2" conduit

E

E

32nd Ave S
(40 mph)

2119 2120 2121 2122 2123 2124

32nd Ave S
(40 mph)

Remove
5-Section Signal Head

E

NB I-29 Ramp

R/W

R/W

R/W Mkr Conc post

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Revise Traffic Signal System - Site 2
Traffic Signal Removal

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 NB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	13

Note:
All stations and offsets are referenced from SCL81 alignment.

Sta. 2120+78.56
50.39' LT
Existing Type IV Signal -S1
Std.- 25' M.A.
Existing Ped Btn #1

New Controller and Cabinet
Econolite 332D
Sta. 2120+44.19
54.56' LT
(Center of Cabinet)

Sta. 2121+30.82
50.69' LT
Existing Type IV Signal -S2
Std.- 11' M.A.
Existing Ped Btn #2

NB I-29 Ramp

32nd Ave S
(40 mph)

2119 2120 2121 2122 2123 2124

32nd Ave S
(40 mph)

NB I-29 Ramp

Sta. 2121+89.26
44.42' RT
Existing Combo. Signal & Ltg. -S3
Std.- 38' M.A.

Existing Feed Point
Sta. 2122+58.39
132.03' RT
(Center of Feed Point)

Sta. 2119+91.14
807.46' RT
New Light Std.
New Video Detection Camera

R/W Mkr Conc post

Legend

- New Signal Head Number
- Existing Signal Head Number
- Existing Pedestrian Head Number
- Existing Signal Mast Arm
- Existing Signal Std. Pole
- Signal Head
- Existing Luminaire
- New Controller and Cabinet
- Existing Feed Point
- New Light Std. Pole
- New Video Detection Camera

Existing Pedestrian Pushbutton Schedule

Pushbutton Number (Existing)	Pushbutton Location	Pushbutton & Signal Location on Pole
1	Type IV Signal Pole S1	S
2	Type IV Signal Pole S2	S

Phase Diagram

5 2 6 4

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Revise Traffic Signal System - Site 2
Traffic Signal Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 NB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	14

Legend

- Existing Pull Box
- New Pull Box
- Existing Conduit/Conductor
- New Conduit/Conductor
- Existing Signal Std. Pole
- Conduit Run Number (see Sheet 16 for more information)
- New Controller and Cabinet
- Existing Feed Point
- New Light Std. Pole

N

NB I-29 Ramp

Existing Signal-S1
Existing Ped Btn #1

New Controller and Cabinet

Sta. 2121+30.38
54.95' LT
Existing Pull Box 1

Note:
All stations and offsets are referenced from SCL81 alignment.

Existing Signal-S2
Existing Ped Btn #2

32nd Ave S
(40 mph)

2119 2120 2121 2122 2123 2124

32nd Ave S
(40 mph)

Sta. 2120+58.90
66.31' RT
Existing Pull Box 3

NB I-29 Ramp

Existing Signal-S3

Sta. 2121+35.66
55.04' RT
Existing Pull Box 2

Sta. 2121+00.50
96.18' RT
New Pull Box 4

Existing Feed Point

Sta. 2119+75.36
798.63' RT
New Pull Box 5

NB I-29 Ramp

New Light Std.
New Video Detection Camera

Phase Diagram

5 2 6 4

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Revise Traffic Signal System - Site 2
Conduit/Conductor Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

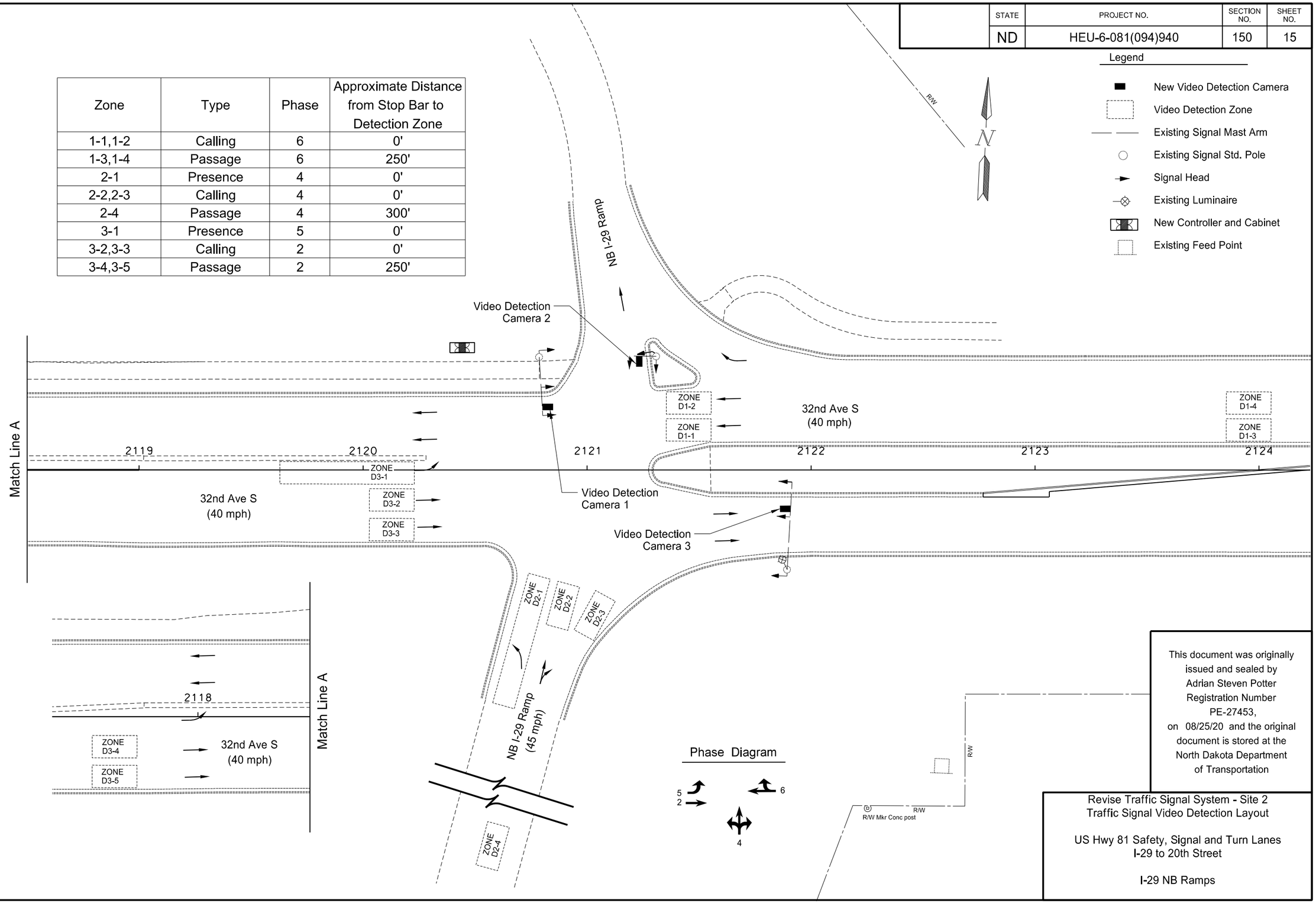
I-29 NB Ramps

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	15

Zone	Type	Phase	Approximate Distance from Stop Bar to Detection Zone
1-1,1-2	Calling	6	0'
1-3,1-4	Passage	6	250'
2-1	Presence	4	0'
2-2,2-3	Calling	4	0'
2-4	Passage	4	300'
3-1	Presence	5	0'
3-2,3-3	Calling	2	0'
3-4,3-5	Passage	2	250'

Legend

- New Video Detection Camera
- Video Detection Zone
- Existing Signal Mast Arm
- Existing Signal Std. Pole
- Signal Head
- Existing Luminaire
- New Controller and Cabinet
- Existing Feed Point



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Revise Traffic Signal System - Site 2
Traffic Signal Video Detection Layout

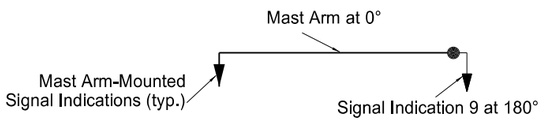
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

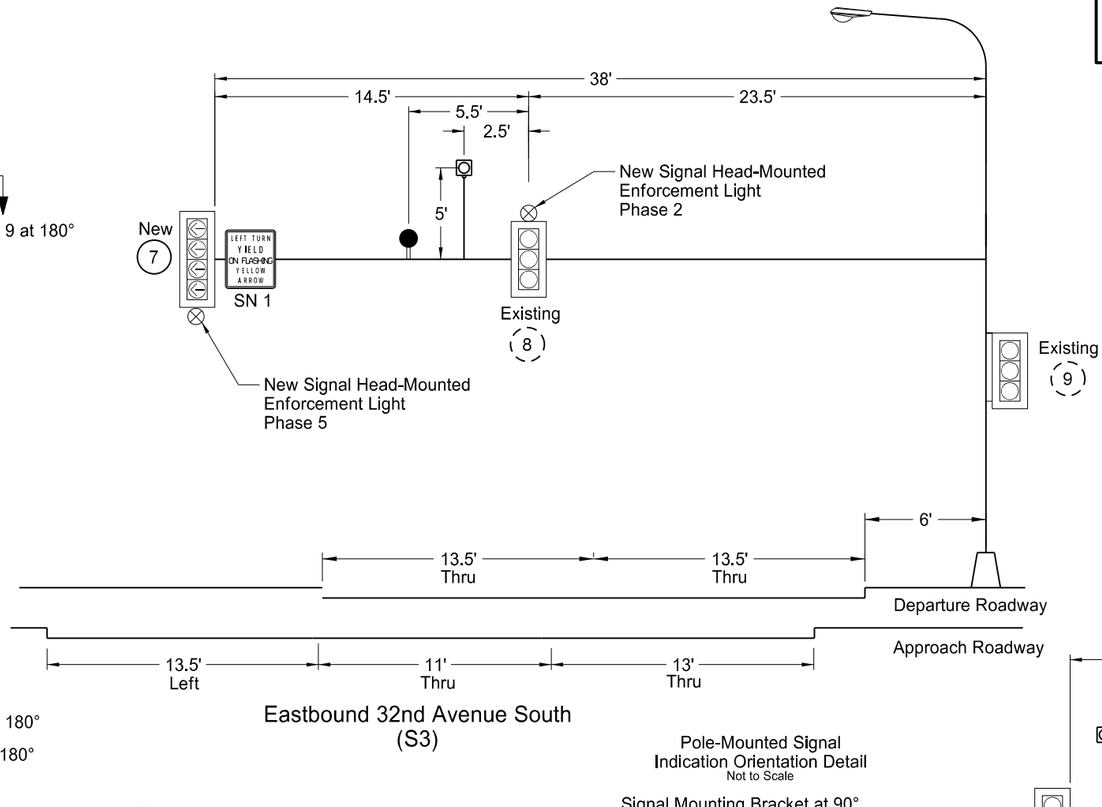
I-29 NB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	16

Notes:
1. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole
2. See Section 110 for sign details.

Pole-Mounted Signal Indication Orientation Detail
Not to Scale





Eastbound 32nd Avenue South
(S3)

Pole-Mounted Signal Indication Orientation Detail
Not to Scale

Westbound 32nd Avenue South
(S1)

Pole-Mounted Signal Indication Orientation Detail
Not to Scale

Northbound NE I-29 Ramp
(S2)

Legend

- Transformer Base
- New Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- New Emergency Vehicle Preemption Indicator Light
- New Emergency Vehicle Preemption GPS Detector and Light
- ⊗ Enforcement Light

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Revise Traffic Signal System - Site 2
Signal Standard & Head Locations

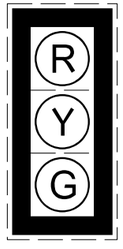
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 NB Ramps

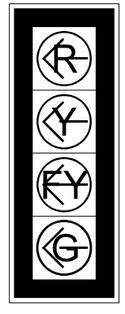
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	17

Conductor			Existing Cable 1 (12 No.12 AWG)			Existing Cable 2 (12 No.12 AWG)			Existing Cable 3 (12 No.12 AWG)			New Cable 4 (14 No.7 AWG)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black				Spare			Spare			Spare			Spare
2	White				Neutral			Neutral			Neutral			Neutral
3	Red		8,9	2	Red	4,5	4	Red	1,2,3	6	Red	6	5	Red Left Arrow
4	Green				Ground			Ground			Ground			Ground
5	Orange		8,9	2	Yellow	4,5	4	Yellow	1,2,3	6	Yellow	6	5	Flashing Yellow Left Arrow
6	Blue		8,9	2	Green	4,5	4	Green	1,2,3	6	Green	6	5	Green Left Arrow
7	White	Black			Spare			Spare			Spare	6	5	Yellow Left Arrow
8	Red	Black	7	5	Red Left Arrow			Spare			Spare			
9	Green	Black			Spare			Spare			Spare			
10	Orange	Black	7	5	Flashing Yellow Left Arrow			Spare			Spare			
11	Blue	Black	7	5	Green Left Arrow	P2	6	Walk	P1	6	Walk			
12	Black	White	7	5	Yellow Left Arrow	P2	6	Don't Walk	P1	6	Don't Walk			

(12" Lenses)
Existing Heads P1, P2



(12" Lenses)
Existing Heads 1, 2, 3, 4
5, 8, 9



(12" Lenses)
New Heads 6, 7

Notes:

1. Use LED indications on new 4-section Flashing Yellow Arrow heads.
2. Use 5" Louvered Black Plate on new 4-section Flashing Yellow Arrow heads.

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Revise Traffic Signal System - Site 2
Signal Heads & Conductor Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 NB Ramps

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	18

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Code	QTY	Type
1	Controller to Existing Signal Std. - S1	32 (EX)	2" (EX)	88	A	1	No. 14 AWG 3 Conductor Cable
				88	B	1	Emergency Detector Cable
				48	C	1	Existing Cable 3
				51	C	1	Push Button (EX)
				89	D	1	Video Detector Cable
				89	F	1	No. 14 AWG 3 Conductor Cable
2	Controller to Existing Pull Box 1	82	3"	92	A	1	No. 14 AWG 3 Conductor Cable
				92	B	1	Emergency Detector Cable
				92	C	1	Existing Cable 2
				91	C	1	New Cable 4
				92	C	1	Push Button (EX)
				92	D	1	Video Detector Cable
3	Existing Pull Box 1 to Existing Signal Std. - S2	3	3"	38	A	1	No. 14 AWG 3 Conductor Cable
				38	B	1	Emergency Detector Cable
				9	C	1	Existing Cable 2
				23	C	1	New Cable 4
				12	C	1	Push Button (EX)
				40	D	1	Video Detector Cable
4	Existing Pull Box 2 to Existing Signal Std. - S3	50 (EX)	2" (EX)	106	A	1	No. 14 AWG 3 Conductor Cable
				106	B	1	Emergency Detector Cable
				56	C	1	Existing Cable 1
				103	D	1	Video Detector Cable
				222	F	2	No. 14 AWG 3 Conductor Cable
5	Existing Pull Box 3 to Existing Pull Box 2	86 (EX)	2" (EX)	92	A	1	No. 14 AWG 3 Conductor Cable
				92	B	1	Emergency Detector Cable
				87	C	1	Existing Cable 1
				92	D	1	Video Detector Cable
				184	F	2	No. 14 AWG 3 Conductor Cable
6A	Controller to Existing Pull Box 3	129 (EX)	2.5" (EX)	139	A	1	No. 14 AWG 3 Conductor Cable
				139	B	1	Emergency Detector Cable
				139	C	1	Existing Cable 1
				139	D	1	Video Detector Cable
				276	F	2	No. 14 AWG 3 Conductor Cable
6B	Controller to Existing Pull Box 3	126 (EX)	2" (EX)	272	E	2	No. 6 RHW (EX)
				136	E	1	No. 6 THW (EX)
6C	Controller to Existing Pull Box 3	125	2"	135	D	1	Video Detector Cable
7	Existing Feed Point to Existing Pull Box 3	106 (EX)	2" (EX)	214	E	2	No. 6 RHW (EX)
				107	E	1	No. 6 THW (EX)
8	Existing Pull Box 3 to Pull Box 4	51	2"	55	D	1	Video Detector Cable
9	Pull Box 4 to Pull Box 5	716	2"	720	D	1	Video Detector Cable
10	Pull Box 5 to Light Std.	18	2"	20	D	1	Video Detector Cable

Cable Code

(EX) = Existing Conductor/Cable Runs
A = Emergency Vehicle Indicator Lamp
B = Emergency Vehicle Detector Cable
C = Signal Control Cable
D = Video Detection Cable
E = Power Cable
F = Enforcement Light Cable

Note:
All conduit and cable lengths are in feet.

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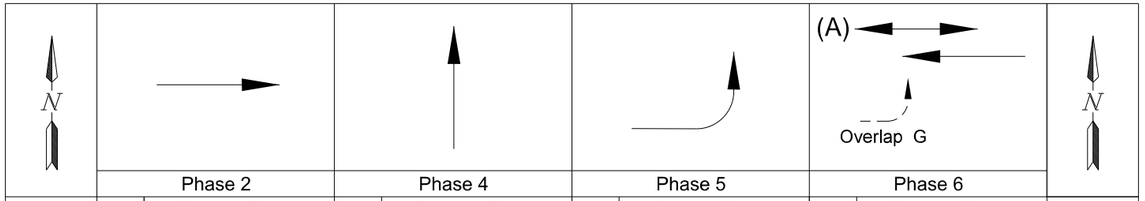
Revise Traffic Signal System - Site 2
Conduit Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 NB Ramps

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	19



Head #	Phase 2 R/W	Phase 2 Clear to Phase	Phase 4 R/W	Phase 4 Clear to Phase	Phase 5 R/W	Phase 5 Clear to Phase	Phase 6 R/W	Phase 6 Clear to Phase	Head #
1		4 5 6		5 6 2		6 2 4	G	2 4 5	1
2		4 5 6		5 6 2		6 2 4	G	2 4 5	2
3		4 5 6		5 6 2		6 2 4	G	2 4 5	3
4		4 5 6	G	Y Y Y		6 2 4		2 4 5	4
5		4 5 6	G	Y Y Y		6 2 4		2 4 5	5
6		4 5 6		5 6 2	~~G~~ ~~Y~~	(B) ~~Y~~	(C)	2 4 5	6
7		4 5 6		5 6 2	~~G~~ ~~Y~~	(B) ~~Y~~	(C)	2 4 5	7
8	G	Y Y (B)		5 6 2		6 2 4		2 4 5	8
9	G	Y Y (B)		5 6 2		6 2 4		2 4 5	9

Blank Squares denote Red Indication

(A) = Pedestrian movements, upon activation

(B) = When one phase is on alone a nonconflicting phase may start timing concurrently without a clearance interval (See Chart A).

(C) = Flashing yellow left turn arrow (protected/permissive mode and permissive only mode).

(D) = Solid yellow left turn arrow (protected/permissive mode and permissive only mode).

Protected Movement

Permitted Movement

Pedestrian Actuated Movement

Chart A

Non-Conflicting Phases

On Phase	Non-Conflicting Phase Allowed to Time Concurrently
2	5 or 6
4	-
5	2
6	2

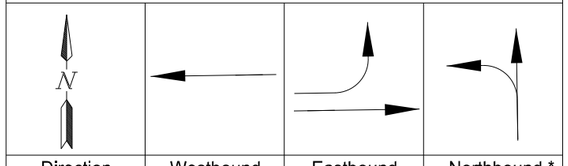
Chart B

Special Overlaps

(Flashing Yellow Left Turn Arrows)

Overlap	Protected Phase	Permissive Phase
E	-	-
F	-	-
G	5	6
H	-	-

Emergency Vehicle Preemption Phasing



Direction	Westbound	Eastbound	Northbound *
Dwell Phases	6	2,5	4
Dwell Overlaps	-	-	-

* Note:

Utilize Phase 4 EVP for Northbound I-29 Ramp queue flush phase.
See Section 6 for timing settings.

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Revise Traffic Signal System - Site 2
Signal Controller Phasing

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 NB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	20

	Future	→	Future	↑	↱	←	Future	Future
	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
		EB		NB	EBL	WB		
BASIC INTERVALS (OR FUNCTIONS)								
Minimum Initial	-	15.0	-	8.0	5.0	15.0	-	-
Vehicle Extension	-	5.0	-	5.0	1.5	5.0	-	-
Maximum Green (Max 1)	-	40.0	-	40.0	40.0	40.0	-	-
Yellow Change	-	4.0	-	4.0	3.5	4.0	-	-
Red Clearance	-	1.5	-	1.0	2.0	1.0	-	-
Walk	-	-	-	-	-	7.0	-	-
Pedestrian Clearance	-	-	-	-	-	7.0	-	-
Delayed Green (Leading Pedestrian Interval)	-	-	-	-	-	6.0	-	-
VOLUME DENSITY TIMING FUNCTIONS								
VARIABLE INITIAL TIMING OPTIONS								
Actuations Before Added Initial	-	-	-	-	-	-	-	-
Added Initial per Actuation	-	-	-	-	-	-	-	-
Maximum Initial	-	-	-	-	-	-	-	-
GAP REDUCTION OPTIONS								
Time Before Reduction	-	20.0	-	-	-	20.0	-	-
Time to Reduce to Minimum Gap	-	20.0	-	-	-	20.0	-	-
Minimum Gap	-	2.5	-	-	-	2.5	-	-
OTHER CONTROLLER FUNCTIONS								
Locking Memory	-	x	-	-	-	x	-	-
Non-Locking Memory	-	-	-	x	x	-	-	-
Phase recall	-	x	-	-	-	x	-	-
Red Revert	-	2.0	-	2.0	2.0	2.0	-	-
Backup Prevent Phases	-	-	-	-	-	-	-	-
No Serve Phases	-	-	-	-	-	-	-	-
Flashing-Normal & Conflict Monitor	-	R	-	R	R	R	-	-

Notes:
1. Operate all left turn phases as either leading or lagging phases.
2. Operate all left turn phases either in protected, protected/permissive, or permissive mode.

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Revise Traffic Signal System - Site 2
Signal Timing Settings

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 NB Ramps

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	21

SPEC	CODE	ITEM DESCRIPTION	UNIT	TOTAL
770	1676	LT STD 6FT MA 40FT MT HT BREAKAWAY	EA	1
772	0100	PULL BOX	EA	2
772	0240	2IN DIAMETER RIGID CONDUIT	LF	930
772	0270	3IN DIAMETER RIGID CONDUIT	LF	100
772	0375	EMERGENCY VEHICLE DETECTOR CABLE	LF	560
772	0433	NO14 AWG 3 CONDUCTOR CABLE	LF	1330
772	0437	NO14 AWG 7 CONDUCTOR CABLE	LF	120
772	1820	1-WAY 4 SEC HEAD W/12IN LENS-POST MTD	EA	1
772	1822	1-WAY 4 SEC HEAD W/12IN LENS-MA MTD	EA	1
772	2070	LAW ENFORCEMENT CONFIRMATION LIGHT	EA	3
772	2260	VIDEO DETECTION CABLE	LF	1490
772	2265	VIDEO DETECTION SYSTEM	EA	1
772	2556	BATTERY BACKUP SYSTEM	EA	1
772	2610	EMERGENCY VEHICLE PREEMPTION UNIT	EA	4
772	2621	EMERGENCY VEHICLE PRE-EMPTION PHASE SELECTOR	EA	1
772	3122	REMOVE CONTROLLER & CABINET	EA	1
772	3140	REMOVE VEHICULAR HEADS	EA	1
		ABANDON CONDUIT	LF	85
		NEW CONTROLLER AND CABINET	EA	1
772	2907	REVISE TRAFFIC SIGNAL SYSTEM - SITE 2	EA	1
		The items appear above for informational purposes; provide all labor and equipment necessary for the signal system to be fully operational as shown in the Plans. Include items in the corresponding price bid for "REVISE TRAFFIC SIGNAL SYSTEM - SITE 2"		

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Revise Traffic Signal System - Site 2
Estimated Traffic Signal Quantities

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

I-29 NB Ramps

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	22

Legend

- Existing Signal Standard
- Existing Pull Box
- Existing Controller and Cabinet
- Existing Signal Mast Arm
- Existing Signal Head
- Existing Feed Point

N

Sta. 2129+01.43
83.72' LT
Remove Exist. PB

Sta. 2128+83.04
73.27' LT
Salvage/Remove PPP

Sta. 2128+64.26
55.06' LT
Remove Signal Std.

Sta. 2128+63.94
6.49' LT
Remove Exist. PB

Sta. 2128+61.41
54.55' RT
Remove Exist. PB

Sta. 2128+81.27
69.84' RT
Remove Signal Std. Pedestal

Sta. 2129+00.91
83.15' RT
Remove Signal Std. Pole

Sta. 2128+83.99
5.39' LT
Salvage/Remove PPP

Sta. 2129+09.40
82.98' RT
Remove Exist. PB

Sta. 2130+20.83
96.04' LT
Remove Exist.
Controller and Cabinet

Sta. 2129+87.87
71.19' LT
Remove Signal Std. Pole

Sta. 2130+25.77
52.35' LT
Remove Exist. PB

Sta. 2130+00.19
5.33' RT
Salvage/Remove PPP

Sta. 2130+26.21
4.56' RT
Remove Exist. PB

Sta. 2130+31.74
50.91' RT
Remove Signal Std. Pole

Sta. 2129+96.47
69.22' RT
Remove Signal Std. Pedestal

Sta. 2129+82.71
82.78' RT
Remove Exist. PB

S 38th St (25 mph)

S 38th St (30 mph)

32nd Ave S (40 mph)

32nd Ave S (40 mph)

R/W

F O

2127 2128 2129 2130 2131 2132

Notes:
1. All stations and offsets are referenced from SCL81 alignment.
2. Abandon all conduit and remove all cable related to existing traffic signal system.

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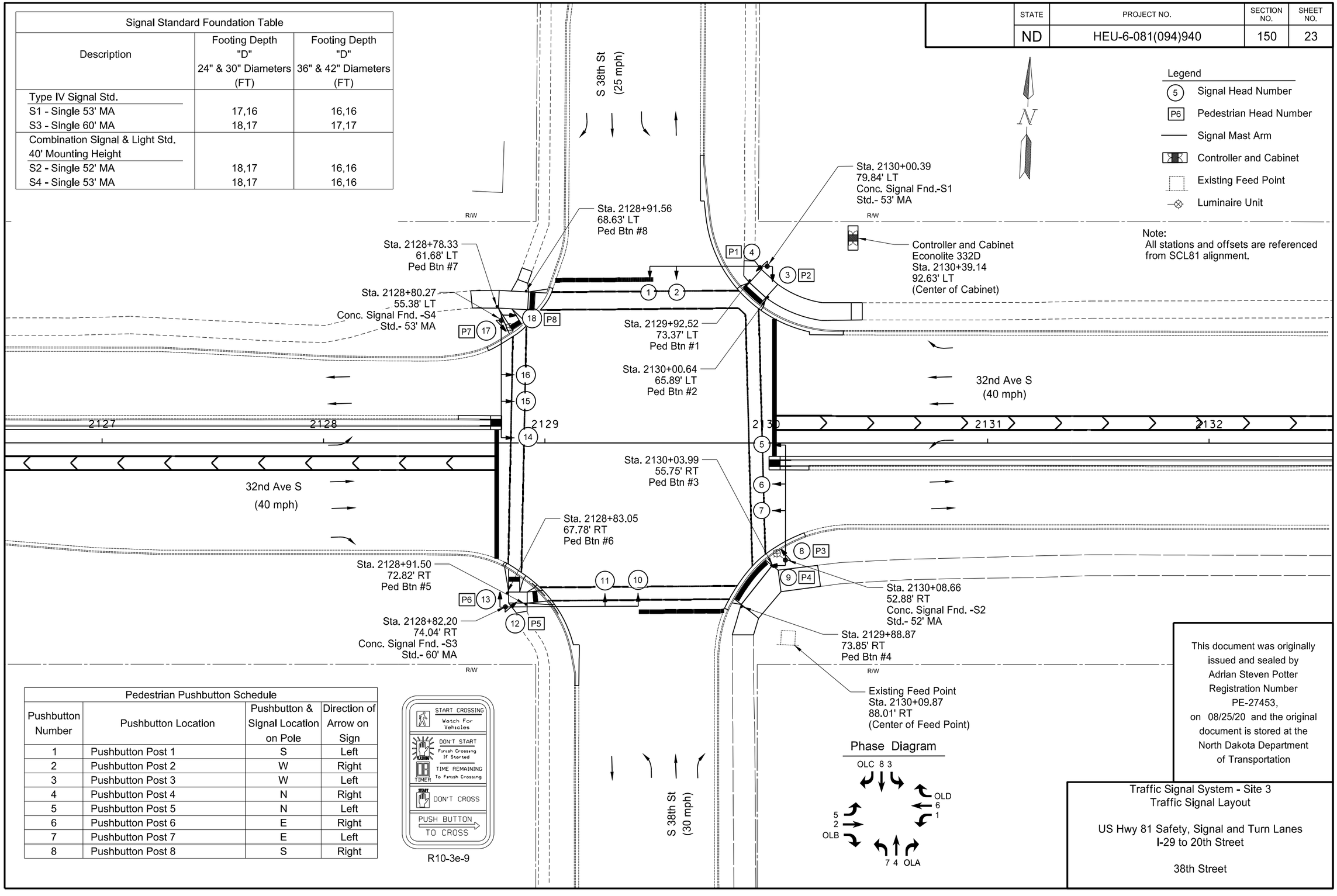
Traffic Signal System - Site 3
Traffic Signal Removal

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

38th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	23

Signal Standard Foundation Table		
Description	Footing Depth "D" 24" & 30" Diameters (FT)	Footing Depth "D" 36" & 42" Diameters (FT)
Type IV Signal Std.		
S1 - Single 53' MA	17,16	16,16
S3 - Single 60' MA	18,17	17,17
Combination Signal & Light Std. 40' Mounting Height		
S2 - Single 52' MA	18,17	16,16
S4 - Single 53' MA	18,17	16,16



Pedestrian Pushbutton Schedule			
Pushbutton Number	Pushbutton Location	Pushbutton & Signal Location on Pole	Direction of Arrow on Sign
1	Pushbutton Post 1	S	Left
2	Pushbutton Post 2	W	Right
3	Pushbutton Post 3	W	Left
4	Pushbutton Post 4	N	Right
5	Pushbutton Post 5	N	Left
6	Pushbutton Post 6	E	Right
7	Pushbutton Post 7	E	Left
8	Pushbutton Post 8	S	Right

R10-3e-9

Traffic Signal System - Site 3
Traffic Signal Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

38th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	24

S 38th St
(25 mph)

Legend
- Pull Box
- 2 — Conduit Run Number (see sheet 30 for more information)
- Controller and Cabinet
- Existing Feed Point

Note:
All stations and offsets are referenced from SCL81 alignment.

Sta. 2128+85.29
78.86' LT
Pull Box 5

Sta. 2129+97.74
84.99' LT
Pull Box 1

Sta. 2130+24.31
67.66' LT
Pull Box 2

Sta. 2128+76.73
69.45' RT
Pull Box 4

Sta. 2130+08.78
70.73' RT
Pull Box 3

R/W

Controller and Cabinet

Reconnect existing street lighting circuit (No. 1) from signal luminaire via direct buried lighting cable to nearest existing lighting unit (approx. 470')

Reconnect existing street lighting circuit (No. 1) from signal luminaire via direct buried lighting cable to nearest existing lighting unit (approx. 350')

Ped Btn #1
Ped Btn #2
Ped Btn #3
Ped Btn #4
Ped Btn #5
Ped Btn #6
Ped Btn #7
Ped Btn #8

Conc. Signal Fnd. -S1
Conc. Signal Fnd. -S2
Conc. Signal Fnd. -S3
Conc. Signal Fnd. -S4

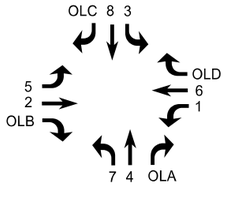
Existing Feed Point

32nd Ave S
(40 mph)

2127 2128 2129 2130 2131 2132

S 38th St
(30 mph)

Phase Diagram



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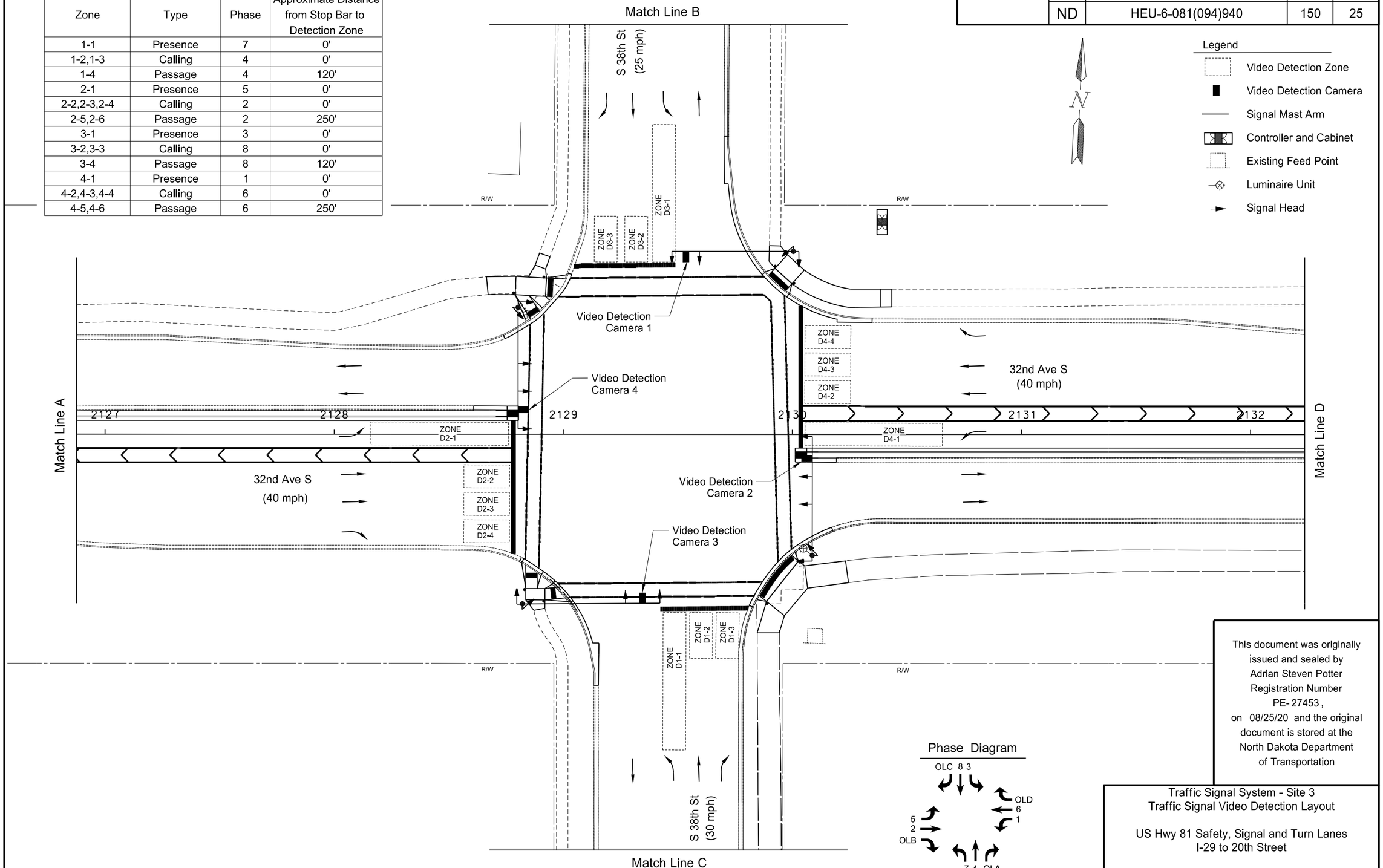
Traffic Signal System - Site 3
Conduit/Conductor Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

38th Street

Zone	Type	Phase	Approximate Distance from Stop Bar to Detection Zone
1-1	Presence	7	0'
1-2,1-3	Calling	4	0'
1-4	Passage	4	120'
2-1	Presence	5	0'
2-2,2-3,2-4	Calling	2	0'
2-5,2-6	Passage	2	250'
3-1	Presence	3	0'
3-2,3-3	Calling	8	0'
3-4	Passage	8	120'
4-1	Presence	1	0'
4-2,4-3,4-4	Calling	6	0'
4-5,4-6	Passage	6	250'

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	25



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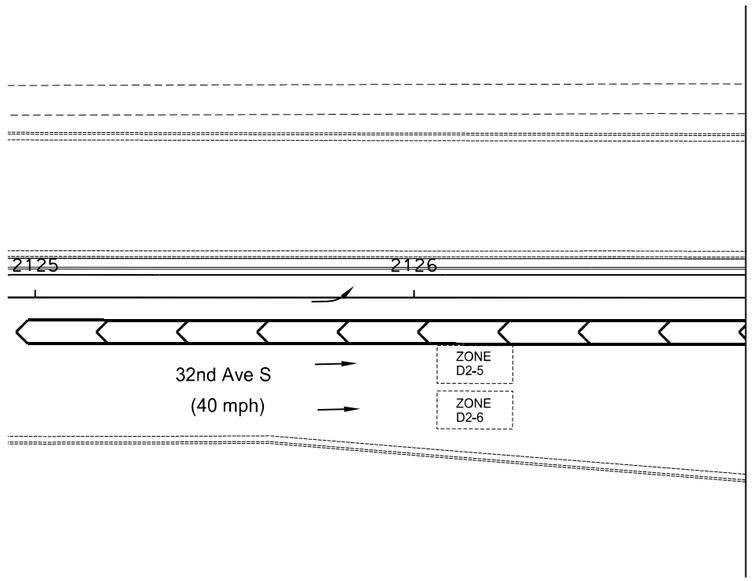
Traffic Signal System - Site 3
Traffic Signal Video Detection Layout

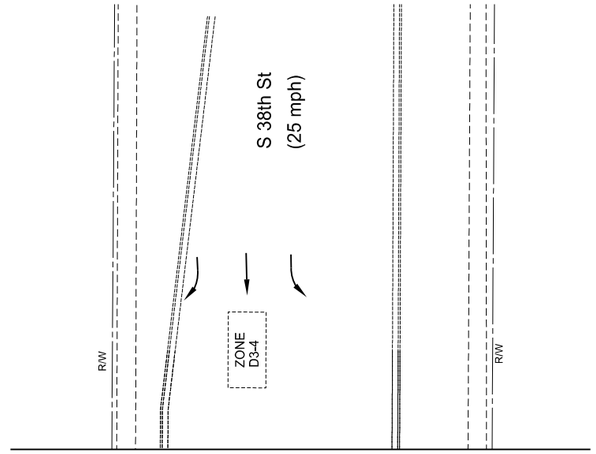
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

38th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	26

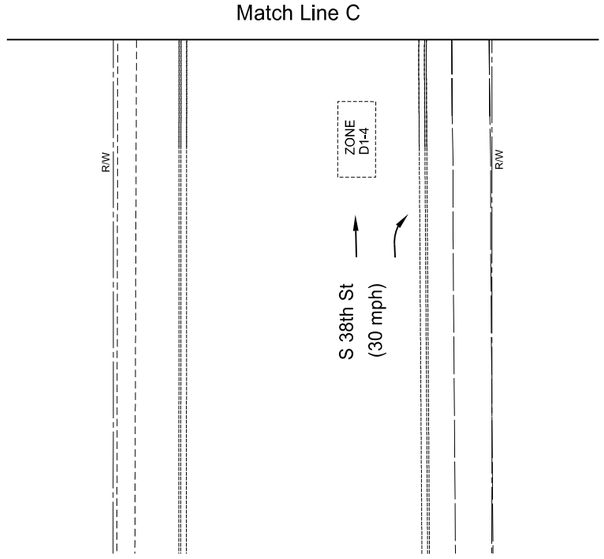


Match Line A

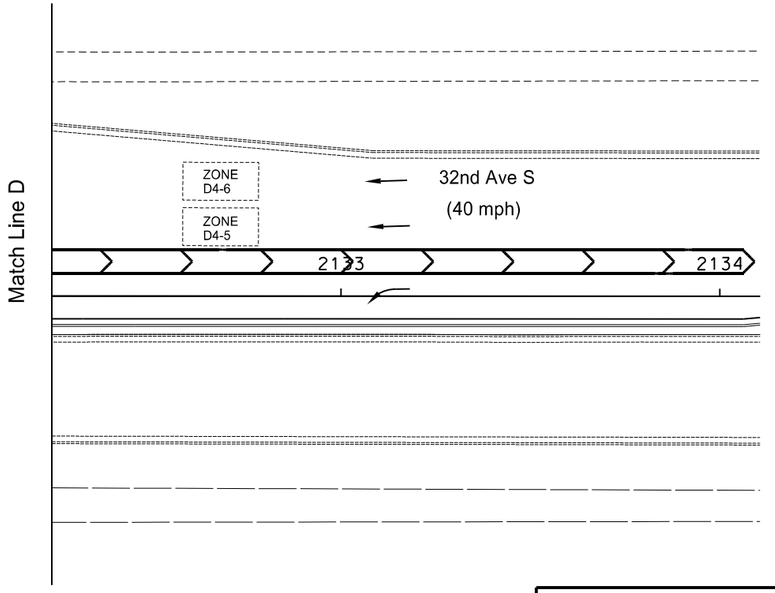


Match Line B

Match Line C



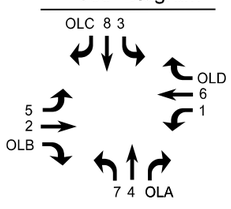
Match Line D



Legend

Video Detection Zone

Phase Diagram



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Traffic Signal System - Site 3
Traffic Signal Video Detection Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

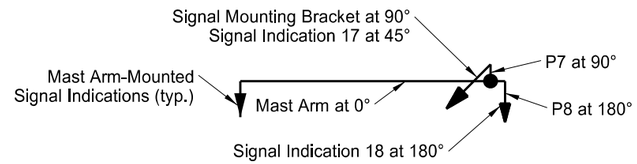
38th Street

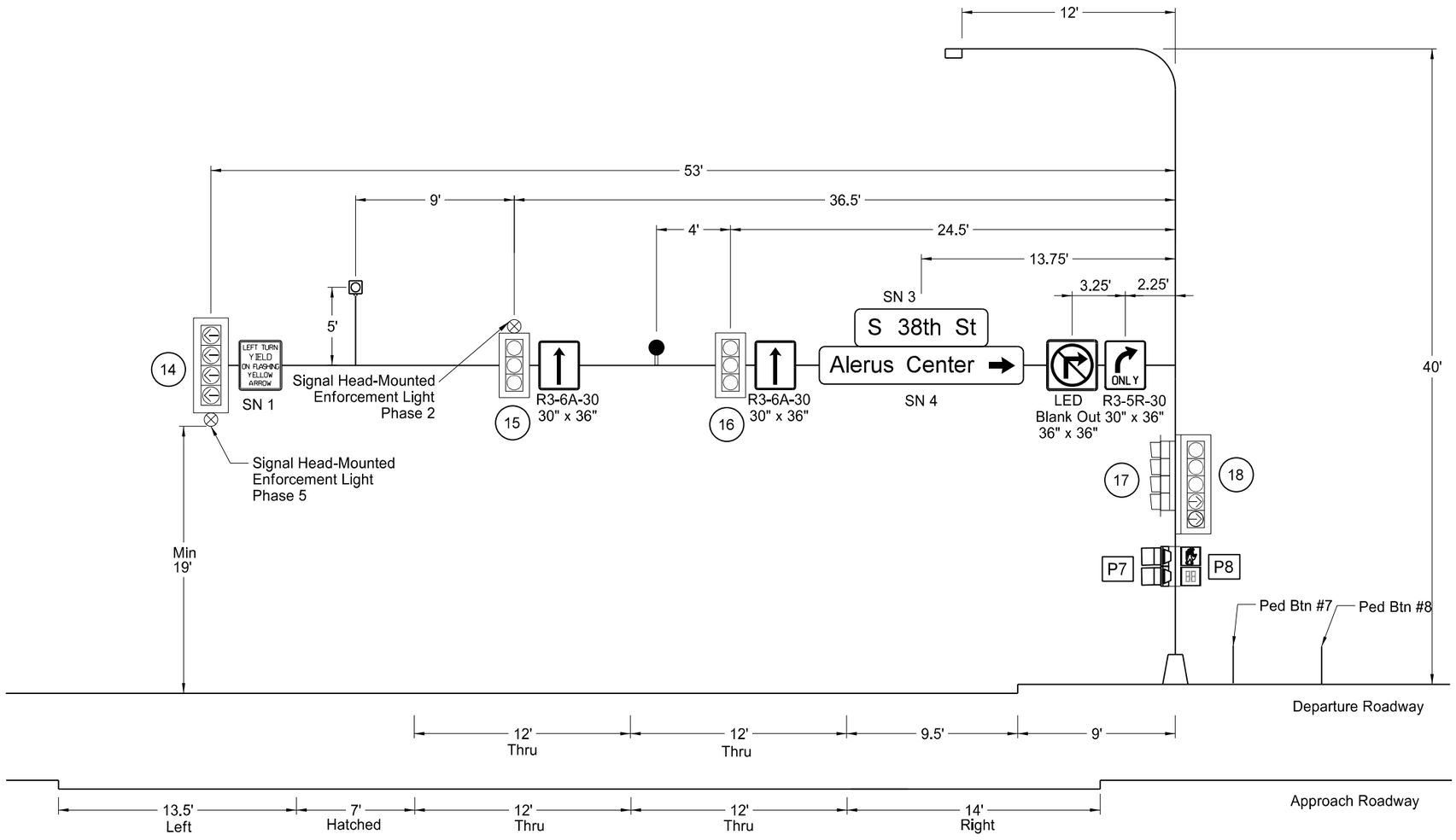
Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	27

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Westbound 32nd Avenue South
(S4)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 3
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

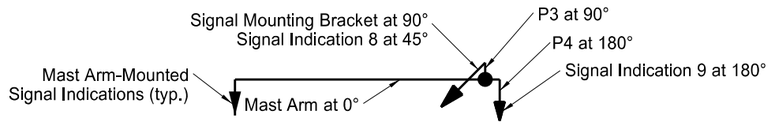
38th Street

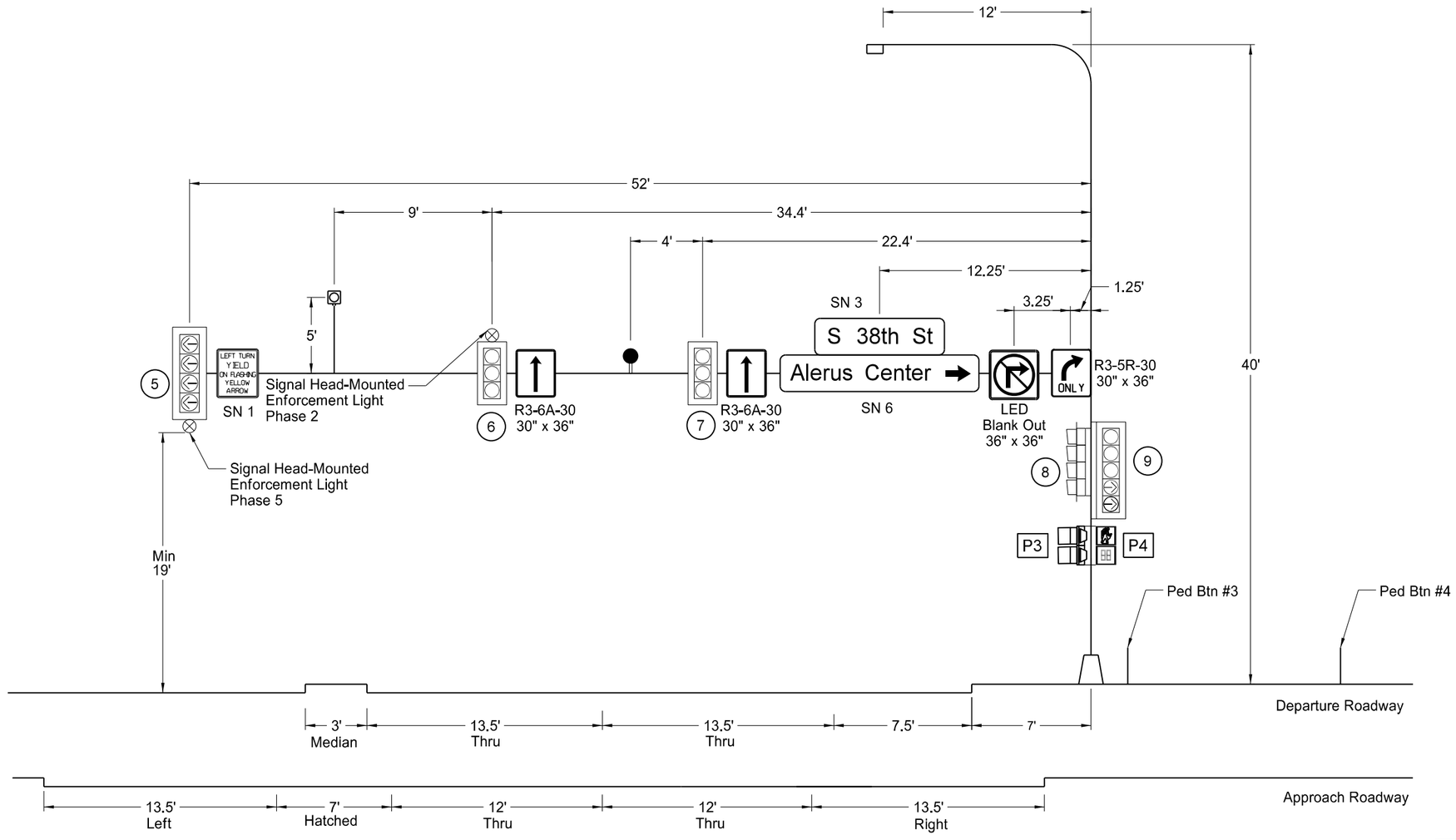
Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	28

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Eastbound 32nd Avenue South
(S2)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- X — Vehicle Signal Head Number
- PX — Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 3
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

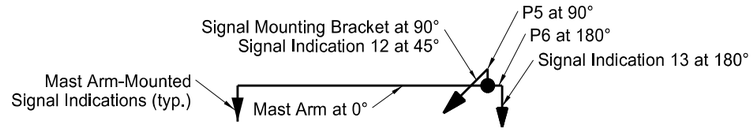
38th Street

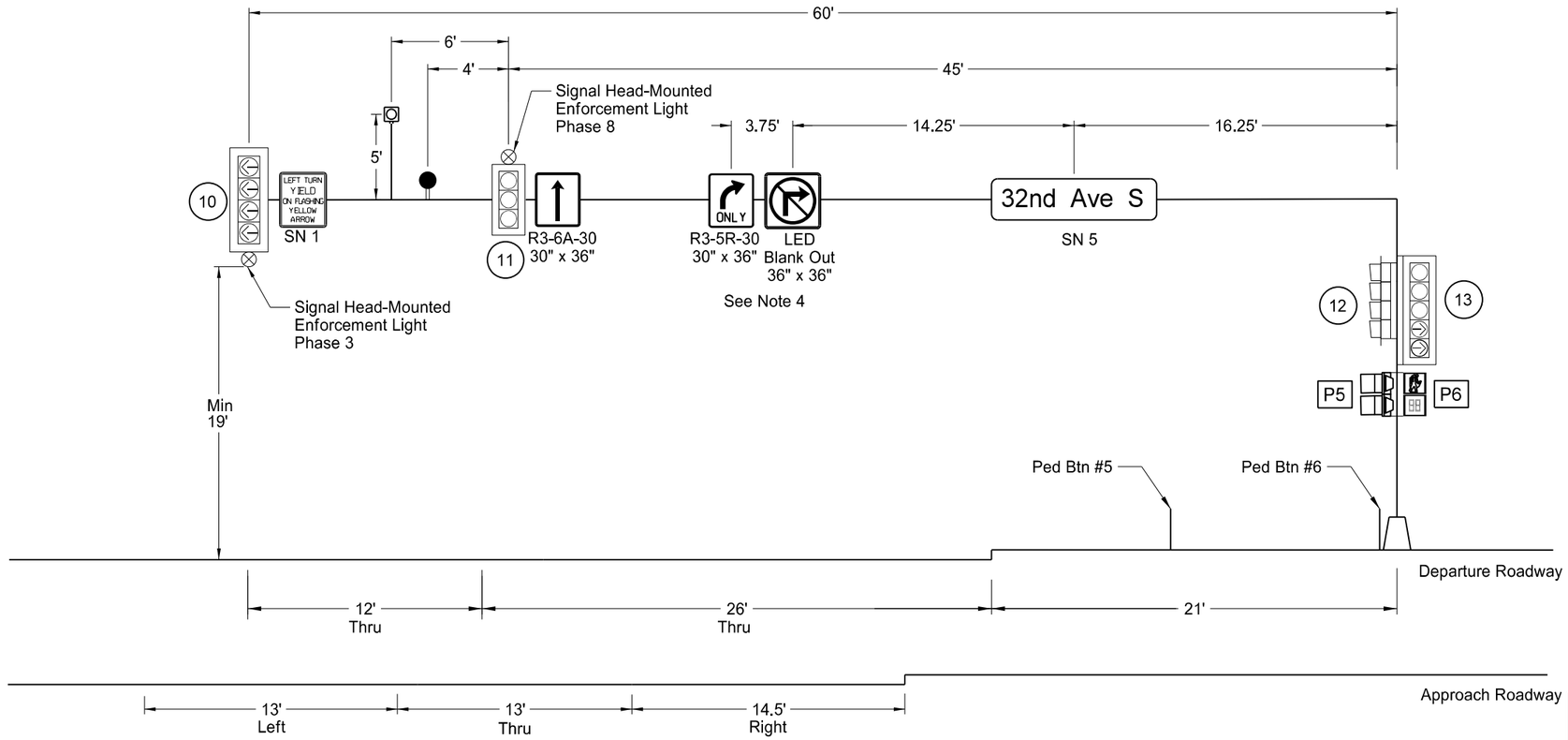
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	29

Notes:

1. Determine the final location of the video detection camera to provide a functional system.
2. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
3. See Section 110 for sign details.
4. Place signs R3-5R-30 and LED Blank Out in line with the center of the right turn lane and to the satisfaction of the engineer.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Southbound South 38th Street
(S3)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- X — Vehicle Signal Head Number
- PX — Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 3
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

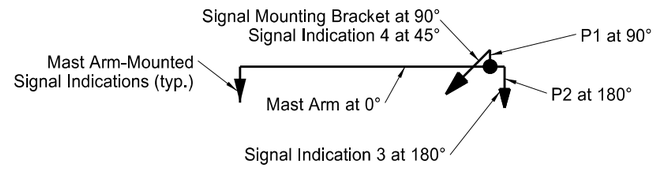
38th Street

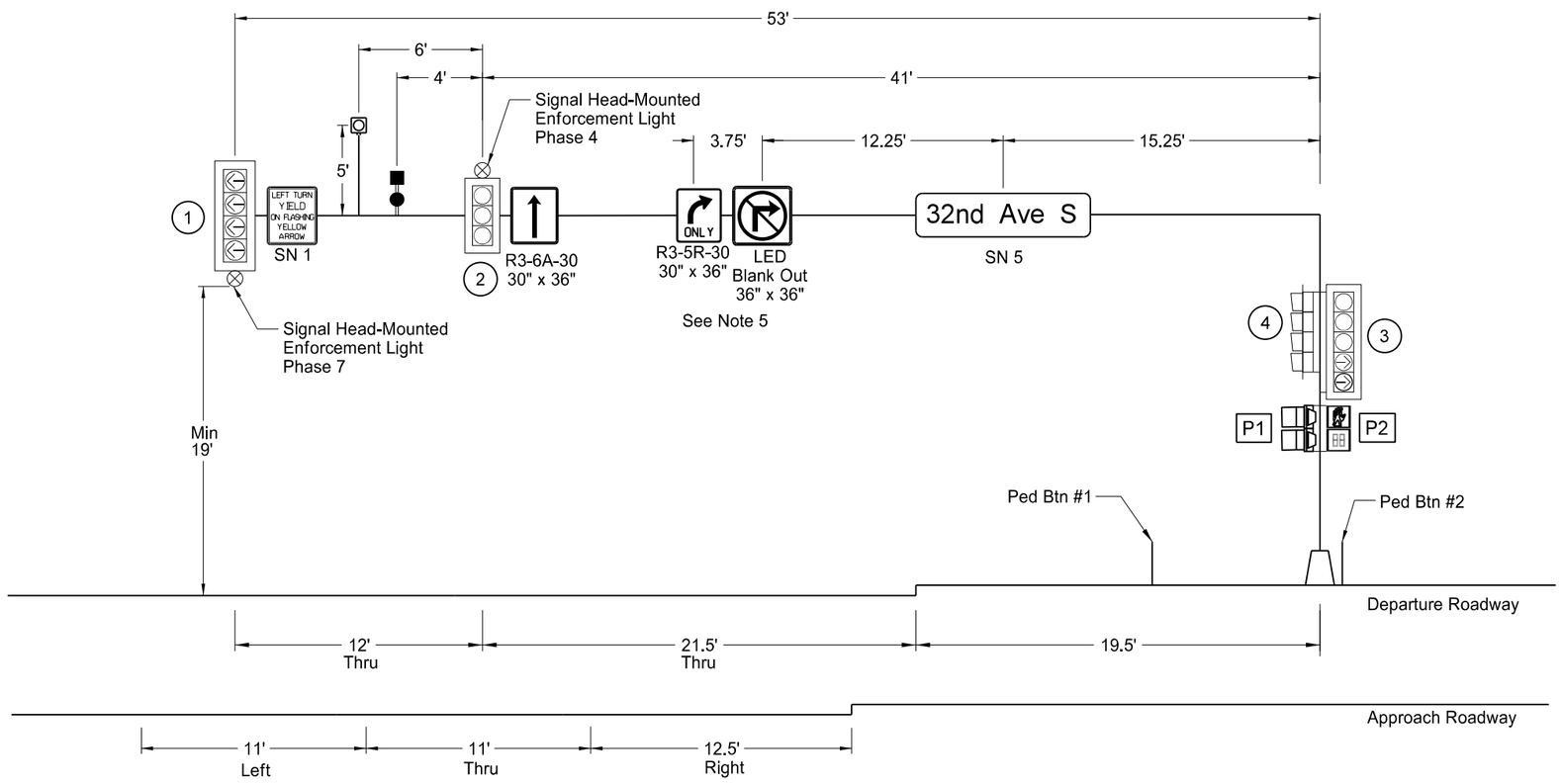
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	30

Notes:

1. Determine the final location of the video detection camera to provide a functional system.
2. Determine the final location of the Emergency Vehicle Preemption GPS detector to provide a functional system.
3. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
4. See Section 110 for sign details.
5. Place signs R3-5R-30 and LED Blank Out in line with the center of the right turn lane and to the satisfaction of the engineer.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Northbound South 38th Street
(S1)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- Emergency Vehicle Preemption GPS Detector and Light
- ⊗ Enforcement Light

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Traffic Signal System - Site 3
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

38th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	31

Conductor			Cable 1 (No.14 AWG 12)			Cable 2 (No.14 AWG 12)			Cable 3 (No.14 AWG 7)			Cable 4 (No.14 AWG 12)			Cable 5 (No.14 AWG 12)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		2,3	4	Green	4	5	Green LT Arrow	P1	6	Don't Walk	6,7	2	Green	8	3	Green LT Arrow
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		2,3	4	Red	4	5	Red LT Arrow	P1	6	Walk	6,7	2	Red	8	3	Red LT Arrow
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		2,3	4	Yellow	4	5	Yellow LT Arrow	P2	4	Don't Walk	6,7	2	Yellow	8	3	Yellow LT Arrow
6	Blue				Spare	4	5	Flashing Yellow LT Arrow	P2	4	Walk			Spare	8	3	Flashing Yellow LT Arrow
7	White	Black			Spare			Spare			Spare			Spare			Spare
8	Red	Black			Spare	1	7	Red LT Arrow				5	5	Red LT Arrow	9	2	Red
9	Green	Black			Spare			Spare						Spare	9	2	Green
10	Orange	Black	3	1 OLA	Yellow RT Arrow	1	7	Yellow LT Arrow				5	5	Yellow LT Arrow	9	7 OLB	Yellow RT Arrow
11	Blue	Black			Spare	1	7	Flashing Yellow LT Arrow				5	5	Flashing Yellow LT Arrow	9	2	Yelllow
12	Black	White	3	1 OLA	Green RT Arrow	1	7	Green LT Arrow				5	5	Green LT Arrow	9	7 OLB	Green RT Arrow

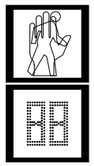
Conductor			Cable 6 (No.14 AWG 7)			Cable 7 (No.14 AWG 12)			Cable 8 (No.14 AWG 12)			Cable 9 (No.14 AWG 7)			Cable 10 (No.14 AWG 12)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		P3	4	Don't Walk	11	8	Green	12	1	Green LT Arrow	P5	2	Don't Walk	15,16	6	Green
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		P3	4	Walk	11	8	Red	12	1	Red LT Arrow	P5	2	Walk	15,16	6	Red
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		P4	2	Don't Walk	11	8	Yellow	12	1	Yellow LT Arrow	P6	8	Don't Walk	15,16	6	Yellow
6	Blue		P4	2	Walk			Spare	12	1	Flashing Yellow LT Arrow	P6	8	Walk			Spare
7	White	Black			Spare			Spare			Spare			Spare			Spare
8	Red	Black				10	3	Red LT Arrow	13	8	Red				14	1	Red LT Arrow
9	Green	Black						Spare	13	8	Green						Spare
10	Orange	Black				10	3	Yellow LT Arrow	13	5 OLC	Yellow RT Arrow				14	1	Yellow LT Arrow
11	Blue	Black				10	3	Flashing Yellow LT Arrow	13	8	Yelllow				14	1	Flashing Yellow LT Arrow
12	Black	White				10	3	Green LT Arrow	13	5 OLC	Green RT Arrow				14	1	Green LT Arrow

Conductor			Cable 11 (No.14 AWG 12)			Cable 12 (No.14 AWG 12)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication
1	Black		17	7	Green LT Arrow	18	6	Green
2	White				Neutral			Neutral
3	Red		17	7	Red LT Arrow	18	6	Red
4	Green				Ground			Ground
5	Orange		17	7	Yellow LT Arrow	18	6	Yellow
6	Blue		17	7	Flashing Yellow LT Arrow	18	3 OLD	Yellow RT Arrow
7	White	Black			Spare	18	3 OLD	Green RT Arrow
8	Red	Black			Neutral			Neutral
9	Green	Black	P7	8	Walk	P8	6	Walk
10	Orange	Black			Spare			Spare
11	Blue	Black	P7	8	Don't Walk	P8	6	Don't Walk
12	Black	White			Spare			Spare

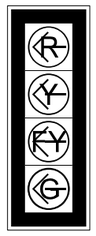
Notes:

1. Use LED indications for all heads.
2. Use 5" Louvered Black Plate with Type XI Yellow Reflective Border (typ.) on all heads.

(12" Lenses)
Heads P1, P2, P3,
P4, P5, P6, P7, P8

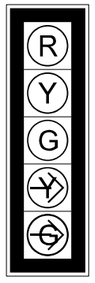


(12" Lenses)
Heads 1, 4, 5, 8,10
12,14,17



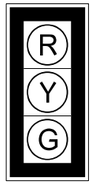
5" Louvered Backplate

(12" Lenses)
Heads 3,9,13,18



5" Louvered Backplate

(12" Lenses)
Heads 2, 6,7,
11,15,16



5" Louvered Backplate

LED Blank Out Sign (36" x 36")
Use white LEDs for arrow
Use red LEDs for prohibition symbol

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Traffic Signal System - Site 3
Signal Heads & Conductor Schedule

US Hwy 81 Safety, Signal and Turn Lane
I-29 to 20th Street

38th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	32

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Cable Run Code	Cable Run QTY	Cable Run Type
1A	Controller to Pull Box 2	30	4"	78	A	2	No. 14 AWG 3 Conductor Cable
				78	B	2	Emergency Detector Cable
				156	C	4	Cable 4,5,7,8
				78	C	2	Cable 6,9
				195	C	5	Push Button
				78	D	2	Video Detector Cable
				156	F	4	No. 14 AWG 3 Conductor Cable
				78	K	2	Electronic Sign
1B	Controller to Pull Box 2	30	2"	39	E	1	Mult 3 No. 6 USE
2	Pull Box 2 to Ped Push Btn. #2	24	2"	32	C	1	Push Button
3A	Pull Box 2 to Pull Box 3	140	4"	292	A	2	No. 14 AWG 3 Conductor Cable
				292	B	2	Emergency Detector Cable
				584	C	4	Cable 4,5,7,8
				292	C	2	Cable 6,9
				584	C	4	Push Button
				292	D	2	Video Detector Cable
				584	F	4	No. 14 AWG 3 Conductor Cable
				292	K	2	Electronic Sign
3B	Pull Box 2 to Pull Box 3	140	2"	149	E	1	Mult 3 No. 6 USE
3C	Pull Box 2 to Pull Box 3	140	4"	Empty conduit for future use			
4	Pull Box 3 to Signal Std. - S2	18	3"	73	A	1	No. 14 AWG 3 Conductor Cable
				73	B	1	Emergency Detector Cable
				196	C	2	Cable 4,5
				90	D	1	Video Detector Cable
				186	F	2	No. 14 AWG 3 Conductor Cable
				61	K	1	Electronic Sign
				35	C	1	Cable 6
5	Pull Box 3 to Ped Push Btn. #3	16	2"	29	C	1	Push Button
6	Pull Box 3 to Ped Push Btn. #4	21	2"	29	C	1	Push Button
7	Pull Box 3 to Pull Box 4	132	3"	138	A	1	No. 14 AWG 3 Conductor Cable
				138	B	1	Emergency Detector Cable
				276	C	2	Cable 7,8
				138	C	1	Cable 9
				276	C	2	Push Button
				138	D	1	Video Detector Cable
				276	F	2	No. 14 AWG 3 Conductor Cable
				138	K	1	Electronic Sign
8	Pull Box 4 to Ped Push Btn. #5	16	2"	24	C	1	Push Button
9	Pull Box 4 to Signal Std. - S3	8	3"	85	A	1	No. 14 AWG 3 Conductor Cable
				85	B	1	Emergency Detector Cable
				182	C	2	Cable 7,8
				43	C	1	Cable 9
				87	D	1	Video Detector Cable
				192	F	2	No. 14 AWG 3 Conductor Cable
				71	K	1	Electronic Sign

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Cable Run Code	Cable Run QTY	Cable Run Type
10	Pull Box 4 to Ped Push Btn. #6	7	2"	15	C	1	Push Button
11	Signal Std. - S4 to Pull Box 5	24	3"	81	A	1	No. 14 AWG 3 Conductor Cable
				81	B	1	Emergency Detector Cable
				315	C	3	Cable 10,11,12
				98	D	1	Video Detector Cable
				210	F	2	No. 14 AWG 3 Conductor Cable
				62	K	1	Electronic Sign
12	Ped Push Btn. #7 to Pull Box 5	19	2"	27	C	1	Push Button
13	Ped Push Btn. #8 to Pull Box 5	12	2"	20	C	1	Push Button
14	Pull Box 5 to Pull Box 1	113	3"	119	A	1	No. 14 AWG 3 Conductor Cable
				119	B	1	Emergency Detector Cable
				357	C	3	Cable 10,11,12
				238	C	2	Push Button
				119	D	1	Video Detector Cable
				238	F	2	No. 14 AWG 3 Conductor Cable
				119	K	1	Electronic Sign
15	Ped Push Btn. #1 to Pull Box 1	13	2"	21	C	1	Push Button
16	Signal Std. - S1 to Pull Box 1	6	3"	79	A	1	No. 14 AWG 3 Conductor Cable
				79	B	1	Emergency Detector Cable
				174	C	2	Cable 1,2
				23	C	1	Cable 3
				81	D	1	Video Detector Cable
				174	F	2	No. 14 AWG 3 Conductor Cable
				59	K	1	Electronic Sign
17	Pull Box 1 to Controller	46	4"	110	A	2	No. 14 AWG 3 Conductor Cable
				110	B	2	Emergency Detector Cable
				275	C	5	Cable 1,2,10,11,12
				55	C	1	Cable 3
				165	C	3	Push Button
				110	D	2	Video Detector Cable
				220	F	4	No. 14 AWG 3 Conductor Cable
				110	K	2	Electronic Sign
18	Pull Box 3 to Existing Feed Point	18	2"	28	E	1	Mult 3 No. 6 USE

Cable Code
A = Emergency Vehicle Indicator Lamp
B = Emergency Vehicle Detector Cable
C = Signal Control Cable
D = Video Detection Cable
E = Power Cable
F = Enforcement Light Cable
K = Electronic Sign Cable

Note:
All conduit and cable lengths are in feet.

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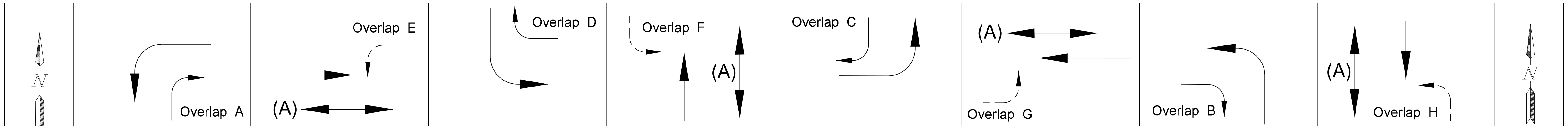
Traffic Signal System - Site 3
Conduit Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

38th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	33



Head #	Phase 1								Phase 2								Phase 3								Phase 4							
	R/W	Clear to Phase							R/W	Clear to Phase							R/W	Clear to Phase							R/W	Clear to Phase						
		2	3	4	5	6	7	8		3	4	5	6	7	8	1		4	5	6	7	8	1	2		5	6	7	8	1	2	3
1																																
2																									G	Y	Y	(B)	(B)	Y	Y	Y
3	G	Y	Y	Y	(B)	(B)	Y	Y																	G	Y	Y	(B)	(B)	Y	Y	Y
4																																
5																																
6									G	Y	Y	(B)	(B)	Y	Y	Y																
7									G	Y	Y	(B)	(B)	Y	Y	Y																
8																	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
9									G	Y	Y	(B)	(B)	Y	Y	Y																
10																	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
11																																
12	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)																
13																																
14	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)																
15																																
16																																
17																																
18																	G	Y	Y	Y	(B)	(B)	Y	Y								

Head #	Phase 5								Phase 6								Phase 7								Phase 8							
	R/W	Clear to Phase							R/W	Clear to Phase							R/W	Clear to Phase							R/W	Clear to Phase						
		6	7	8	1	2	3	4		7	8	1	2	3	4	5		8	1	2	3	4	5	6		1	2	3	4	5	6	7
1																	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
2																																
3																																
4	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)																
5	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)																
6																																
7																																
8																																
9																	G	Y	Y	Y	(B)	(B)	Y	Y								
10																																
11																									G	Y	Y	(B)	(B)	Y	Y	Y
12																																
13	G	Y	Y	Y	(B)	(B)	Y	Y																	G	Y	Y	(B)	(B)	Y	Y	Y
14																																
15									G	Y	Y	(B)	(B)	Y	Y	Y																
16									G	Y	Y	(B)	(B)	Y	Y	Y																
17																	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
18									G	Y	Y	(B)	(B)	Y	Y	Y																

Blank Squares Denote Red Indication
(A) = Pedestrian movements, upon activation.
(B) = When one phase is on alone, a nonconflicting phase may start timing concurrently without a clearance interval (See Chart A).
(C) = Flashing yellow left turn arrow (protected/permissive mode and permissive only mode).
(D) = Solid yellow left turn arrow (protected/permissive mode and permissive only mode).

Protected Movement

Permitted Movement

Pedestrian Actuated Movement

Chart A

Non-Conflicting Phases

On Phase	Non-Conflicting Phase Allowed to Time Concurrently
1	5 or 6
2	5 or 6
3	7 or 8
4	7 or 8
5	1 or 2
6	1 or 2
7	3 or 4
8	3 or 4

Chart B

Overlaps

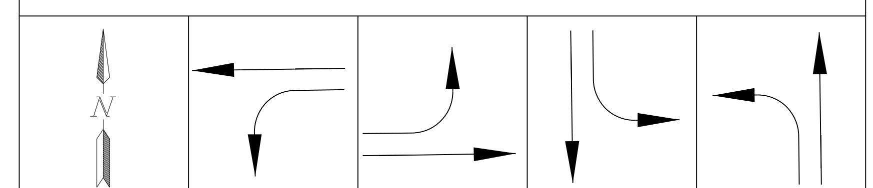
Overlap	Protected Phase	Ped Protect Phases
A	1	-
B	7	-
C	5	-
D	3	-

Chart C

Special Overlaps
(Flashing Yellow Left Turn Arrows)

Overlap	Protected Phase	Permissive Phase
E	1	2
F	3	4
G	5	6
H	7	8

Emergency Vehicle Preemption Phasing



Direction	Westbound	Eastbound*	Southbound	Northbound
Dwell Phases	1,6	2,5	3,8	4,7
Dwell Overlaps	OLJ	OLL	OLI	OLK

*Note:
Utilize Phase 2 and 5 EVP for Northbound I-29 Ramp queue flush phase at 38th Street.
See Section 6 for timing settings.

Chart D

No Turn on Red Sign Activation Overlaps

Overlap	Direction of vehicular travel - Signal Std.	Conflicting Left Turn Phase	Parallel Pedestrian Phase	Perpendicular Pedestrian Phase
I	Northbound - S1	3	4 Ped	2 Ped
J	Eastbound - S2	1	2 Ped	8 Ped
K	Southbound - S3	7	8 Ped	6 Ped
L	Westbound - S4	5	6 Ped	4 Ped

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Traffic Signal System - Site 3
Signal Controller Phasing

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

38th Street

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	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	34

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
	WBLT	EB	SBLT	NB	EBLT	WB	NBLT	SB
BASIC INTERVALS (OR FUNCTIONS)								
Minimum Initial	5.0	15.0	5.0	10.0	5.0	15.0	5.0	10.0
Vehicle Extension	1.5	5.0	1.5	5.0	1.5	5.0	1.5	5.0
Maximum Green (Max 1)	15.0	40.0	15.0	40.0	15.0	40.0	15.0	40.0
Yellow Change	3.5	4.0	3.5	3.5	3.5	4.0	3.5	3.5
Red Clearance	2.0	1.0	2.5	2.5	2.0	1.0	2.5	2.5
Walk	-	7.0	-	7.0	-	7.0	-	7.0
Pedestrian Clearance	-	22.0	-	32.0	-	23.0	-	29.0
Delayed Green (Leading Pedestrian Interval)	-	6.0	-	6.0	-	6.0	-	6.0
VOLUME DENSITY TIMING FUNCTIONS								
VARIABLE INITIAL TIMING OPTIONS								
Actuations Before Added Initial	-	-	-	-	-	-	-	-
Added Initial per Actuation	-	-	-	-	-	-	-	-
Maximum Initial	-	-	-	-	-	-	-	-
GAP REDUCTION OPTIONS								
Time Before Reduction	-	20.0	-	-	-	20.0	-	-
Time to Reduce to Minimum Gap	-	20.0	-	-	-	20.0	-	-
Minimum Gap	-	2.5	-	-	-	2.5	-	-
OTHER CONTROLLER FUNCTIONS								
Locking Memory	-	x	-	x	-	x	-	x
Non-Locking Memory	x	-	x	-	x	-	x	-
Phase recall	-	x	-	-	-	x	-	-
Red Revert	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Backup Prevent Phases	-	-	-	-	-	-	-	-
No Serve Phases	-	-	-	-	-	-	-	-
Flashing-Normal & Conflict Monitor	R	R	R	R	R	R	R	R

Notes:
1. Operate all left turn phases as either leading or lagging phases.
2. Operate all left turn phases either in protected, protected/permissive, or permissive mode.

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Traffic Signal System - Site 3
Signal Timing Settings

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

38th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	35

SPEC	CODE	ITEM DESCRIPTION	UNIT	TOTAL
770	0445	MULTIPLE UNDERGROUND CABLE 3NO6 STYLE USE	LF	220
770	0464	MULTIPLE UNDERGROUND CABLE 3NO4-1NO6 STYLE USE	LF	900
770	4210	LED LUMINAIRE	EA	2
772	0020	CONCRETE FOUNDATION-TRAFFIC SIGNALS	EA	5
772	0100	PULL BOX	EA	5
772	0240	2IN DIAMETER RIGID CONDUIT	LF	380
772	0270	3IN DIAMETER RIGID CONDUIT	LF	340
772	0290	4IN DIAMETER RIGID CONDUIT	LF	380
772	0375	EMERGENCY VEHICLE DETECTOR CABLE	LF	1060
772	0432	NO14 AWG 2 CONDUCTOR CABLE	LF	1660
772	0433	NO14 AWG 3 CONDUCTOR CABLE	LF	4290
772	0437	NO14 AWG 7 CONDUCTOR CABLE	LF	670
772	0442	NO14 AWG 12 CONDUCTOR CABLE	LF	2520
772	0601	TYPE II SIGNAL STANDARD	EA	1
772	0653	TYPE IV SIGNAL STD 53FT MA	EA	1
772	1223	COMBO 52FT MA SIG & LT STD-TYPE C	EA	1
772	1232	COMBO 53FT MA SIG & LT STD-TYPE C	EA	1
772	1812	1-WAY 3 SEC HEAD W/12IN LENS-MA MTD	EA	6
772	1820	1-WAY 4 SEC HEAD W/12IN LENS-POST MTD	EA	4
772	1822	1-WAY 4 SEC HEAD W/12IN LENS-MA MTD	EA	4
772	1830	1-WAY 5 SEC HEAD W/12IN LENS-POST MTD	EA	4
772	2060	PEDESTRIAN COUNTDOWN SIGNAL HEAD-POST MTD	EA	6
772	2061	PEDESTRIAN COUNTDOWN SIGNAL HEAD-PEDESTAL MTD	EA	2
772	2070	LAW ENFORCEMENT CONFIRMATION LIGHT	EA	8
772	2200	PEDESTRIAN PUSHBUTTON POST	EA	7
772	2215	PEDESTRIAN PUSHBUTTON & SIGN	EA	8
772	2260	VIDEO DETECTION CABLE	LF	1100
772	2265	VIDEO DETECTION SYSTEM	EA	1
772	2556	BATTERY BACKUP SYSTEM	EA	1
772	2610	EMERGENCY VEHICLE PREEMPTION UNIT	EA	4
772	2621	EMERGENCY VEHICLE PRE-EMPTION PHASE SELECTOR	EA	1
772	3125	REMOVE TRAFFIC SIGNAL SYSTEM	EA	1
		TYPE IV SIGNAL STD 60FT MA	EA	1
		36"X36" LED SIGN - "NO TURN ON RED"	EA	4
		CONTROLLER AND CABINET	EA	1
772	9813	TRAFFIC SIGNAL SYSTEM - SITE 3	EA	1
		The items appear above for informational purposes; provide all labor and equipment necessary for the signal system to be fully operational as shown in the Plans. Include items in the corresponding price bid for "TRAFFIC SIGNAL SYSTEM - SITE 3"		

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Traffic Signal System - Site 3
Estimated Traffic Signal Quantities

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

38th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	36

Sta. 2142+97.24
87.16' LT
Remove Exist. PB

Sta. 2143+10.94
82.43' LT
Remove Signal Std. Pole

Sta. 2143+29.40
80.65' LT
Remove Exist.
Controller and Cabinet

Sta. 2143+43.81
81.35' LT
Remove Exist. Feed Point

Sta. 2143+27.84
54.88' LT
Remove Exist. PB

Sta. 2142+27.02
89.66' LT
Remove Exist. PB

Sta. 2142+38.73
60.84' LT
Salvage/Remove PPP

Sta. 2142+31.96
46.34' LT
Remove Signal Std. Pole

Sta. 2142+29.70
6.00' LT
Salvage/Remove PPP

Sta. 2143+24.78
5.48' RT
Salvage/Remove PPP

S 34th St
(30 mph)

32nd Ave S
(40 mph)

2140 2141 2142 2143 2144 2145

Sta. 2142+22.87
5.33' LT
Remove Exist. PB

Sta. 2143+29.10
5.16' RT
Remove Exist. PB

Sta. 2143+27.54
50.64' RT
Remove Exist. PB

Sta. 2143+21.28
55.00' RT
Remove Signal Std. Pole

Sta. 2143+01.62
83.72' RT
Remove Exist. PB

Sta. 2142+30.37
73.85' RT
Remove Signal Std. Pole

Sta. 2142+45.71
82.82' RT
Remove Exist. PB

Legend

- Existing Signal Standard
- Existing Pull Box
- Existing Controller and Cabinet
- Existing Signal Mast Arm
- Existing Signal Head
- Existing Feed Point

Notes:
1. All stations and offsets are referenced from SCL81 alignment.
2. Abandon all conduit and remove all cable related to existing traffic signal system.

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Traffic Signal System - Site 4
Traffic Signal Removal

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	37

Signal Standard Foundation Table		
Description	Footing Depth "D" 24" & 30" Diameters (FT)	Footing Depth "D" 36" & 42" Diameters (FT)
Combination Signal & Light Std. 40' Mounting Height		
S1 - Single 54' MA	18,17	16,16
S2 - Single 53' MA	18,17	16,16
S3 - Single 53' MA	18,17	16,16
S4 - Single 51' MA	17,16	16,16

Legend
- (5) Signal Head Number
- P6 Pedestrian Head Number
- Signal Mast Arm
- Controller and Cabinet
- Existing Feed Point
- Luminaire Unit

S 34th St (30 mph)

Sta. 2143+24.76
87.06' LT
Conc. Signal Fnd. -S1
Std.- 54' MA

Controller and Cabinet
Econolite 332D
Sta. 2143+62.57
91.41' LT
(Center of Cabinet)

Feed Point
Sta. 2143+69.98
91.98' LT
(Center of Feed Point)

Note:
All stations and offsets are referenced from SCL81 alignment.

R/W

Sta. 2142+48.46
64.83' LT
Ped Btn #8

Sta. 2142+34.25
52.46' LT
Conc. Signal Fnd. -S4
Std.- 51' MA

Sta. 2142+32.71
46.31' LT
Ped Btn #7

Sta. 2143+16.72
79.06' LT
Ped Btn #1

Sta. 2143+24.75
67.48' LT
Ped Btn #2

32nd Ave S
(40 mph)

2140 2141 2142 2143 2144 2145

Sta. 2143+25.90
54.05' RT
Conc. Signal Fnd. -S2
Std.- 53' MA

Sta. 2142+20.49
76.88' RT
Ped Btn #5

Sta. 2143+21.02
65.90' RT
Ped Btn #3

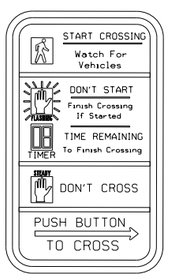
Sta. 2142+13.35
69.69' RT
Ped Btn #6

Sta. 2143+14.89
71.84' RT
Ped Btn #4

Sta. 2142+14.33
85.32' RT
Conc. Signal Fnd. -S3
Std.- 53' MA

Utility Easement

Pedestrian Pushbutton Schedule			
Pushbutton Number	Pushbutton Location	Pushbutton & Signal Location on Pole	Direction of Arrow on Sign
1	Pushbutton Post 1	S	Left
2	Pushbutton Post 2	W	Right
3	Pushbutton Post 3	W	Left
4	Pushbutton Post 4	N	Right
5	Pushbutton Post 5	N	Left
6	Pushbutton Post 6	E	Right
7	Pushbutton Post 7	E	Left
8	Pushbutton Post 8	N	Left



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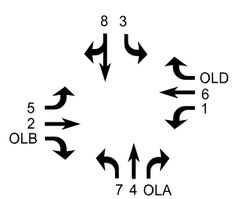
Phase Diagram



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Traffic Signal System - Site 4
Traffic Signal Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

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STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	38

S 34th St
(30 mph)

N

Legend
- Pull Box
- 2 — Conduit Run Number (see sheet 44 for more information)
- Controller and Cabinet
- Existing Feed Point

Note:
All stations and offsets are referenced from SCL81 alignment.

Sta. 2143+13.83
90.12' LT
Pull Box 1

Conc. Signal Fnd. -S1

Controller and Cabinet

Feed Point

R/W

Ped Btn #8

Sta. 2142+35.77
55.66' LT
Pull Box 6

Conc. Signal Fnd. -S4

Reconnect existing street lighting circuit (No. 1) from signal luminaire via direct buried lighting cable to nearest existing lighting unit (approx. 135')

Ped Btn #7

Ped Btn #1

Ped Btn #2

Reconnect existing street lighting circuit (No. 2) from signal luminaire via direct buried lighting cable to nearest existing lighting unit (approx. 420')

Sta. 2143+54.30
72.23' LT
Pull Box 2

32nd Ave S
(40 mph)

2140 2141 2142 2143 2144 2145

32nd Ave S
(40 mph)

Conc. Signal Fnd. -S2

Ped Btn #3

Ped Btn #4

Ped Btn #5

Ped Btn #6

Reconnect existing street lighting circuit (No. 1) from signal luminaire via direct buried lighting cable to nearest existing lighting unit (approx. 270')

Sta. 2142+00.03
86.73' RT
Pull Box 5

Sta. 2143+48.50
56.36' RT
Pull Box 3

Reconnect existing street lighting circuit (No. 2) from signal luminaire via direct buried lighting cable to nearest existing lighting unit (approx. 240')

Utility Easement

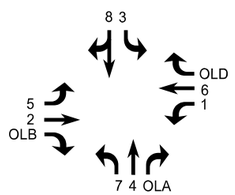
R/W

Conc. Signal Fnd. -S3

Sta. 2143+08.49
84.33' RT
Pull Box 4

S 34th St
(30 mph)

Phase Diagram



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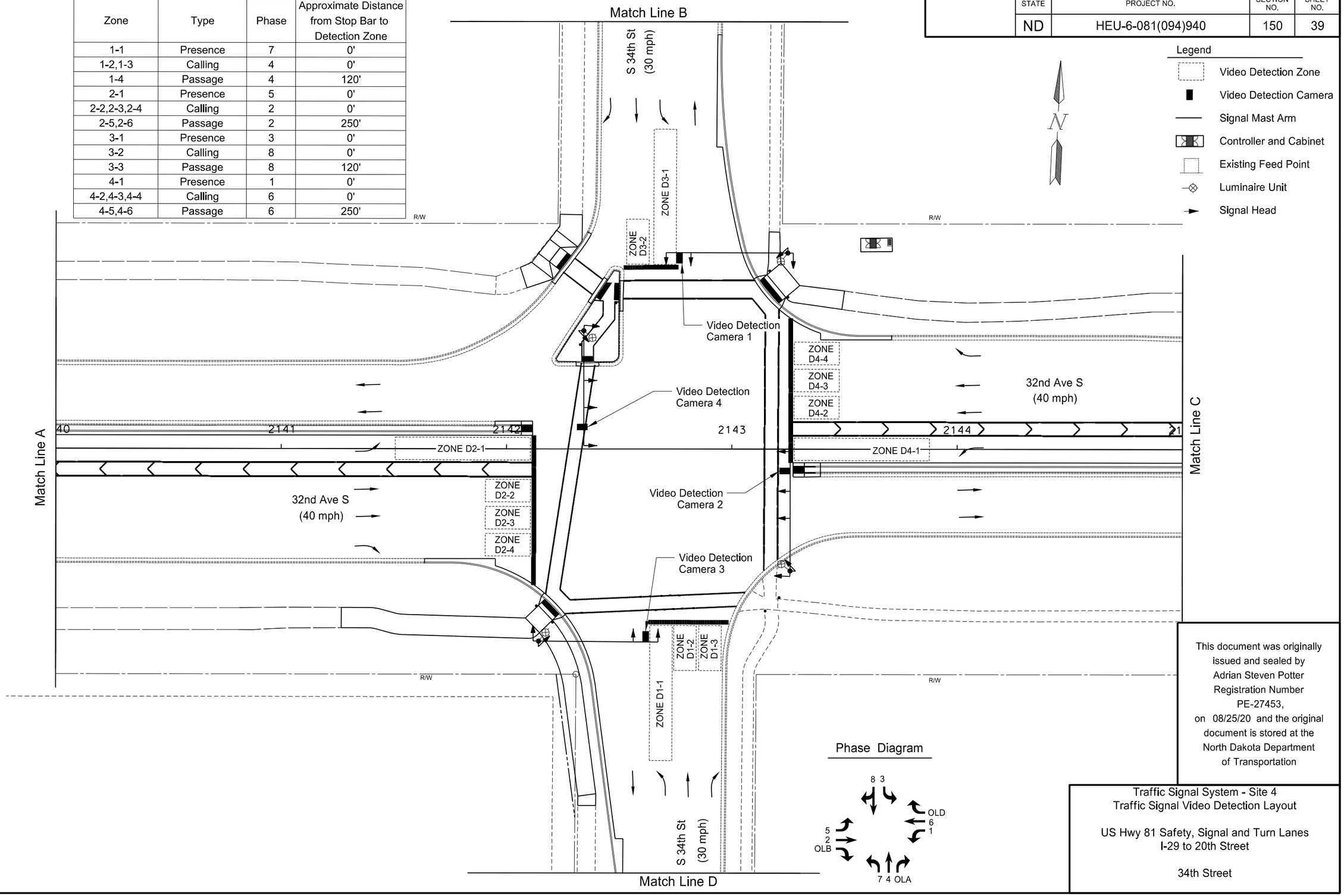
Traffic Signal System - Site 4
Conduit/Conductor Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	39

Zone	Type	Phase	Approximate Distance from Stop Bar to Detection Zone
1-1	Presence	7	0'
1-2,1-3	Calling	4	0'
1-4	Passage	4	120'
2-1	Presence	5	0'
2-2,2-3,2-4	Calling	2	0'
2-5,2-6	Passage	2	250'
3-1	Presence	3	0'
3-2	Calling	8	0'
3-3	Passage	8	120'
4-1	Presence	1	0'
4-2,4-3,4-4	Calling	6	0'
4-5,4-6	Passage	6	250'



Legend

- Video Detection Zone
- Video Detection Camera
- Signal Mast Arm
- Controller and Cabinet
- Existing Feed Point
- Luminaire Unit
- Signal Head

Phase Diagram

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Traffic Signal System - Site 4
Traffic Signal Video Detection Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

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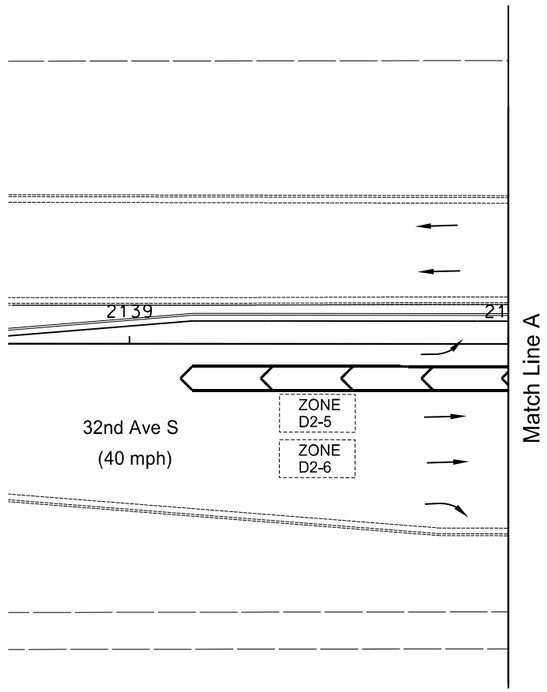
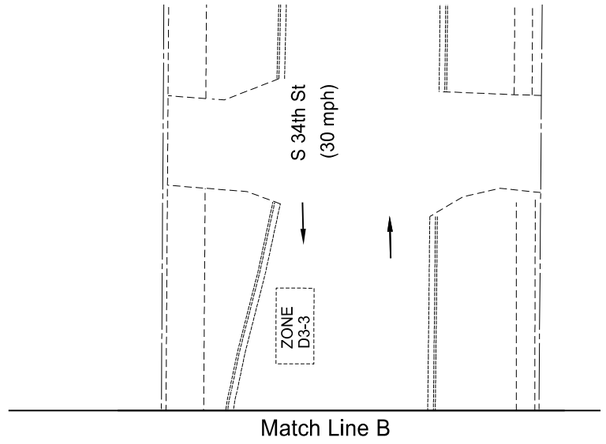
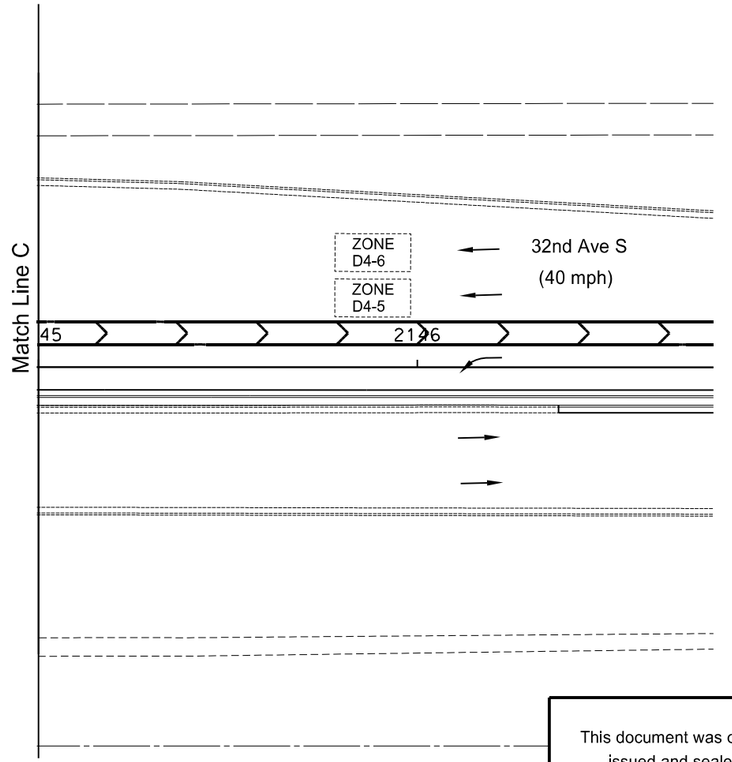
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	40

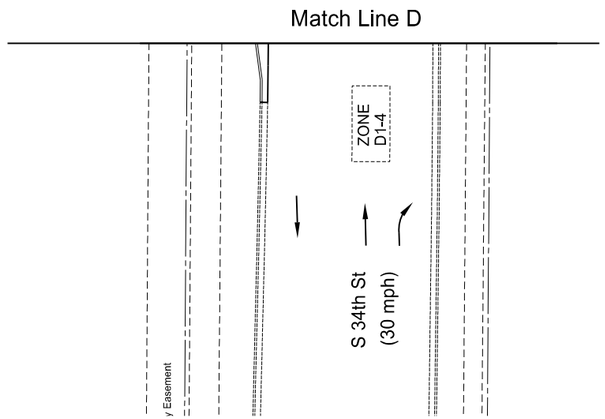




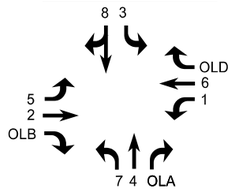
Legend

Video Detection Zone





Phase Diagram



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Traffic Signal System - Site 4
Traffic Signal Video Detection Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

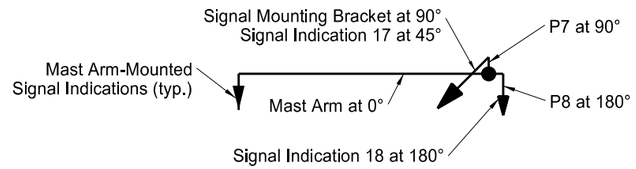
34th Street

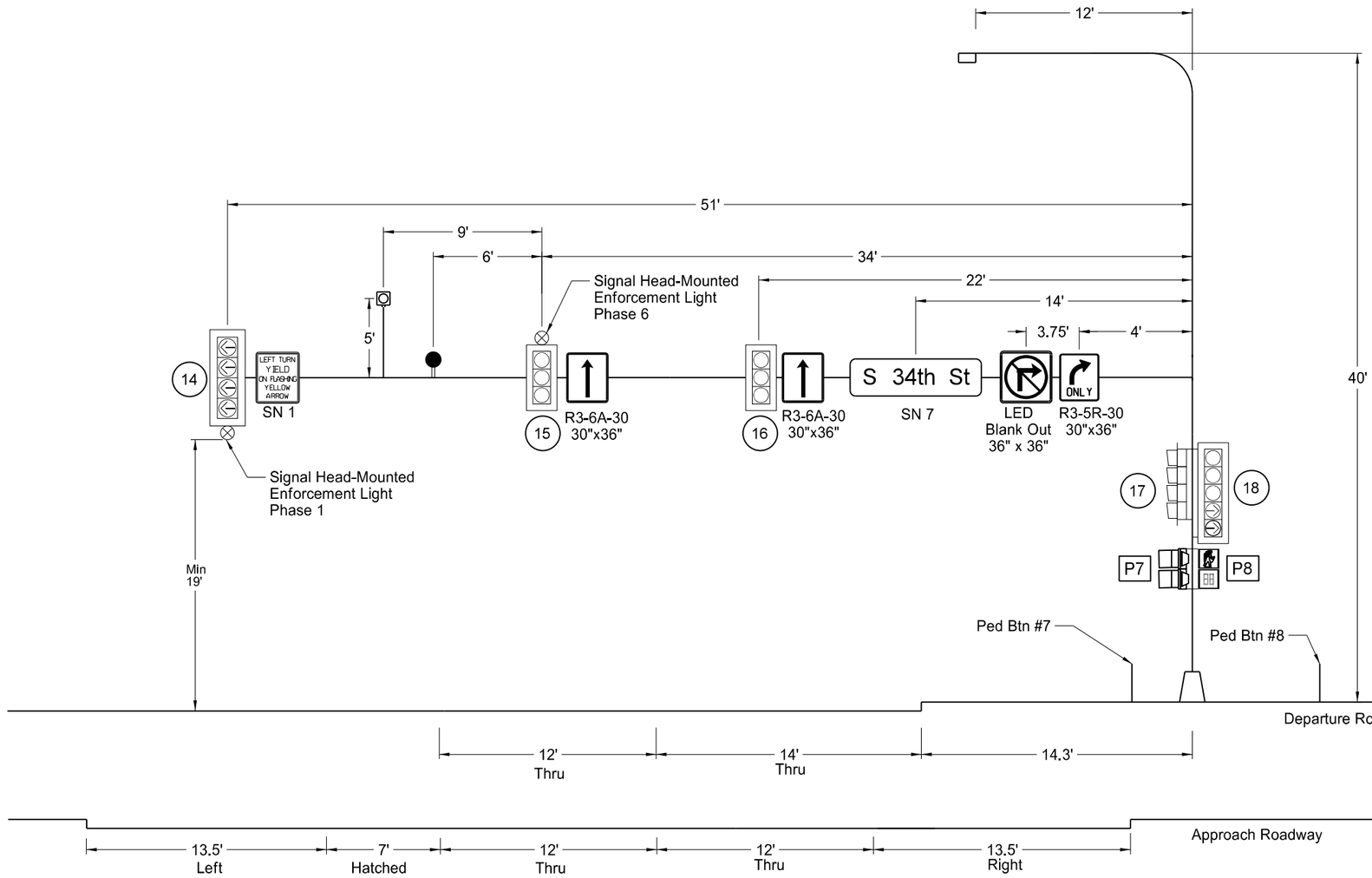
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	41

Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Westbound 32nd Avenue South
(S4)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- X — Vehicle Signal Head Number
- PX — Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 4
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

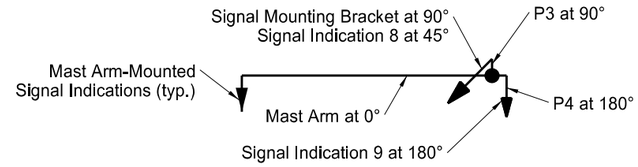
34th Street

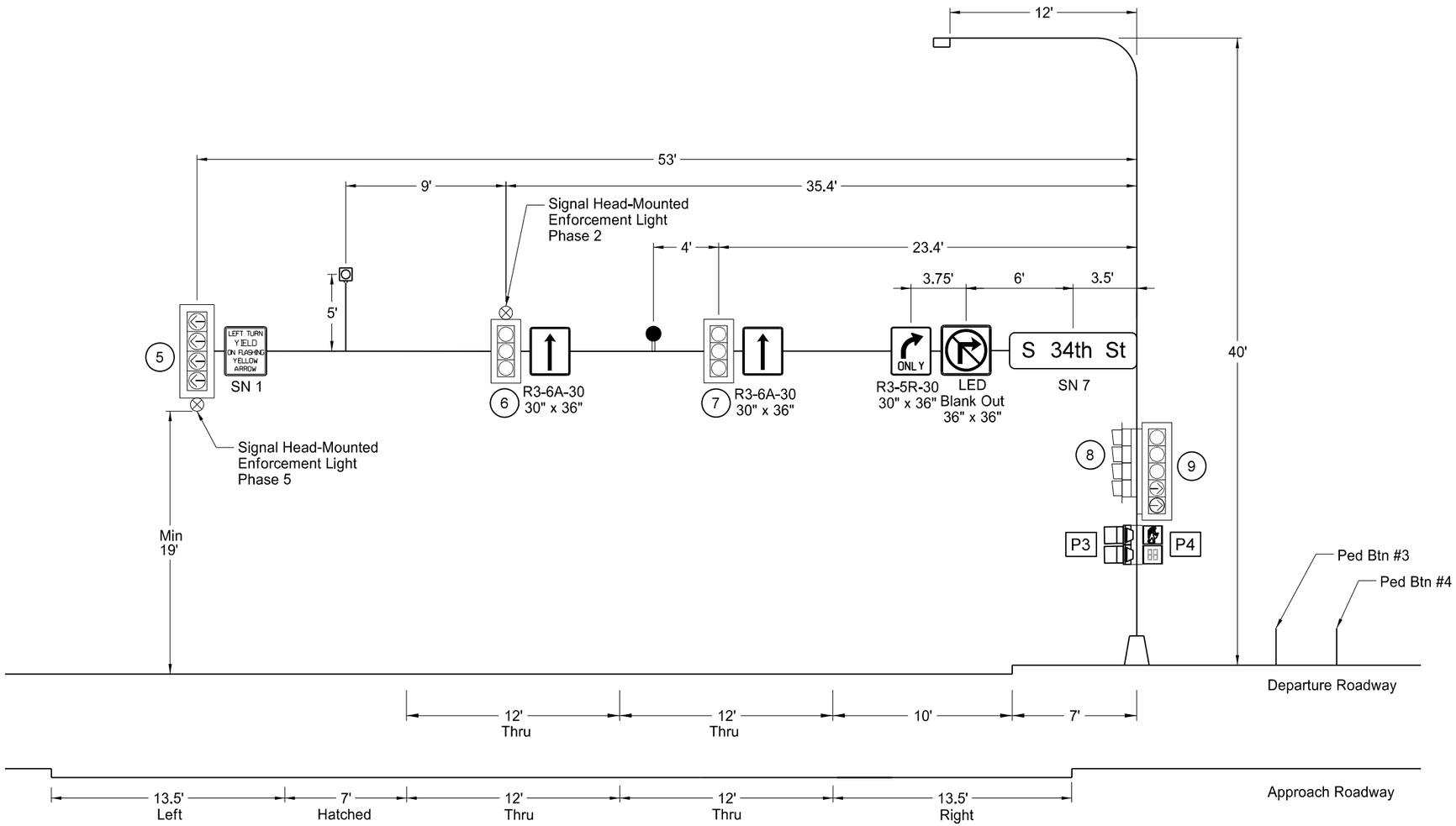
Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	42

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Eastbound 32nd Avenue South
(S2)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

This document was originally issued and sealed by Adrian Steven Potter Registration Number PE-27453, on 08/28/20 and the original document is stored at the North Dakota Department of Transportation

Traffic SIgnal System - Site 4
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

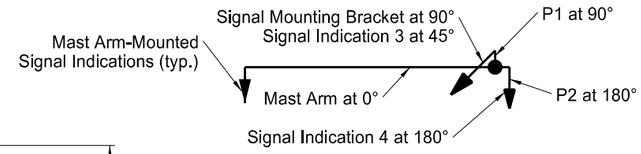
34th Street

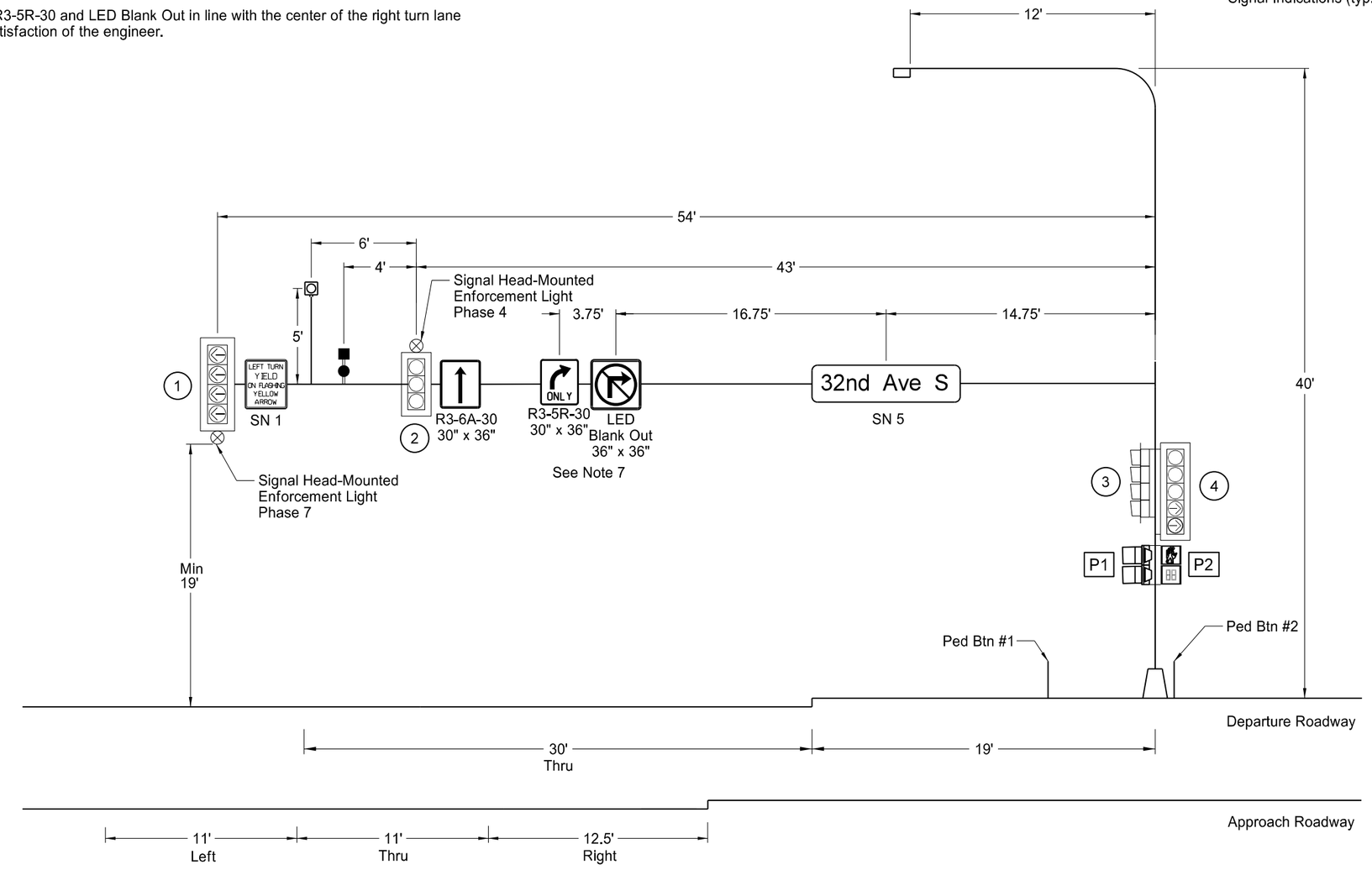
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	43

Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Determine the final location of the Emergency Vehicle Preemption GPS detector to provide a functional system.
5. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
6. See Section 110 for sign details.
7. Place signs R3-5R-30 and LED Blank Out in line with the center of the right turn lane and to the satisfaction of the engineer.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Northbound South 34th Street
(S1)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- Emergency Vehicle Preemption GPS Detector and Light
- Enforcement Light

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Traffic Signal System - Site 4
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

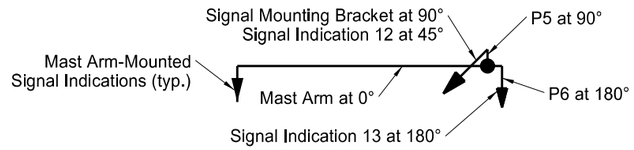
34th Street

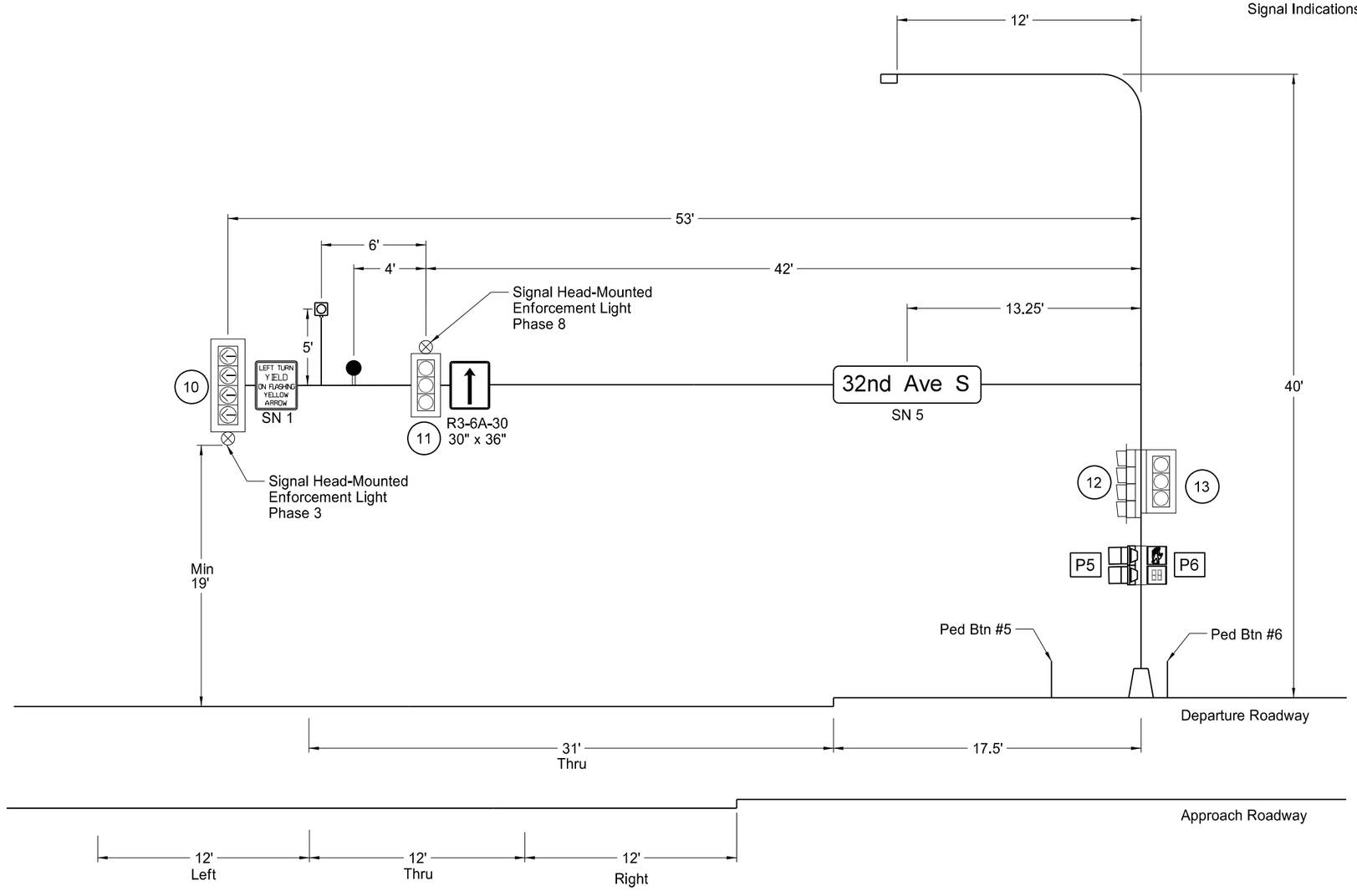
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	44

Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Southbound South 34th Street
(S3)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 4
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	45

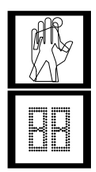
Conductor			Cable 1 (No.14 AWG 12)			Cable 2 (No.14 AWG 12)			Cable 3 (No.14 AWG 7)			Cable 4 (No.14 AWG 12)			Cable 5 (No.14 AWG 12)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		2,4	4	Green	3	5	Green LT Arrow	P1	6	Don't Walk	6,7	2	Green	8	3	Green LT Arrow
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		2,4	4	Red	3	5	Red LT Arrow	P1	6	Walk	6,7	2	Red	8	3	Red LT Arrow
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		2,4	4	Yellow	3	5	Yellow LT Arrow	P2	4	Don't Walk	6,7	2	Yellow	8	3	Yellow LT Arrow
6	Blue				Spare	3	5	Flashing Yellow LT Arrow	P2	4	Walk			Spare	8	3	Flashing Yellow LT Arrow
7	White	Black			Spare			Spare			Spare			Spare			Spare
8	Red	Black			Spare	1	7	Red LT Arrow				5	5	Red LT Arrow			Neutral
9	Green	Black			Spare			Spare						Spare	P3	4	Walk
10	Orange	Black	4	1 OLA	Yellow RT Arrow	1	7	Yellow LT Arrow				5	5	Yellow LT Arrow			Spare
11	Blue	Black			Spare	1	7	Flashing Yellow LT Arrow				5	5	Flashing Yellow LT Arrow	P3	4	Don't Walk
12	Black	White	4	1 OLA	Green RT Arrow	1	7	Green LT Arrow				5	5	Green LT Arrow			Spare

Conductor			Cable 6 (No.14 AWG 12)			Cable 7 (No.14 AWG 12)			Cable 8 (No.14 AWG 12)			Cable 9 (No.14 AWG 7)			Cable 10 (14 No.12 AWG)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		9	2	Green	11,13	8	Green	10	3	Green LT Arrow	P5	2	Don't Walk	15,16,18	6	Green
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		9	2	Red	11,13	8	Red	10	3	Red LT Arrow	P5	2	Walk	15,16,18	6	Red
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		9	2	Yellow	11,13	8	Yellow	10	3	Yellow LT Arrow	P6	8	Don't Walk	15,16,18	6	Yellow
6	Blue		9	7 OLB	Yellow RT Arrow			Spare	10	3	Flashing Yellow LT Arrow	P6	8	Walk			Spare
7	White	Black	9	7 OLB	Green RT Arrow			Spare			Spare			Spare			Spare
8	Red	Black			Neutral			Spare	12	1	Red LT Arrow						Spare
9	Green	Black	P4	2	Walk			Spare			Spare						Spare
10	Orange	Black			Spare			Spare	12	1	Yellow LT Arrow				18	3 OLD	Yellow RT Arrow
11	Blue	Black	P4	2	Don't Walk			Spare	12	1	Flashing Yellow LT Arrow						Spare
12	Black	White			Spare			Spare	12	1	Green LT Arrow				18	3 OLD	Green RT Arrow

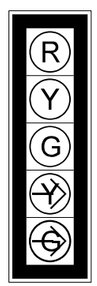
Conductor			Cable 11 (No.14 AWG 12)			Cable 12 (No.14 AWG 7)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication
1	Black		14	1	Green LT Arrow	P7	8	Don't Walk
2	White				Neutral			Neutral
3	Red		14	1	Red LT Arrow	P7	8	Walk
4	Green				Ground			Ground
5	Orange		14	1	Yellow LT Arrow	P8	6	Don't Walk
6	Blue		14	1	Flashing Yellow LT Arrow	P8	6	Walk
7	White	Black			Spare			Spare
8	Red	Black	17	7	Red LT Arrow			
9	Green	Black			Spare			
10	Orange	Black	17	7	Yellow LT Arrow			
11	Blue	Black	17	7	Flashing Yellow LT Arrow			
12	Black	White	17	7	Green LT Arrow			

Notes:

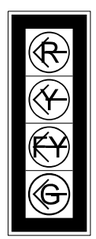
1. Use LED indications for all heads.
2. Use 5" Louvered Black Plate with Type XI Yellow Reflective Border (typ.) on all heads.



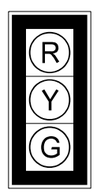
(12" Lenses)
Heads P1, P2, P3,
P4, P5, P6, P7, P8



(12" Lenses)
Heads 4,9,18



(12" Lenses)
Heads 1, 3, 5, 8,10
12,14,17



(12" Lenses)
Heads 2, 6,7,
11,13,15,16

LED Blank Out Sign (36" x 36")
Use white LEDs for arrow
Use red LEDs for prohibition symbol

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Traffic Signal System - Site 4
Signal Heads & Conductor Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	46

Conduit Run	Location	Conduit Run		Cable Run			
		Length	Size	Length	Code	QTY	Type
1	Controller to Pull Box 2	21	4"	60	A	2	No. 14 AWG 3 Conductor Cable
				60	B	2	Emergency Detector Cable
				150	C	5	Cable 4,5,6,7,8
				30	C	1	Cable 9
				150	C	5	Push Button
				60	D	2	Video Detector Cable
				120	F	4	No. 14 AWG 3 Conductor Cable
				30	K	1	Electronic Sign
2	Pull Box 2 to Ped Push Btn. #2	30	2"	38	C	1	Push Button
3A	Pull Box 2 to Pull Box 3	129	4"	270	A	2	No. 14 AWG 3 Conductor Cable
				270	B	2	Emergency Detector Cable
				675	C	5	Cable 4,5,6,7,8
				135	C	1	Cable 9
				540	C	4	Push Button
				270	D	2	Video Detector Cable
				540	F	4	No. 14 AWG 3 Conductor Cable
				135	K	1	Electronic Sign
3B	Pull Box 2 to Pull Box 3	129	4"	Empty conduit for future use			
4	Pull Box 3 to Signal Std. - S2	23	3"	79	A	1	No. 14 AWG 3 Conductor Cable
				79	B	1	Emergency Detector Cable
				312	C	3	Cable 4,5,6
				96	D	1	Video Detector Cable
				208	F	2	No. 14 AWG 3 Conductor Cable
				66	K	1	Electronic Sign
5	Pull Box 3 to Ped Push Btn. #3	29	2"	37	C	1	Push Button
6	Pull Box 3 to Ped Push Btn. #4	37	2"	45	C	1	Push Button
7	Pull Box 3 to Pull Box 4	49	3"	55	A	1	No. 14 AWG 3 Conductor Cable
				55	B	1	Emergency Detector Cable
				110	C	2	Cable 7,8
				55	C	1	Cable 9
				110	C	2	Push Button
				55	D	1	Video Detector Cable
				110	F	2	No. 14 AWG 3 Conductor Cable
8	Pull Box 4 to Pull Box 5	109	3"	115	A	1	No. 14 AWG 3 Conductor Cable
				115	B	1	Emergency Detector Cable
				230	C	2	Cable 7,8
				115	C	1	Cable 9
				230	C	2	Push Button
				115	D	1	Video Detector Cable
				230	F	2	No. 14 AWG 3 Conductor Cable
9	Pull Box 5 to Signal Std. - S3	15	3"	89	A	1	No. 14 AWG 3 Conductor Cable
				89	B	1	Emergency Detector Cable
				192	C	2	Cable 7,8
				32	C	1	Cable 9
				91	D	1	Video Detector Cable
				192	F	2	No. 14 AWG 3 Conductor Cable

Conduit Run	Location	Conduit Run		Cable Run			
		Length	Size	Length	Code	QTY	Type
10	Pull Box 5 to Ped Push Btn. #5	23	2"	31	C	1	Push Button
11	Pull Box 5 to Ped Push Btn. #6	22	2"	30	C	1	Push Button
12	Ped Push Btn. #7 to Pull Box 6	12	2"	20	C	1	Push Button
13	Signal Std. - S4 to Pull Box 6	13	3"	77	A	1	No. 14 AWG 3 Conductor Cable
				77	B	1	Emergency Detector Cable
				176	C	2	Cable 10,11
				30	C	1	Cable 12
				80	D	1	Video Detector Cable
				176	F	2	No. 14 AWG 3 Conductor Cable
				51	K	1	Electronic Sign
14	Ped Push Btn. #8 to Pull Box 6	22	2"	30	C	1	Push Button
15	Pull Box 6 to Pull Box 1	83	3"	89	A	1	No. 14 AWG 3 Conductor Cable
				89	B	1	Emergency Detector Cable
				178	C	2	Cable 10,11
				89	C	1	Cable 12
				178	C	2	Push Button
				89	D	1	Video Detector Cable
				178	F	2	No. 14 AWG 3 Conductor Cable
				89	K	1	Electronic Sign
16	Ped Push Btn. #1 to Pull Box 1	15	2"	23	C	1	Push Button
17	Signal Std. - S1 to Pull Box 1	14	3"	89	A	1	No. 14 AWG 3 Conductor Cable
				89	B	1	Emergency Detector Cable
				192	C	2	Cable 1,2
				31	C	1	Cable 3
				91	D	1	Video Detector Cable
				192	F	2	No. 14 AWG 3 Conductor Cable
				72	K	1	Electronic Sign
18	Pull Box 1 to Controller	50	4"	118	A	2	No. 14 AWG 3 Conductor Cable
				118	B	2	Emergency Detector Cable
				236	C	4	Cable 1,2,10,11
				118	C	2	Cable 3,12
				177	C	3	Push Button
				118	D	2	Video Detector Cable
				236	F	4	No. 14 AWG 3 Conductor Cable
				118	K	2	Electronic Sign
19	Controller to Feed Point	8	2"	18	E	1	Mult 3 No. 6 USE

Cable Code

A = Emergency Vehicle Indicator Lamp
B = Emergency Vehicle Detector Cable
C = Signal Control Cable
D = Video Detection Cable
E = Power Cable
F = Enforcement Light Cable
K = Electronic Sign Cable

Note:
All conduit and cable lengths are in feet.

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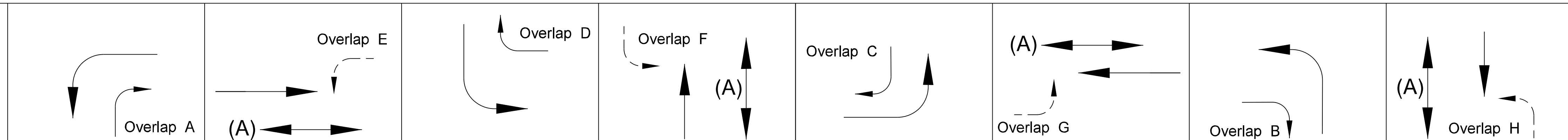
Traffic Signal System - Site 4
Conduit Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	47



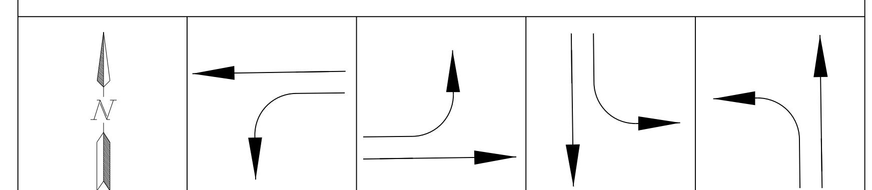
Head #	Phase 1 R/W	Phase 1 Clear to Phase							Phase 2 R/W	Phase 2 Clear to Phase							Phase 3 R/W	Phase 3 Clear to Phase							Phase 4 R/W	Phase 4 Clear to Phase						
	R/W	2	3	4	5	6	7	8	R/W	3	4	5	6	7	8	1	R/W	4	5	6	7	8	1	2	R/W	5	6	7	8	1	2	3
1																																
2																									G	Y	Y	(B)	(B)	Y	Y	Y
3																																
4	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→																	G	Y	Y	(B)	(B)	Y	Y	Y
5																																
6									G	Y	Y	(B)	(B)	Y	Y	Y																
7									G	Y	Y	(B)	(B)	Y	Y	Y																
8																	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
9									G	Y	Y	(B)	(B)	Y	Y	Y																
10																	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
11																																
12	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)																
13																																
14	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)																
15																																
16																																
17																																
18																	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								

Head #	Phase 5 R/W	Phase 5 Clear to Phase							Phase 6 R/W	Phase 6 Clear to Phase							Phase 7 R/W	Phase 7 Clear to Phase							Phase 8 R/W	Phase 8 Clear to Phase						
	R/W	6	7	8	1	2	3	4	R/W	7	8	1	2	3	4	5	R/W	8	1	2	3	4	5	6	R/W	1	2	3	4	5	6	7
1																	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
2																																
3	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)																
4																																
5	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)																
6																																
7																																
8																																
9																	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								
10																																
11																									G	Y	Y	(B)	(B)	Y	Y	Y
12																																
13																									G	Y	Y	(B)	(B)	Y	Y	Y
14																																
15									G	Y	Y	(B)	(B)	Y	Y	Y																
16									G	Y	Y	(B)	(B)	Y	Y	Y																
17																	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
18									G	Y	Y	(B)	(B)	Y	Y	Y																

Blank Squares Denote Red Indication
(A) = Pedestrian movements, upon activation.
(B) = When one phase is on alone a nonconflicting phase may start timing concurrently without a clearance interval (See Chart A).
(C) = Flashing yellow left turn arrow (protected/permissive mode and permissive only mode).
(D) = Solid yellow left turn arrow (protected/permissive mode and permissive only mode).

Protected Movement
Permitted Movement
Pedestrian Actuated Movement

Emergency Vehicle Preemption Phasing



Direction	Westbound	Eastbound	Southbound	Northbound
Dwell Phases	1,6	2,5	3,8	4,7
Dwell Overlaps	OLJ	OLK	OLI	-

Chart B
Overlaps

Overlap	Protected Phase	Ped Protect Phases
A	1	-
B	7	-
C	-	-
D	3	-

Chart A
Non-Conflicting Phases

On Phase	Non-Conflicting Phase Allowed to Time Concurrently
1	5 or 6
2	5 or 6
3	7 or 8
4	7 or 8
5	1 or 2
6	1 or 2
7	3 or 4
8	3 or 4

Chart C
Special Overlaps
(Flashing Yellow Left Turn Arrows)

Overlap	Protected Phase	Permissive Phase
E	1	2
F	3	4
G	5	6
H	7	8

Chart D
No Turn on Red Sign Activation Overlaps

Overlap	Direction of vehicular travel - Signal Std.	Conflicting Left Turn Phase	Parallel Pedestrian Phase	Perpendicular Pedestrian Phase
I	Northbound - S1	3	4 Ped	2 Ped
J	Eastbound - S2	1	2 Ped	8 Ped
K	Westbound - S4	5	6 Ped	4 Ped

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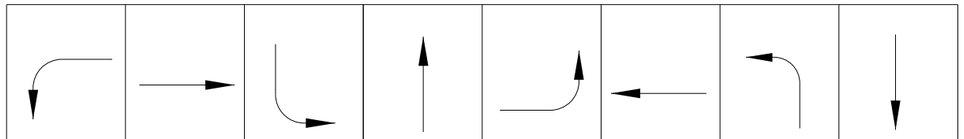
Traffic Signal System - Site 4
Signal Controller Phasing

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	48



	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
	WBLT	EB	SBLT	NB	EBLT	WB	NBLT	SB
BASIC INTERVALS (OR FUNCTIONS)								
Minimum Initial	5.0	15.0	5.0	10.0	5.0	15.0	5.0	10.0
Vehicle Extension	1.5	5.0	1.5	5.0	1.5	5.0	1.5	5.0
Maximum Green (Max 1)	40.0	60.0	40.0	60.0	40.0	60.0	40.0	60.0
Yellow Change	3.5	4.0	3.5	3.5	3.5	4.0	3.5	3.5
Red Clearance	2.0	1.0	2.5	2.5	2.0	1.0	2.0	2.5
Walk	-	7.0	-	7.0	-	7.0	-	7.0
Pedestrian Clearance	-	21.0	-	32.0	-	15.0	-	28.0
Delayed Green (Leading Pedestrian Interval)	-	6.0	-	6.0	-	6.0	-	6.0
VOLUME DENSITY TIMING FUNCTIONS								
VARIABLE INITIAL TIMING OPTIONS								
Actuations Before Added Initial	-	-	-	-	-	-	-	-
Added Initial per Actuation	-	-	-	-	-	-	-	-
Maximum Initial	-	-	-	-	-	-	-	-
GAP REDUCTION OPTIONS								
Time Before Reduction	-	20.0	-	-	-	20.0	-	-
Time to Reduce to Minimum Gap	-	20.0	-	-	-	20.0	-	-
Minimum Gap	-	2.5	-	-	-	2.5	-	-
OTHER CONTROLLER FUNCTIONS								
Locking Memory	-	x	-	x	-	x	-	x
Non-Locking Memory	x	-	x	-	x	-	x	-
Phase recall	-	x	-	-	-	x	-	-
Red Revert	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Backup Prevent Phases	-	-	-	-	-	-	-	-
No Serve Phases	-	-	-	-	-	-	-	-
Flashing-Normal & Conflict Monitor	R	R	R	R	R	R	R	R

Notes:
1. Operate all left turn phases as either leading or lagging phases.
2. Operate all left turn phases either in protected, protected/permissive, or permissive mode.

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Traffic Signal System - Site 4
Signal Timing Settings

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	49

SPEC	CODE	ITEM DESCRIPTION	UNIT	TOTAL
770	0445	MULTIPLE UNDERGROUND CABLE 3NO6 STYLE USE	LF	20
770	0464	MULTIPLE UNDERGROUND CABLE 3NO4-1NO6 STYLE USE	LF	1310
770	4210	LED LUMINAIRE	EA	4
772	0020	CONCRETE FOUNDATION-TRAFFIC SIGNALS	EA	4
772	0100	PULL BOX	EA	6
772	0240	2IN DIAMETER RIGID CONDUIT	LF	250
772	0270	3IN DIAMETER RIGID CONDUIT	LF	350
772	0290	4IN DIAMETER RIGID CONDUIT	LF	350
772	0375	EMERGENCY VEHICLE DETECTOR CABLE	LF	1050
772	0432	NO14 AWG 2 CONDUCTOR CABLE	LF	1640
772	0433	NO14 AWG 3 CONDUCTOR CABLE	LF	3790
772	0437	NO14 AWG 7 CONDUCTOR CABLE	LF	640
772	0442	NO14 AWG 12 CONDUCTOR CABLE	LF	2460
772	0551	FEED POINT-COMBO LIGHTING & SIGNAL-PAD MOUNT	EA	1
772	1172	COMBO 47FT MA SIG & LT STD-TYPE C	EA	1
772	1242	COMBO 53FT MA SIG & LT STD-TYPE C	EA	2
772	1242	COMBO 54FT MA SIG & LT STD-TYPE C	EA	1
772	1812	1-WAY 3 SEC HEAD W/12IN LENS-MA MTD	EA	7
772	1820	1-WAY 4 SEC HEAD W/12IN LENS-POST MTD	EA	4
772	1822	1-WAY 4 SEC HEAD W/12IN LENS-MA MTD	EA	4
772	1830	1-WAY 5 SEC HEAD W/12IN LENS-POST MTD	EA	3
772	2060	PEDESTRIAN COUNTDOWN SIGNAL HEAD-POST MTD	EA	8
772	2070	LAW ENFORCEMENT CONFIRMATION LIGHT	EA	8
772	2200	PEDESTRIAN PUSHBUTTON POST	EA	7
772	2215	PEDESTRIAN PUSHBUTTON & SIGN	EA	8
772	2260	VIDEO DETECTION CABLE	LF	1070
772	2265	VIDEO DETECTION SYSTEM	EA	1
772	2556	BATTERY BACKUP SYSTEM	EA	1
772	2610	EMERGENCY VEHICLE PREEMPTION UNIT	EA	4
772	2621	EMERGENCY VEHICLE PRE-EMPTION PHASE SELECTOR	EA	1
		36"X36" LED SIGN - "NO TURN ON RED"	EA	3
		CONTROLLER AND CABINET	EA	1
772	9814	TRAFFIC SIGNAL SYSTEM - SITE 4	EA	1
		The items appear above for informational purposes; provide all labor and equipment necessary for the signal system to be fully operational as shown in the Plans. Include items in the corresponding price bid for "TRAFFIC SIGNAL SYSTEM - SITE 4"		

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Traffic Signal System - Site 4
Estimated Traffic Signal Quantities

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

34th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	50

Notes:
1. All stations and offsets are referenced from SCL81 alignment.
2. Abandon all conduit and remove all cable related to existing traffic signal syatem.

Legend
- Existing Signal Standard
- Existing Pull Box
- Existing Controller and Cabinet
- Existing Signal Mast Arm
- Existing Signal Head
- Existing Feed Point

Sta. 2152+88.40
77.49' LT
Remove Exist. PB

Sta. 2152+61.62
95.27' LT
Remove Exist.
Controller and Cabinet

Sta. 2152+56.74
105.85' LT
Remove Exist. Feed Point

Sta. 2152+84.10
74.67' LT
Remove Signal Std. Pedestal

Sta. 2152+61.07
42.21' LT
Remove Signal Std. Pole

Sta. 2153+72.97
77.66' LT
Remove Signal Std. Pole

Sta. 2154+06.02
65.43' LT
Remove Exist. PB

31st St
(15 mph)

R/W

E

FO

32nd Ave S
(40 mph)

2151 2152 2153 2154 2155 2156

Sta. 2153+80.27
41.90 RT'
Remove Signal Std. Pole

32nd Ave S
(40 mph)

10' Utility Easement

Sta. 2152+84.34
61.28' RT
Remove Exist. PB

Sta. 2152+83.90
67.25' RT
Remove Signal Std. Pole

31st St
(30 mph)

Sta. 2153+72.30
53.05' RT
Remove Exist. PB

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Traffic Signal System - Site 5
Traffic Signal Removal

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

31st Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	51

Signal Standard Foundation Table		
Description	Footing Depth "D" 24" & 30" Diameters (FT)	Footing Depth "D" 36" & 42" Diameters (FT)
Type II Signal Std.		
S2	4	3
S5	4	3
S7	4	3
Combination Signal & Light Std. 40' Mounting Height		
S1 - Single 53' MA	18,17	16,16
S3 - Single 58' MA	19,18	17,17
S4 - Single 51' MA	18,17	16,16
S6 - Single 57' MA	19,18	17,17

Legend
- (5) Signal Head Number
- P6 Pedestrian Head Number
- Signal Mast Arm
- Controller and Cabinet
- Feed Point
- Luminaire Unit

N

31st St (15 mph)

Pedestal Power Source
Exact location to be determined in field by power company

Sta. 2152+83.23
75.93' LT
Conc. Signal Fnd. -S2
Ped Btn #7

Sta. 2153+85.73
87.45' LT
Conc. Signal Fnd. -S3
Std.- 58' MA

R/W

Feed Point
Sta. 2152+53.36
77.17' LT
(Center of Feed Point)

Controller and Cabinet
Econolite 332D
Sta. 2152+60.78
77.68' LT
(Center of Cabinet)

Sta. 2153+78.81
79.67' LT
Ped Btn #2

Sta. 2152+61.25
54.64' LT
Conc. Signal Fnd. -S1
Std.- 53' MA

Sta. 2152+63.80
49.42' LT
Ped Btn #1

Sta. 2153+93.57
66.82' LT
Ped Btn #3

32nd Ave S
(40 mph)

2151 2152 2153 2154 2155 2156

Note:
All stations and offsets are referenced from SCL81 alignment.

32nd Ave S
(40 mph)

Sta. 2153+88.62
49.17' RT
Ped Btn #4

Sta. 2152+61.25
63.52' RT
Conc. Signal Fnd. -S7
Ped Btn #8

Sta. 2153+65.45
63.93' RT
Ped Btn #5

Sta. 2152+73.40
72.73' RT
Ped Btn #6

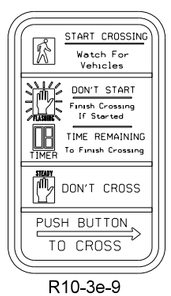
Sta. 2152+63.55
84.62' RT
Conc. Signal Fnd. -S6
Std.- 57' MA

Sta. 2153+92.11
51.99' RT
Conc. Signal Fnd. -S4
Std.- 51' MA

Sta. 2153+70.80
64.47' RT
Conc. Signal Fnd. -S5

R/W

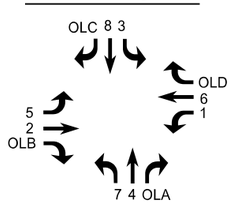
Pedestrian Pushbutton Schedule			
Pushbutton Number	Pushbutton Location	Pushbutton & Signal Location on Pole	Direction of Arrow on Sign
1	Pushbutton Post 1	E	Left
2	Pushbutton Post 2	S	Left
3	Pushbutton Post 3	W	Right
4	Pushbutton Post 4	W	Left
5	Pushbutton Post 5	N	Right
6	Pushbutton Post 6	N	Left
7	Type II Signal Pole S2	S	Right
8	Type II Signal Pole S7	E	Right



R10-3e-9

31st St (30 mph)

Phase Diagram



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Traffic Signal System - Site 5
Traffic Signal Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

31st Street

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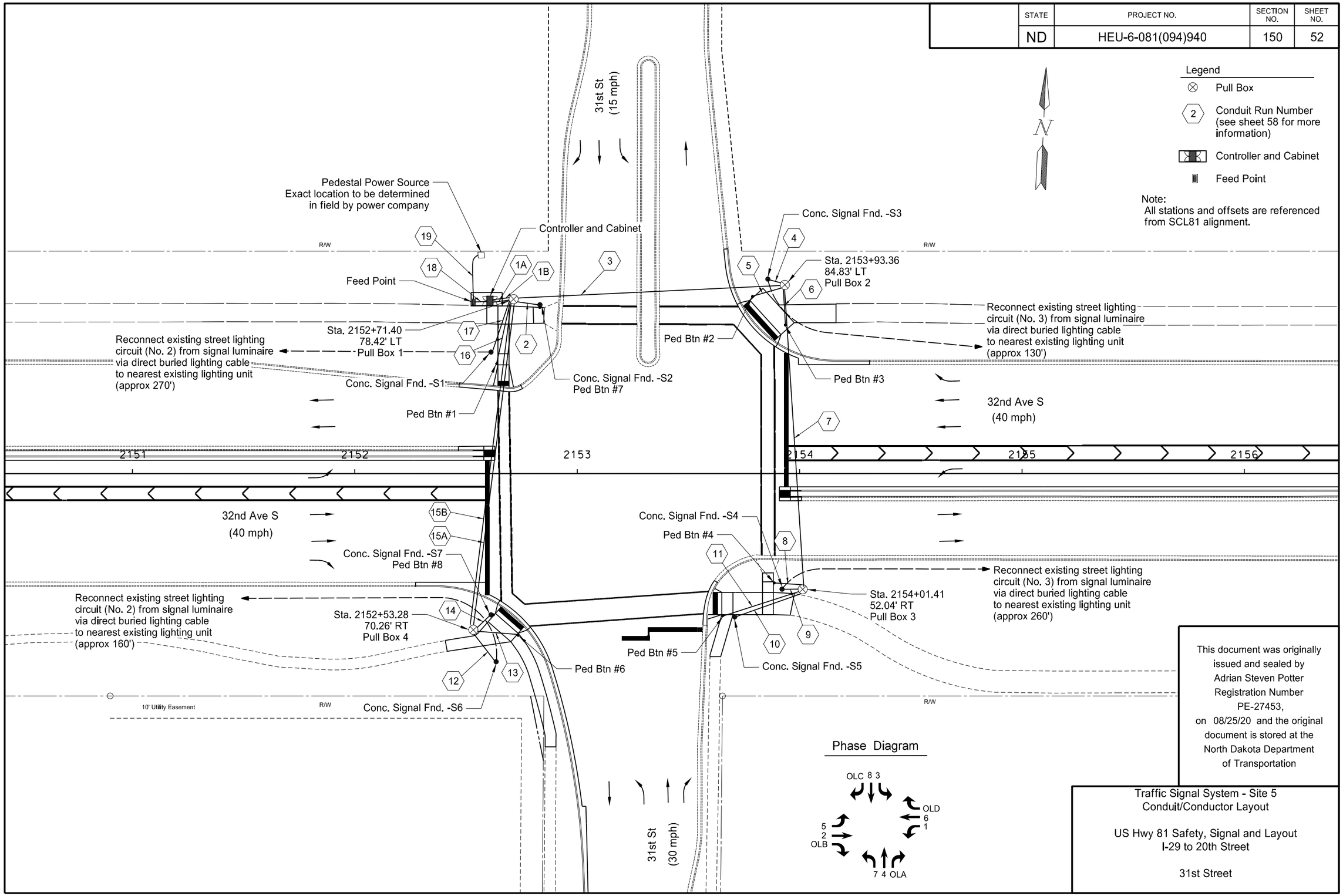
STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	52

Legend

- Pull Box
- 2 — Conduit Run Number (see sheet 58 for more information)
- Controller and Cabinet
- Feed Point

Note:
All stations and offsets are referenced from SCL81 alignment.



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Traffic Signal System - Site 5
Conduit/Conductor Layout

US Hwy 81 Safety, Signal and Layout
I-29 to 20th Street

31st Street

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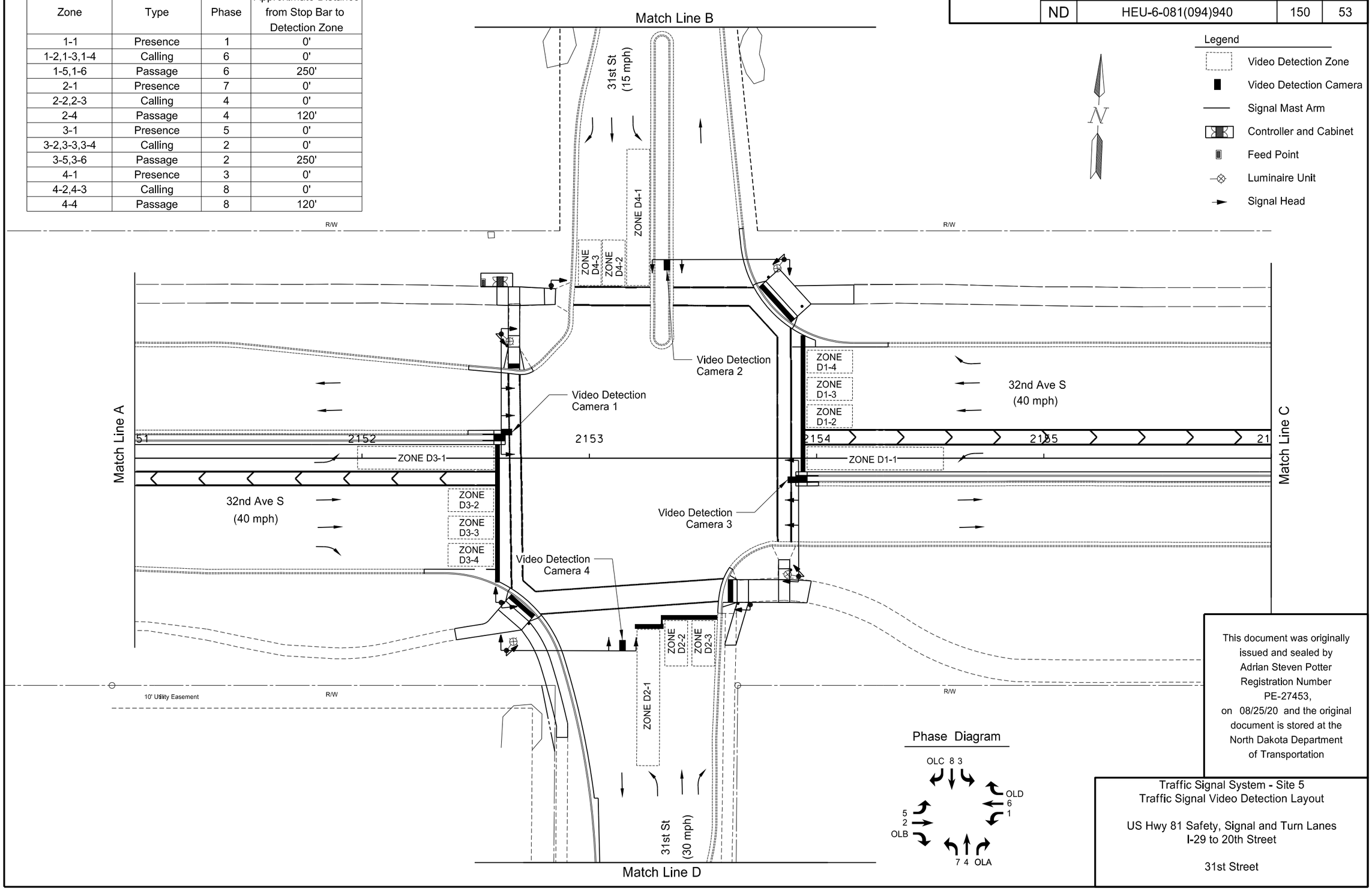
Zone	Type	Phase	Approximate Distance from Stop Bar to Detection Zone
1-1	Presence	1	0'
1-2,1-3,1-4	Calling	6	0'
1-5,1-6	Passage	6	250'
2-1	Presence	7	0'
2-2,2-3	Calling	4	0'
2-4	Passage	4	120'
3-1	Presence	5	0'
3-2,3-3,3-4	Calling	2	0'
3-5,3-6	Passage	2	250'
4-1	Presence	3	0'
4-2,4-3	Calling	8	0'
4-4	Passage	8	120'

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	53

Legend
- Video Detection Zone
- Video Detection Camera
- Signal Mast Arm
- Controller and Cabinet
- Feed Point
- Luminaire Unit
- Signal Head



Phase Diagram

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Traffic Signal System - Site 5
Traffic Signal Video Detection Layout

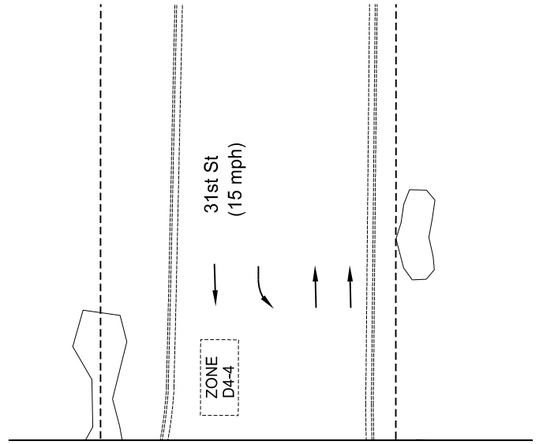
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

31st Street

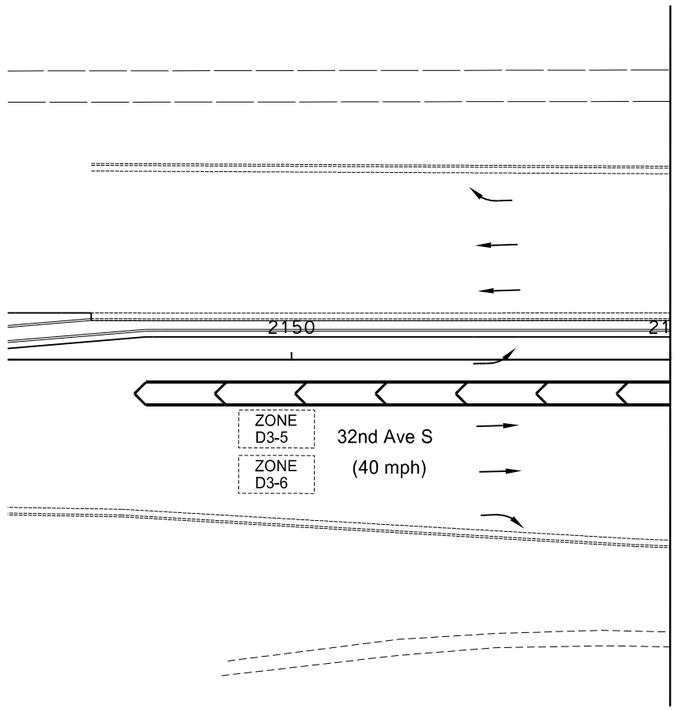
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	54

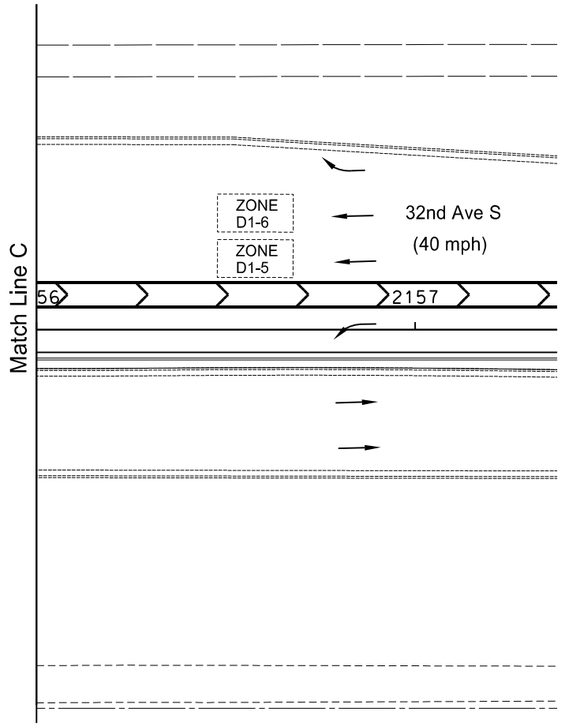
Legend

Video Detection Zone

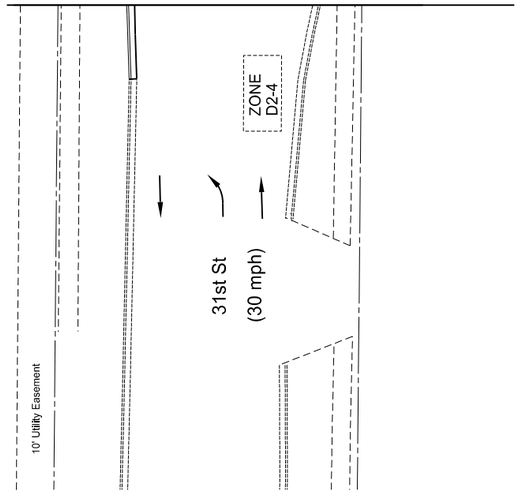


Match Line B

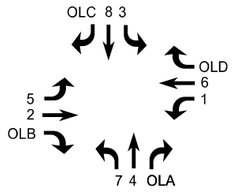




Match Line D



Phase Diagram



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Traffic Signal System - Site 5
Traffic Signal Video Detection Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

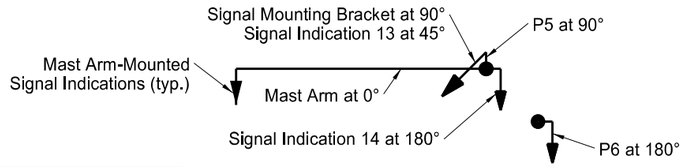
31st Street

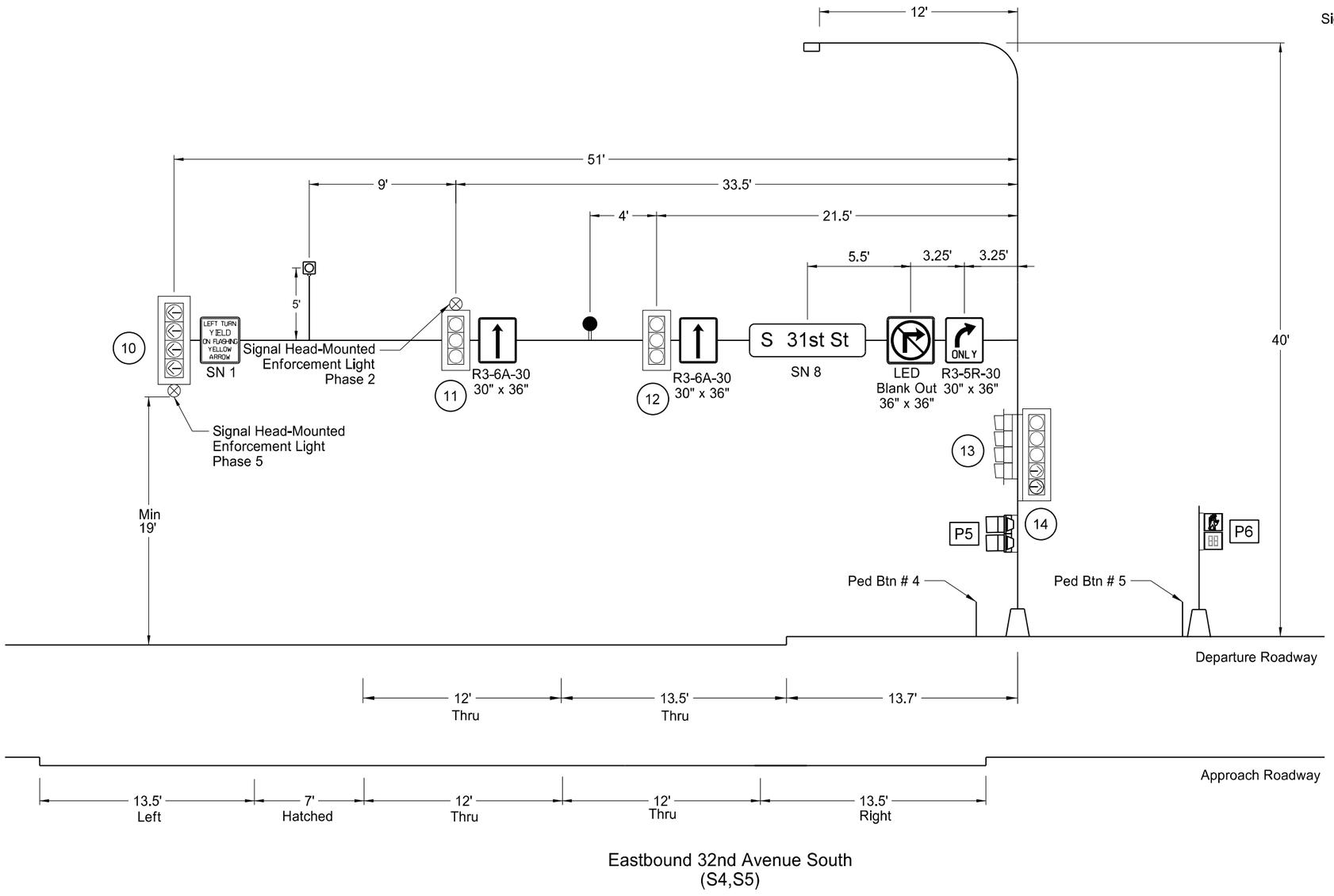
Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	55

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Eastbound 32nd Avenue South
(S4,S5)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 5
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

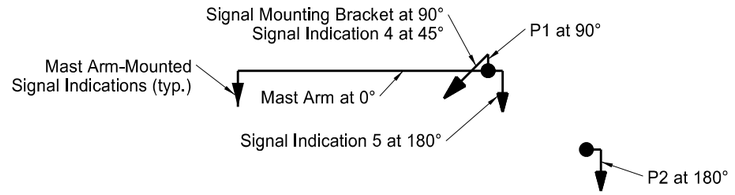
31st Street

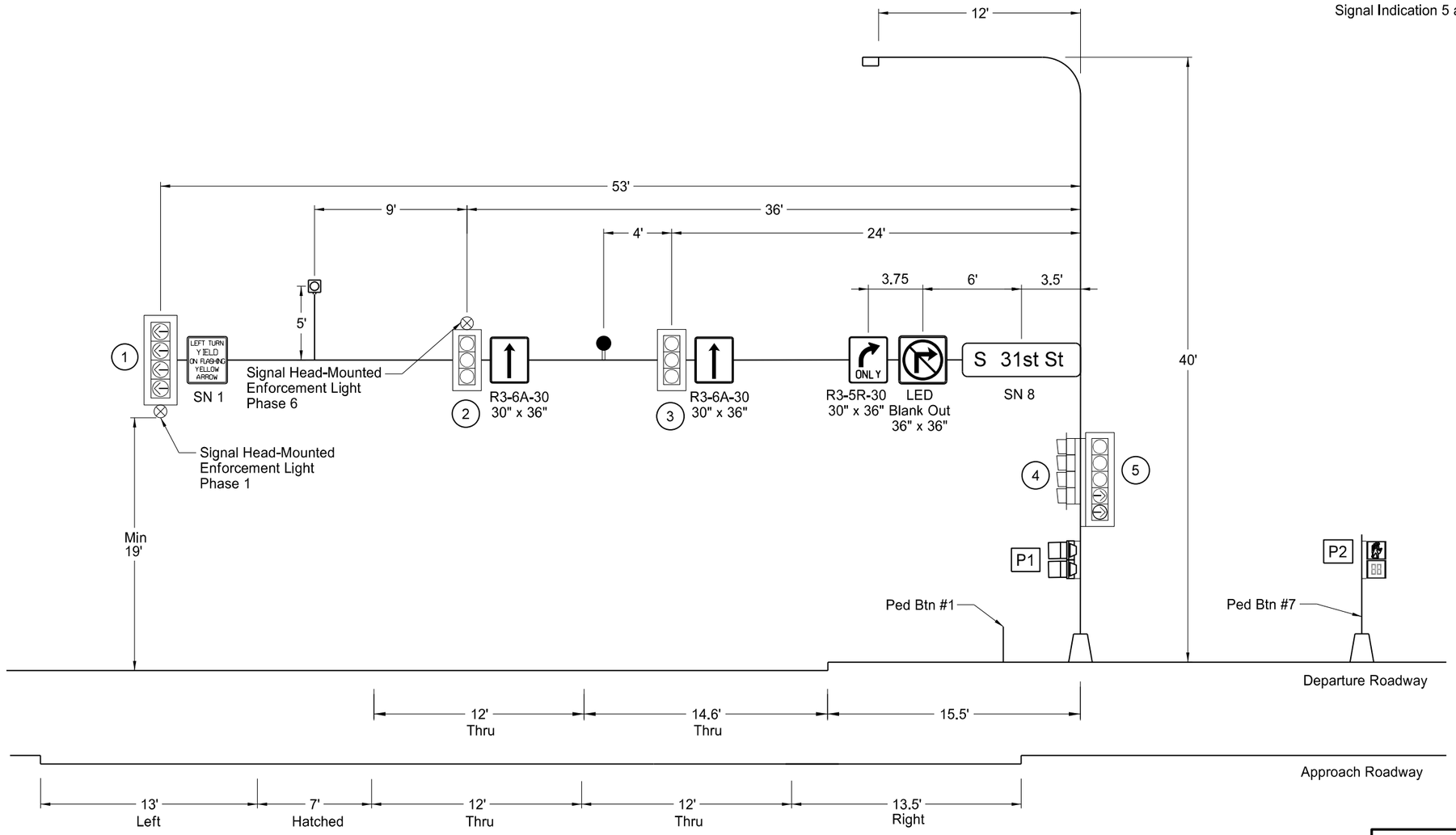
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	56

Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Westbound 32nd Avenue South
(S1,S2)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- X — Vehicle Signal Head Number
- PX — Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 5
SIgnal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

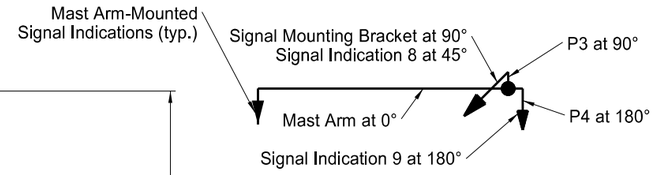
31st Street

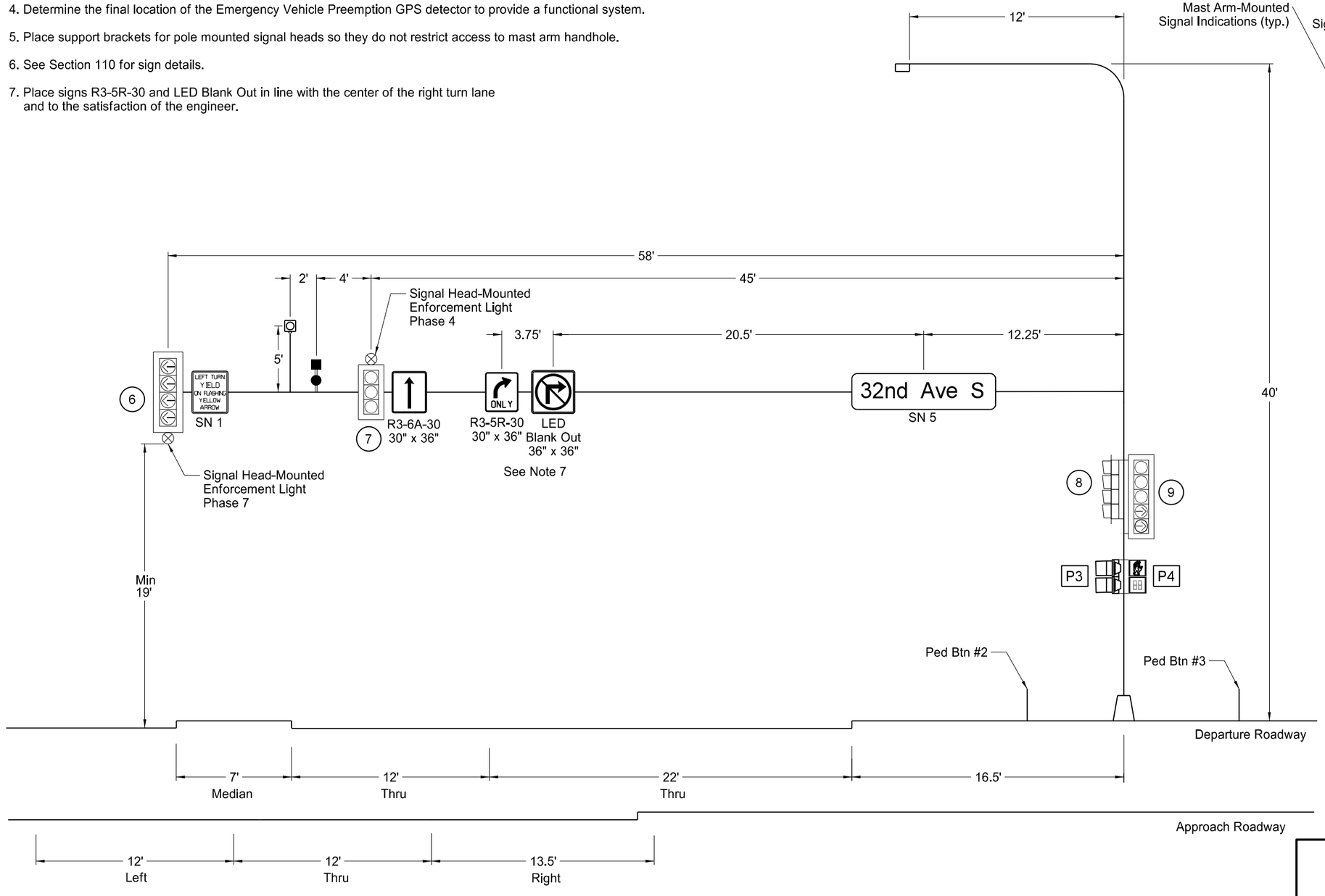
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	57

Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Determine the final location of the Emergency Vehicle Preemption GPS detector to provide a functional system.
5. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
6. See Section 110 for sign details.
7. Place signs R3-5R-30 and LED Blank Out in line with the center of the right turn lane and to the satisfaction of the engineer.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Northbound South 31st Street
(S3)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- PX Pedestrian Head Number
- Emergency Vehicle Preemption GPS Detector and Light
- Enforcement Light

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Traffic Signal System - Site 5
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

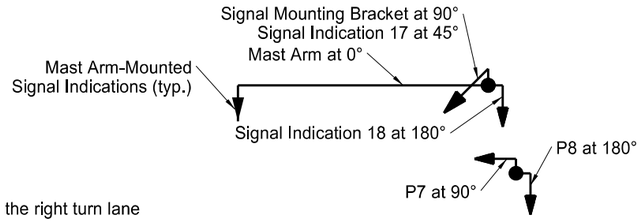
31st Street

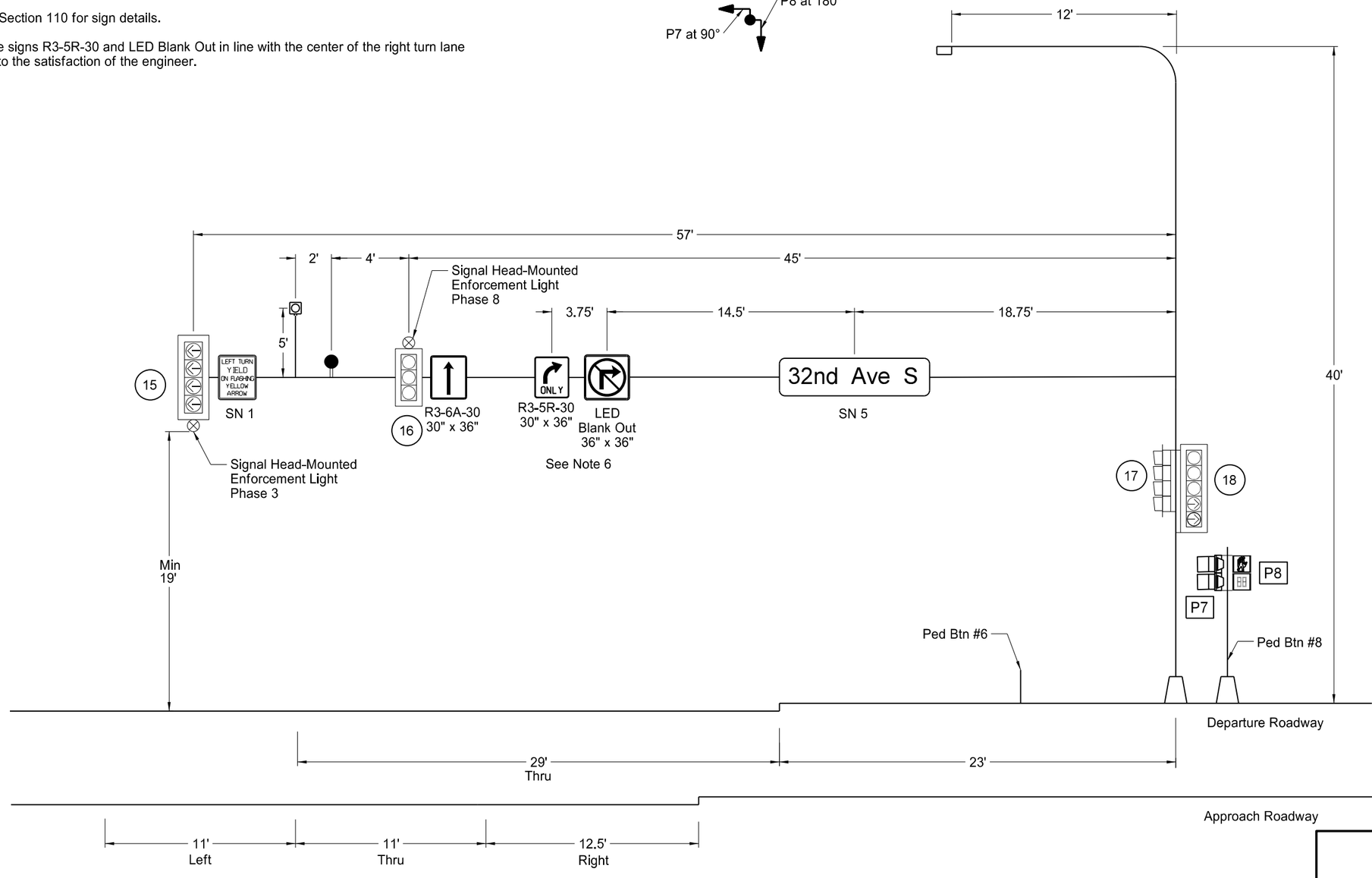
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	58

Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.
6. Place signs R3-5R-30 and LED Blank Out in line with the center of the right turn lane and to the satisfaction of the engineer.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Southbound South 31st Street
(S6,S7)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- PX Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 5
Signal Standard & Head Locations

US Hwy 81 Safety, Signals and Turn Lanes
I-29 to 20th Street

31st Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	59

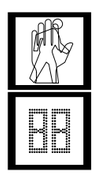
Conductor			Cable 1 (No.14 AWG 12)			Cable 2 (No.14 AWG 12)			Cable 3 (No.14 AWG 5)			Cable 4 (No.14 AWG 5)			Cable 5 (No.14 AWG 12)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		2,3	6	Green	4	7	Green LT Arrow	P1	8	Don't Walk	P2	6	Don't Walk	7,9	4	Green
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		2,3	6	Red	4	7	Red LT Arrow	P1	8	Walk	P2	6	Walk	7,9	4	Red
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		2,3	6	Yellow	4	7	Yellow LT Arrow			Spare			Spare	7,9	4	Yellow
6	Blue				Spare	4	7	Flashing Yellow LT Arrow									Spare
7	White	Black			Spare			Spare									Spare
8	Red	Black	1	1	Red LT Arrow	5	6	Red									Spare
9	Green	Black			Spare	5	6	Green									Spare
10	Orange	Black	1	1	Yellow LT Arrow	5	3 OLD	Yellow RT Arrow							9	1 OLA	Yellow RT Arrow
11	Blue	Black	1	1	Flashing Yellow LT Arrow	5	6	Yelllow									Spare
12	Black	White	1	1	Green LT Arrow	5	3 OLD	Green RT Arrow							9	1 OLA	Green RT Arrow

Conductor			Cable 6 (No.14 AWG 12)			Cable 7 (No.14 AWG 12)			Cable 8 (No.14 AWG 12)			Cable 9 (No.14 AWG 12)			Cable 10 (No.14 AWG 5)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		8	5	Green LT Arrow	P3	6	Don't Walk	11,12	2	Green	13	3	Green LT Arrow	P5	4	Don't Walk
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		8	5	Red LT Arrow	P3	6	Walk	11,12	2	Red	13	3	Red LT Arrow	P5	4	Walk
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		8	5	Yellow LT Arrow	P4	4	Don't Walk	11,12	2	Yellow	13	3	Yellow LT Arrow			Spare
6	Blue		8	5	Flashing Yellow LT Arrow	P4	4	Walk			Spare	13	3	Flashing Yellow LT Arrow			
7	White	Black			Spare			Spare			Spare			Spare			
8	Red	Black	6	7	Red LT Arrow			Spare	10	5	Red LT Arrow	14	2	Red			
9	Green	Black			Spare			Spare			Spare	14	2	Green			
10	Orange	Black	6	7	Yellow LT Arrow			Spare	10	5	Yellow LT Arrow	14	7 OLB	Yellow RT Arrow			
11	Blue	Black	6	7	Flashing Yellow LT Arrow			Spare	10	5	Flashing Yellow LT Arrow	14	2	Yelllow			
12	Black	White	6	7	Green LT Arrow			Spare	10	5	Green LT Arrow	14	7 OLB	Green RT Arrow			

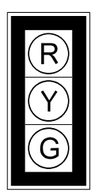
Conductor			Cable 11 (No.14 AWG 5)			Cable 12 (No.14 AWG 12)			Cable 13 (No.14 AWG 12)			Cable 14 (No.14 AWG 7)		
Run	Base	Tracer	Head	Phase	Indication	Head		Indication	Head		Indication	Head	Phase	Indication
1	Black		P6	2	Don't Walk	16	8	Green	17	1	Green LT Arrow	P7	2	Don't Walk
2	White				Neutral			Neutral			Neutral			Neutral
3	Red		P6	2	Walk	16	8	Red	17	1	Red LT Arrow	P7	2	Walk
4	Green				Ground			Ground			Ground			Ground
5	Orange				Spare	16	8	Yellow	17	1	Yellow LT Arrow	P8	8	Don't Walk
6	Blue							Spare	17	1	Flashing Yellow LT Arrow	P8	8	Walk
7	White	Black						Spare			Spare			Spare
8	Red	Black				15	3	Red LT Arrow	18	8	Red			
9	Green	Black						Spare	18	8	Green			
10	Orange	Black				15	3	Yellow LT Arrow	18	5 OLC	Yellow RT Arrow			
11	Blue	Black				15	3	Flashing Yellow LT Arrow	18	8	Yelllow			
12	Black	White				15	3	Green LT Arrow	18	5 OLC	Green RT Arrow			

Notes:

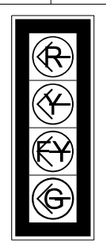
1. Use LED indications for all heads .
2. Use 5" Louvered Black Plate with Type XI Yellow Reflective Border (typ.) on all heads.



(12" Lenses)
Heads P1, P2, P3, P4, P5, P6, P7, P8

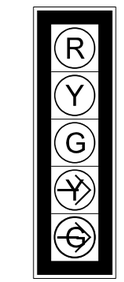


(12" Lenses)
Heads 2, 3, 7, 11,12,16



(12" Lenses)
Heads 1, 4, 6, 8,10 13,15,17

LED Blank Out Sign (36" x 36")
Use white LEDs for arrow
Use red LEDs for prohibition symbol



(12" Lenses)
Heads 5, 9,14,18

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Traffic Signal System - Site 5
SIgnal Heads & Conductor Schedule

US Hwy 81 Safety, Signal and Turn Lane
I-29 to 20th Street

31st Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	60

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Cable Run Code	Cable Run QTY	Cable Run Type
1A	Controller to Pull Box 1	11	4"	40	A	2	No. 14 AWG 3 Conductor Cable
				40	B	2	Emergency Detector Cable
				80	C	4	Cable 1,2,12,13
				40	C	2	Cable 3,4
				20	C	1	Cable 14
				80	C	4	Push Button
				40	D	2	Video Detector Cable
				80	F	4	No. 14 AWG 3 Conductor Cable
				40	K	2	Electronic Sign
1B	Controller to Pull Box 1	11	4"	40	A	2	No. 14 AWG 3 Conductor Cable
				40	B	2	Emergency Detector Cable
				100	C	5	Cable 5,6,7,8,9
				40	C	2	Cable 10,11
				80	C	4	Push Button
				40	D	2	Video Detector Cable
				80	F	4	No. 14 AWG 3 Conductor Cable
				40	K	2	Electronic Sign
2	Pull Box 1 to Signal Std. - S3	12	2"	29	C	1	Cable 4
				25	C	1	Push Button
3	Pull Box 1 to Pull Box 2	122	4"	256	A	2	No. 14 AWG 3 Conductor Cable
				256	B	2	Emergency Detector Cable
				640	C	5	Cable 5,6,7,8,9
				256	C	2	Cable 10,11
				512	C	4	Push Button
				256	D	2	Video Detector Cable
				512	F	4	No. 14 AWG 3 Conductor Cable
				256	K	2	Electronic Sign
4	Pull Box 2 to Signal Std. - S3	8	3"	85	A	1	No. 14 AWG 3 Conductor Cable
				85	B	1	Emergency Detector Cable
				282	C	3	Cable 5,6,7
				87	D	1	Video Detector Cable
				188	F	2	No. 14 AWG 3 Conductor Cable
				70	K	1	Electronic Sign
5	Pull Box 2 to Ped Push Btn. #2	16	2"	24	C	1	Push Button
6	Pull Box 2 to Ped Push Btn. #3	18	2"	26	C	1	Push Button
7	Pull Box 2 to Pull Box 3	137	4"	143	A	1	No. 14 AWG 3 Conductor Cable
				143	B	1	Emergency Detector Cable
				286	C	2	Cable 8,9
				286	C	2	Cable 10,11
				286	C	2	Push Button
				143	D	1	Video Detector Cable
				286	F	2	No. 14 AWG 3 Conductor Cable
				143	K	1	Electronic Sign
8	Pull Box 3 to Ped Push Btn. #4	14	2"	22	C	1	Push Button
9	Pull Box 3 to Signal Std. - S4	10	3"	64	A	1	No. 14 AWG 3 Conductor Cable
				64	B	1	Emergency Detector Cable
				178	C	2	Cable 8,9
				27	C	1	Cable 10
				81	D	1	Video Detector Cable
				178	F	2	No. 14 AWG 3 Conductor Cable
				48	K	1	Electronic Sign
10	Pull Box 3 to Signal Std. - S5	33	2"	50	C	1	Cable 11
11	Pull Box 3 to Ped Push Btn. #5	38	2"	46	C	1	Push Button
12	Signal Std. - S6 to Pull Box 4	18	3"	95	A	1	No. 14 AWG 3 Conductor Cable
				95	B	1	Emergency Detector Cable
				206	C	2	Cable 12,13
				97	D	1	Video Detector Cable
				206	F	2	No. 14 AWG 3 Conductor Cable
				81	K	1	Electronic Sign
13	Ped Push Btn. #6 to Pull Box 4	21	2"	29	C	1	Push Button
14	Signal Std. - S7 to Pull Box 4	11	2"	28	C	1	Cable 14
				24	C	1	Push Button
15A	Pull Box 4 to Pull Box 1	150	4"	156	A	1	No. 14 AWG 3 Conductor Cable
				156	B	1	Emergency Detector Cable
				312	C	2	Cable 12,13
				156	C	1	Cable 14
				312	C	2	Push Button
				156	D	1	Video Detector Cable
				312	F	2	No. 14 AWG 3 Conductor Cable
				156	K	1	Electronic Sign
15B	Pull Box 4 to Pull Box 1	150	4"	Empty conduit for future use			
16	Ped Push Btn. #1 to Pull Box 1	30	2"	38	C	1	Push Button
17	Signal Std. - S1 to Pull Box 1	26	3"	82	A	1	No. 14 AWG 3 Conductor Cable
				82	B	1	Emergency Detector Cable
				214	C	2	Cable 1,2
				43	C	1	Cable 3
				99	D	1	Video Detector Cable
				214	F	2	No. 14 AWG 3 Conductor Cable
				69	K	1	Electronic Sign
18	Controller to Feed Point	8	2"	18	E	1	Mult 3 No. 6 USE
19	Pedestal Power Source to Feed Point	21	2"	31	E	1	Mult 3 No. 6 USE

Cable Code

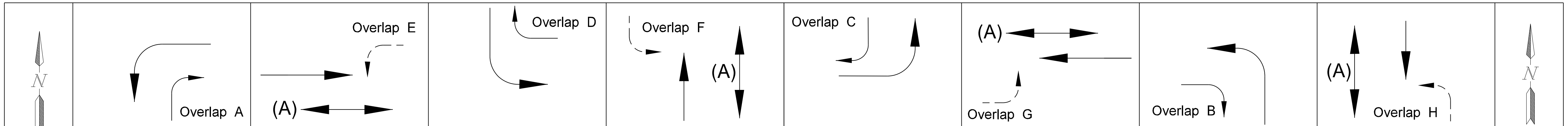
A = Emergency Vehicle Indicator Lamp
B = Emergency Vehicle Detector Cable
C = Signal Control Cable
D = Video Detection Cable
E = Power Cable
F = Enforcement Light Cable
K = Electronic Sign Cable

Note:
All conduit and cable lengths are in feet.

Traffic Signal System - Site 5
Conduit Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-20 to 20th Street

31st Street



Head #	Phase 1								Phase 2							
	R/W	Clear to Phase							R/W	Clear to Phase						
		2	3	4	5	6	7	8		3	4	5	6	7	8	1
1	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
2																
3																
4																
5																
6																
7																
8																
9	G	Y	Y	Y	(B)	(B)	Y	Y								
10																
11									G	Y	Y	(B)	(B)	Y	Y	Y
12									G	Y	Y	(B)	(B)	Y	Y	Y
13																
14									G	Y	Y	(B)	(B)	Y	Y	Y
15																
16																
17	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
18																

Head #	Phase 3								Phase 4							
	R/W	Clear to Phase							R/W	Clear to Phase						
		4	5	6	7	8	1	2		5	6	7	8	1	2	3
1																
2																
3																
4																
5	G	Y	Y	Y	(B)	(B)	Y	Y								
6																
7									G	Y	Y	(B)	(B)	Y	Y	Y
8																
9									G	Y	Y	(B)	(B)	Y	Y	Y
10																
11																
12																
13	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
14																
15	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
16																
17																
18																

Head #	Phase 5								Phase 6							
	R/W	Clear to Phase							R/W	Clear to Phase						
		6	7	8	1	2	3	4		7	8	1	2	3	4	5
1																
2									G	Y	Y	(B)	(B)	Y	Y	Y
3									G	Y	Y	(B)	(B)	Y	Y	Y
4																
5									G	Y	Y	(B)	(B)	Y	Y	Y
6																
7																
8	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
9																
10	G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
11																
12																
13																
14																
15																
16																
17																
18	G	Y	Y	Y	(B)	(B)	Y	Y								

Phase 7								Phase 8								Head #
R/W	Clear to Phase							R/W	Clear to Phase							
	8	1	2	3	4	5	6		1	2	3	4	5	6	7	
																1
																2
																3
G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)	4
																5
G	Y	Y	Y	(B)	(B)	Y	Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)	6
																7
																8
																9
																10
																11
																12
																13
G	Y	Y	Y	(B)	(B)	Y	Y									14
																15
								G	Y	Y	(B)	(B)	Y	Y	Y	16
																17
								G	Y	Y	(B)	(B)	Y	Y	Y	18

Blank Squares Denote Red Indication
(A) = Pedestrian movements, upon activation.
(B) = When one phase is on alone, a nonconflicting phase may start timing concurrently without a clearance interval (See Chart A).
(C) = Flashing yellow left turn arrow (protected/permissive mode and permissive only mode).
(D) = Solid yellow left turn arrow (protected/permissive mode and permissive only mode).

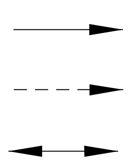

Protected Movement
Permitted Movement
Pedestrian Actuated Movement

Chart A
Non-Conflicting Phases

On Phase	Non-Conflicting Phase Allowed to Time Concurrently
1	5 or 6
2	5 or 6
3	7 or 8
4	7 or 8
5	1 or 2
6	1 or 2
7	3 or 4
8	3 or 4

Chart B
Overlaps

Overlap	Protected Phase	Ped Protect Phases
A	1	-
B	7	-
C	5	-
D	3	-

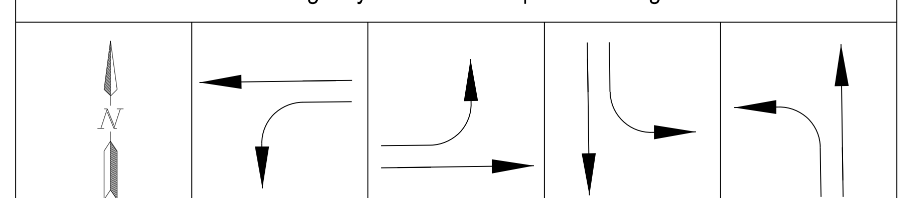
Chart C
Special Overlaps
(Flashing Yellow Left Turn Arrows)

Overlap	Protected Phase	Permissive Phase
E	1	2
F	3	4
G	5	6
H	7	8

Chart D
No Turn on Red Sign Activation Overlaps

Overlap	Direction of vehicular travel - Signal Std.	Conflicting Left Turn Phase	Parallel Pedestrian Phase	Perpendicular Pedestrian Phase
I	Westbound - S1	5	6 Ped	4 Ped
J	Northbound - S3	3	4 Ped	2 Ped
K	Eastbound - S4	1	2 Ped	8 Ped
L	Southbound - S6	7	8 Ped	6 Ped

Emergency Vehicle Preemption Phasing



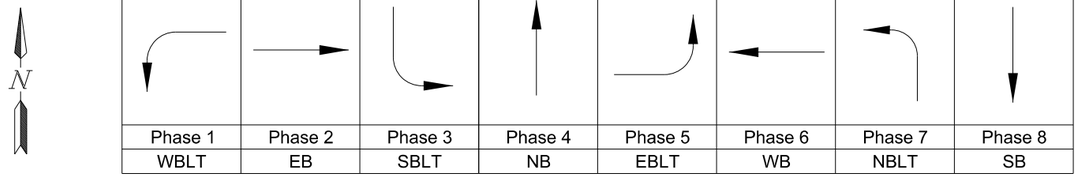
Direction	Westbound	Eastbound	Southbound	Northbound
Dwell Phases	1,6	2,5	3,8	4,7
Dwell Overlaps	OLK	OLI	OLJ	OLL

Traffic Signal System - Site 5
Signal Controller Phasing

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

31st Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	62



	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
	WBLT	EB	SBLT	NB	EBLT	WB	NBLT	SB
BASIC INTERVALS (OR FUNCTIONS)								
Minimum Initial	5.0	15.0	5.0	10.0	5.0	15.0	5.0	10.0
Vehicle Extension	1.5	5.0	1.5	5.0	1.5	5.0	1.5	5.0
Maximum Green (Max 1)	15.0	40.0	15.0	40.0	15.0	40.0	15.0	40.0
Yellow Change	3.5	4.0	3.5	3.5	3.5	4.0	3.5	3.5
Red Clearance	2.5	1.0	2.5	2.5	2.5	1.0	2.0	2.5
Walk	-	7.0	-	7.0	-	7.0	-	7.0
Pedestrian Clearance	-	22.0	-	26.0	-	21.0	-	26.0
Delayed Green (Leading Pedestrian Interval)	-	6.0	-	6.0	-	6.0	-	6.0
VOLUME DENSITY TIMING FUNCTIONS								
VARIABLE INITIAL TIMING OPTIONS								
Actuations Before Added Initial	-	-	-	-	-	-	-	-
Added Initial per Actuation	-	-	-	-	-	-	-	-
Maximum Initial	-	-	-	-	-	-	-	-
GAP REDUCTION OPTIONS								
Time Before Reduction	-	20.0	-	-	-	20.0	-	-
Time to Reduce to Minimum Gap	-	20.0	-	-	-	20.0	-	-
Minimum Gap	-	2.5	-	-	-	2.5	-	-
OTHER CONTROLLER FUNCTIONS								
Locking Memory	-	x	-	x	-	x	-	x
Non-Locking Memory	x	-	x	-	x	-	x	-
Phase recall	-	x	-	-	-	x	-	-
Red Revert	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Backup Prevent Phases	-	-	-	-	-	-	-	-
No Serve Phases	-	-	-	-	-	-	-	-
Flashing-Normal & Conflict Monitor	R	R	R	R	R	R	R	R

Notes:
1. Operate all left turn phases as either leading or lagging phases.
2. Operate all left turn phases either in protected, protected/permissive, or permissive mode.

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Traffic Signal System - Site 5
Signal Timing Settings

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

31st Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	63

SPEC	CODE	ITEM DESCRIPTION	UNIT	TOTAL
770	0445	MULTIPLE UNDERGROUND CABLE 3NO6 STYLE USE	LF	20
770	0464	MULTIPLE UNDERGROUND CABLE 3NO4-1NO6 STYLE USE	LF	1040
770	4210	LED LUMINAIRE	EA	4
772	0020	CONCRETE FOUNDATION-TRAFFIC SIGNALS	EA	7
772	0100	PULL BOX	EA	4
772	0240	2IN DIAMETER RIGID CONDUIT	LF	260
772	0270	3IN DIAMETER RIGID CONDUIT	LF	90
772	0290	4IN DIAMETER RIGID CONDUIT	LF	610
772	0375	EMERGENCY VEHICLE DETECTOR CABLE	LF	970
772	0432	NO14 AWG 2 CONDUCTOR CABLE	LF	1510
772	0433	NO14 AWG 3 CONDUCTOR CABLE	LF	3920
772	0435	NO14 AWG 5 CONDUCTOR CABLE	LF	780
772	0437	NO14 AWG 7 CONDUCTOR CABLE	LF	210
772	0442	NO14 AWG 12 CONDUCTOR CABLE	LF	2300
772	0551	FEED POINT-COMBO LIGHTING & SIGNAL-PAD MOUNT	EA	1
772	0601	TYPE II SIGNAL STANDARD	EA	3
772	1222	COMBO 51FT MA SIG & LT STD-TYPE C	EA	1
772	1232	COMBO 53FT MA SIG & LT STD-TYPE C	EA	1
772	1272	COMBO 57FT MA SIG & LT STD-TYPE C	EA	1
772	1282	COMBO 58FT MA SIG & LT STD-TYPE C	EA	1
772	1812	1-WAY 3 SEC HEAD W/12IN LENS-MA MTD	EA	6
772	1820	1-WAY 4 SEC HEAD W/12IN LENS-POST MTD	EA	4
772	1822	1-WAY 4 SEC HEAD W/12IN LENS-MA MTD	EA	4
772	1830	1-WAY 5 SEC HEAD W/12IN LENS-POST MTD	EA	4
772	2060	PEDESTRIAN COUNTDOWN SIGNAL HEAD-POST MTD	EA	4
772	2061	PEDESTRIAN COUNTDOWN SIGNAL HEAD-PEDESTAL MTD	EA	4
772	2070	LAW ENFORCEMENT CONFIRMATION LIGHT	EA	8
772	2200	PEDESTRIAN PUSHBUTTON POST	EA	6
772	2215	PEDESTRIAN PUSHBUTTON & SIGN	EA	8
772	2260	VIDEO DETECTION CABLE	LF	1000
772	2265	VIDEO DETECTION SYSTEM	EA	1
772	2556	BATTERY BACKUP SYSTEM	EA	1
772	2610	EMERGENCY VEHICLE PREEMPTION UNIT	EA	4
772	2621	EMERGENCY VEHICLE PRE-EMPTION PHASE SELECTOR	EA	1
772	3125	REMOVE TRAFFIC SIGNAL SYSTEM	EA	1
		36"X36" LED SIGN - "NO TURN ON RED"	EA	4
		CONTROLLER AND CABINET	EA	1
772	9815	TRAFFIC SIGNAL SYSTEM - SITE 5	EA	1
		The items appear above for informational purposes; provide all labor and equipment necessary for the signal system to be fully operational as shown in the Plans. Include items in the corresponding price bid for "TRAFFIC SIGNAL SYSTEM - SITE 5"		

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Traffic Signal System - Site 5
Estimated Traffic Signal Quantities

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

31st Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	64

Notes:
1. All stations and offsets are referenced from SCL81 alignment.
2. Abandon all conduit and remove all cable related to the existing traffic signal system.

Legend
- Existing Signal Standard
- Existing Pull Box
- Existing Controller and Cabinet
- Existing Signal Mast Arm
- Existing Signal Head
- Existing Feed Point

Sta. 2168+46.46
73.07' LT
Remove Exist. PB

Sta. 2168+46.09
67.79' LT
Remove Signal Std. Pedestal

Sta. 2168+15.86
43.44' LT
Remove Exist. PB

Sta. 2168+21.37
42.95' LT
Remove Signal Std. Pole

Sta. 2168+22.83
7.00' LT
Salvage/Remove PPP

Sta. 2168+19.53
4.65' LT
Remove Exist. PB

Sta. 2168+44.45
73.98' RT
Salvage/Remove PPP

Sta. 2168+18.29
70.15' RT
Remove Exist. PB

Sta. 2168+60.38
89.25' RT
Remove Signal Std. Pole

Sta. 2167+95.16
97.60' RT
Remove Exist.
Controller and Cabinet

Sta. 2168+59.50
93.06' RT
Remove Exist. PB

Sta. 2169+18.96
70.23' LT
Salvage/Remove PPP

Sta. 2169+74.95
61.62' LT
Remove Signal Std. Pole

Sta. 2169+89.15
55.73' LT
Remove Exist. PB

Sta. 2169+90.28
11.24' RT
Salvage/Remove PPP

Sta. 2169+92.44
64.44' RT
Remove Exist. PB

Sta. 2169+89.03
64.36' RT
Remove Signal Std. Pole

Sta. 2169+06.21
87.37' RT
Salvage/Remove PPP

Sta. 2169+01.93
94.36' RT
Remove Exist. PB

Sta. 2169+70.81
91.46' RT
Remove Exist. PB

Columbia Rd
(40 mph)

32nd Ave S
(40 mph)

2167 2168 2169 2170 2171 2172

R/W
E
FO
OH
10' Utility Easement
20' Easement
40' Easement
75' Utility Easement
20.5' MinnKota Power Co-Op Easement

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Traffic Signal System - Site 6
Traffic Signal Removal

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	65

Signal Standard Foundation Table		
Description	Footing Depth "D" 24" & 30" Diameters (FT)	Footing Depth "D" 36" & 42" Diameters (FT)
Type II Signal Std.		
S2	4	3
S3	4	3
S5	4	3
S6	4	3
S8	4	3
S10	4	3
Combination Signal & Light Std. 30' Mounting Height		
S1 - Single 65' MA	23,21	20,20
S7 - Single 65' MA	23,21	21,20
Combination Signal & Light Std. 40' Mounting Height		
S4 - Single 60' MA	19,18	17,17
S9 - Single 58' MA	19,18	17,17

Note:
All stations and offsets are referenced from SCL81 alignment.

Legend
- (5) Signal Head Number
- P6 Pedestrian Head Number
- Signal Mast Arm
- Controller and Cabinet
- Existing Feed Point
- Luminaire Unit

Columbia Rd (40 mph)

32nd Ave S (40 mph)

Sta. 2168+44.94
72.20' LT
Conc. Signal Fnd. -S6

Sta. 2169+73.54
72.83' LT
Conc. Signal Fnd. -S7
Std.- 65' MA

Sta. 2169+72.01
67.05' LT
Ped Btn #3

Sta. 2168+20.75
54.73' LT
Conc. Signal Fnd. -S4
Std.- 60' MA

Sta. 2168+43.22
62.14' LT
Ped Btn #2

Sta. 2168+31.00
51.01' LT
Conc. Signal Fnd. -S5
Ped Btn #7

Sta. 2169+92.83
61.14' LT
Conc. Signal Fnd. -S8
Ped Btn #8

Sta. 2169+88.30
65.41' RT
Ped Btn #4

Sta. 2168+27.01
70.01' RT
Conc. Signal Fnd. -S3

Sta. 2169+78.79
73.06' RT
Ped Btn #5

Sta. 2168+35.40
71.75' RT
Ped Btn #1

Sta. 2169+96.10
65.72' RT
Conc. Signal Fnd. -S9
Std.- 58' MA

Sta. 2169+77.19
76.65' RT
Conc. Signal Fnd. -S10

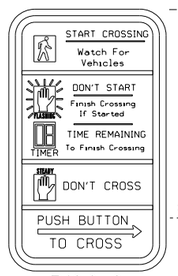
Controller and Cabinet
Econolite 332D
Sta. 2167+88.56
98.47' RT
(Center of Cabinet)

Existing Feed Point
Sta. 2167+76.84
99.26' RT
(Center of Feed Point)

Sta. 2168+50.22
84.10' RT
Conc. Signal Fnd. -S2
Ped Btn #6

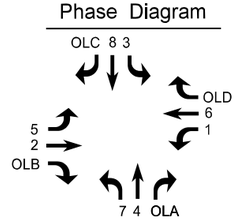
Sta. 2168+45.60
105.41' RT
Conc. Signal Fnd. -S1
Std.- 65' MA

Pedestrian Pushbutton Schedule			
Pushbutton Number	Pushbutton Location	Pushbutton & Signal Location on Pole	Direction of Arrow on Sign
1	Pushbutton Post 1	E	Right
2	Pushbutton Post 2	S	Right
3	Pushbutton Post 3	S	Left
4	Pushbutton Post 4	W	Left
5	Pushbutton Post 5	N	Right
6	Type II Signal Pole S2	N	Left
7	Type II Signal Pole S5	E	Right
8	Type II Signal Pole S8	W	Left



R10-3e-9

Phase Diagram



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Traffic Signal System - Site 6
Traffic Signal Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

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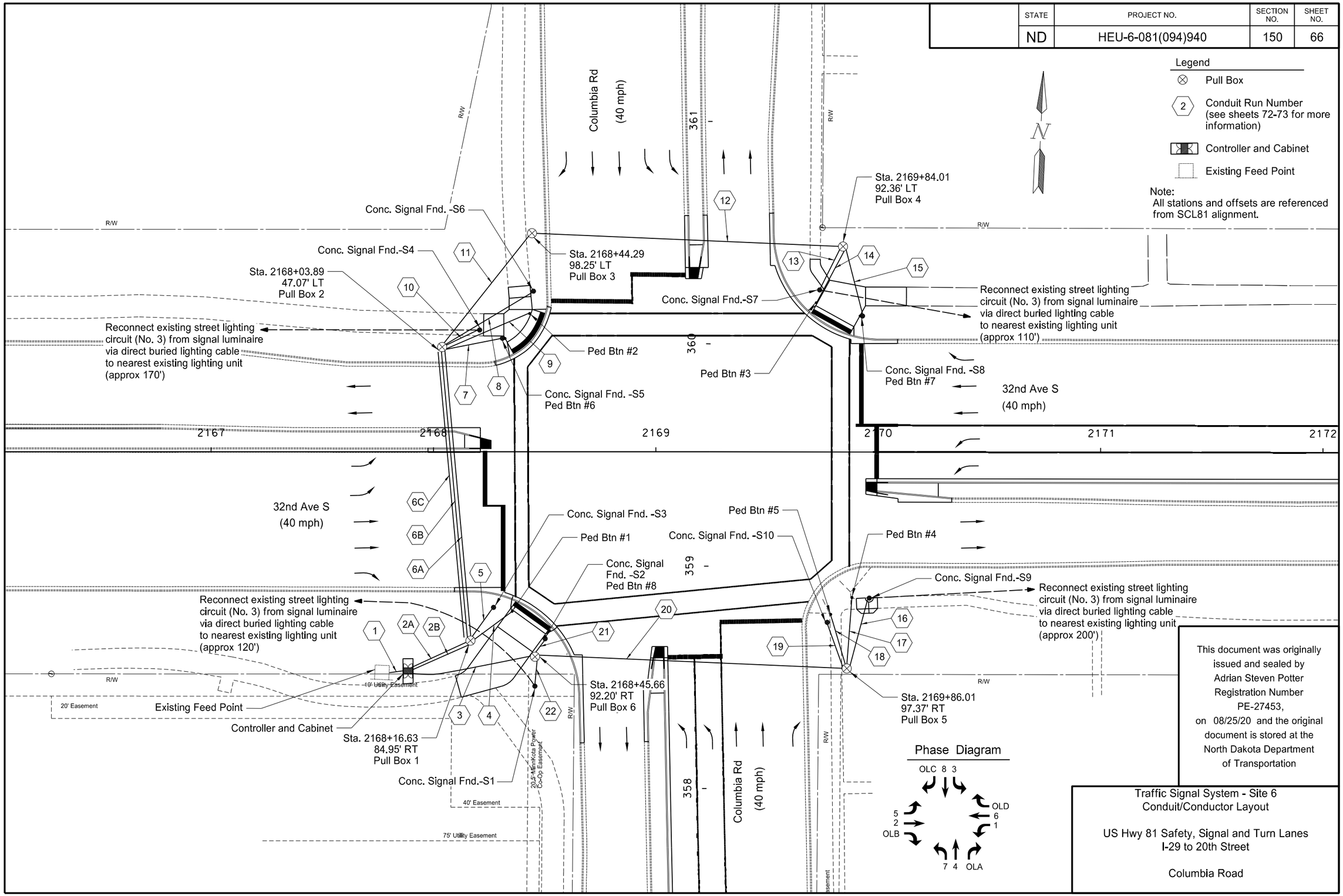
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	66

Legend

- Pull Box
- 2 — Conduit Run Number (see sheets 72-73 for more information)
- Controller and Cabinet
- Existing Feed Point

Note:
All stations and offsets are referenced from SCL81 alignment.



Phase Diagram

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Traffic Signal System - Site 6
Conduit/Conductor Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

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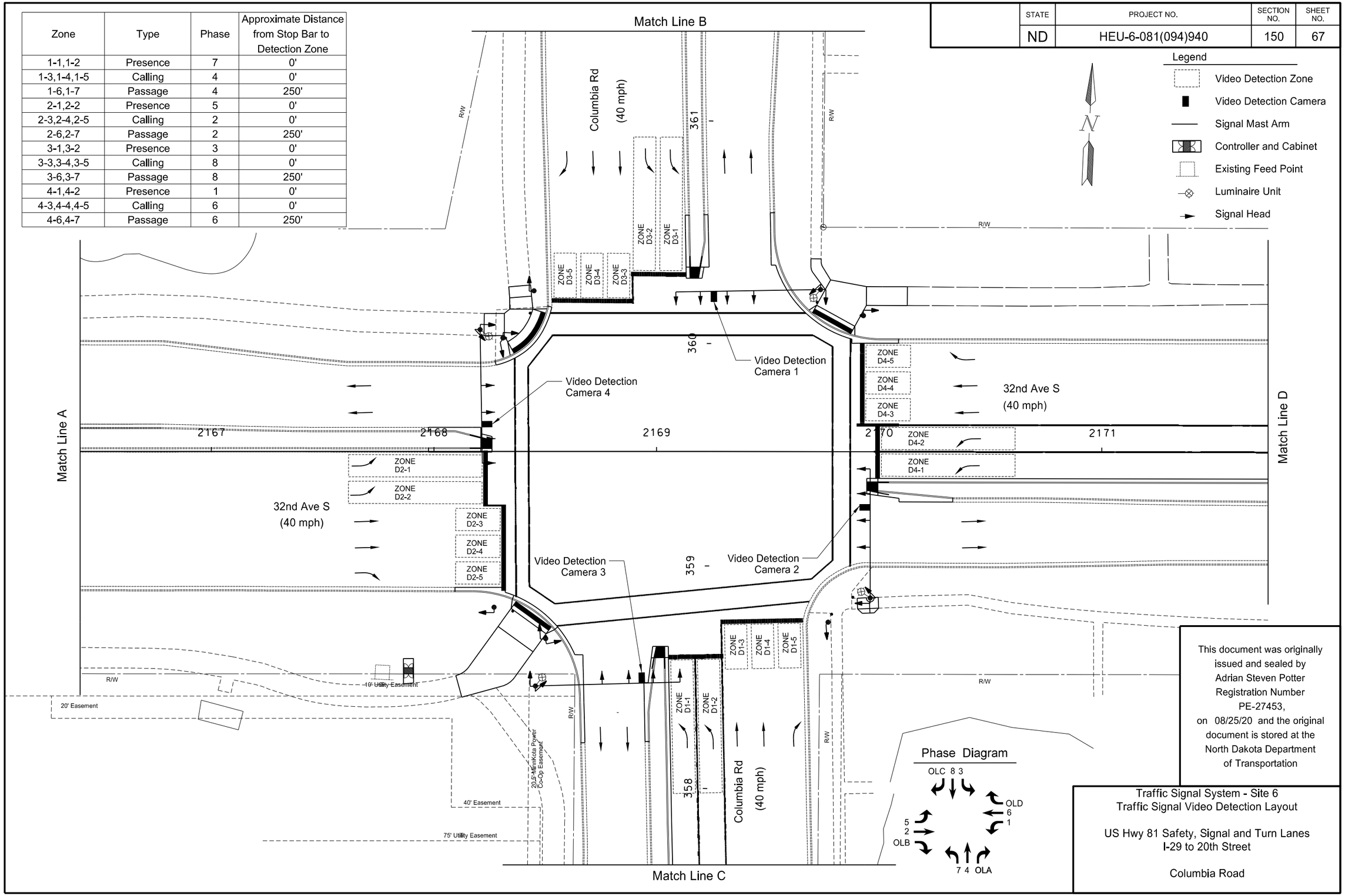
Zone	Type	Phase	Approximate Distance from Stop Bar to Detection Zone
1-1,1-2	Presence	7	0'
1-3,1-4,1-5	Calling	4	0'
1-6,1-7	Passage	4	250'
2-1,2-2	Presence	5	0'
2-3,2-4,2-5	Calling	2	0'
2-6,2-7	Passage	2	250'
3-1,3-2	Presence	3	0'
3-3,3-4,3-5	Calling	8	0'
3-6,3-7	Passage	8	250'
4-1,4-2	Presence	1	0'
4-3,4-4,4-5	Calling	6	0'
4-6,4-7	Passage	6	250'

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	67



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Traffic Signal System - Site 6
Traffic Signal Video Detection Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

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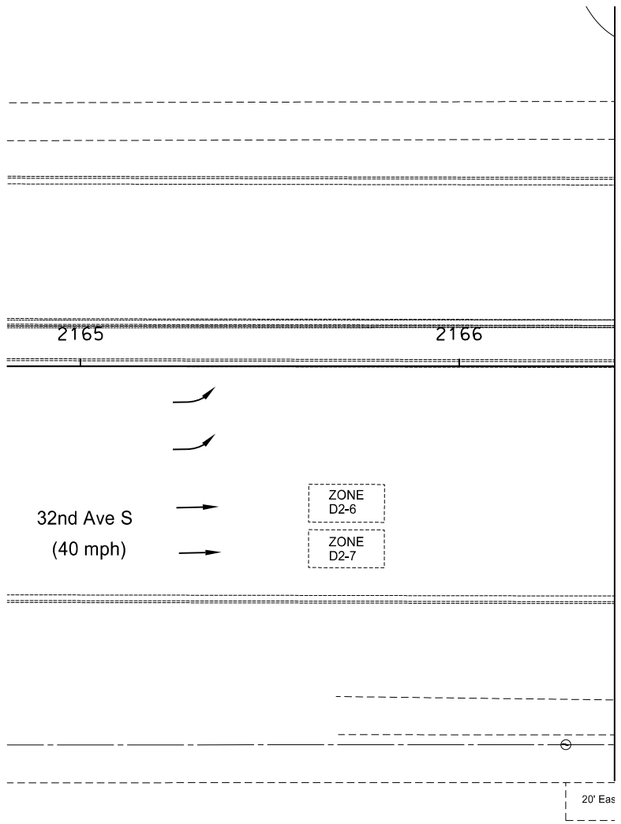
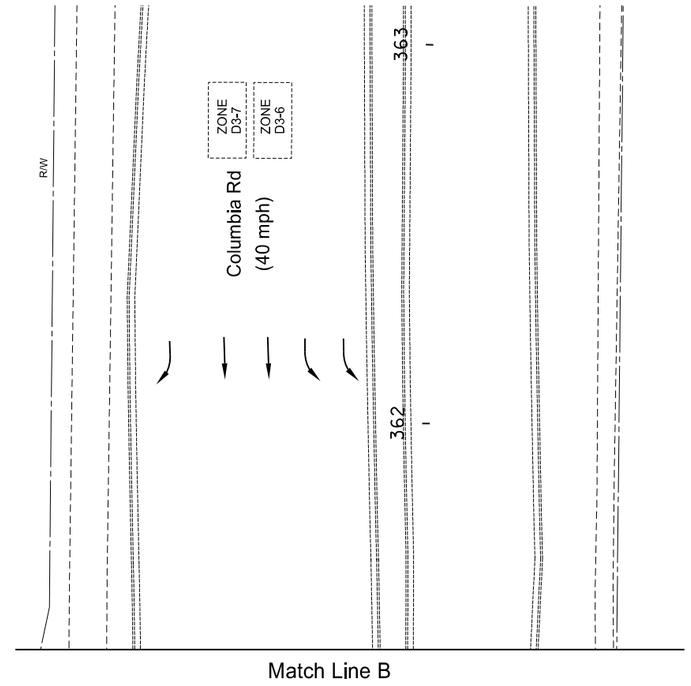
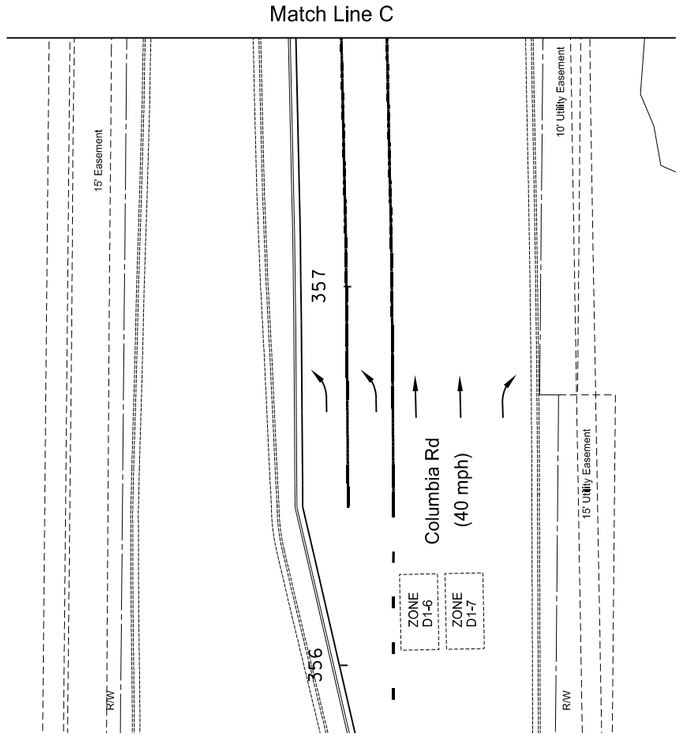
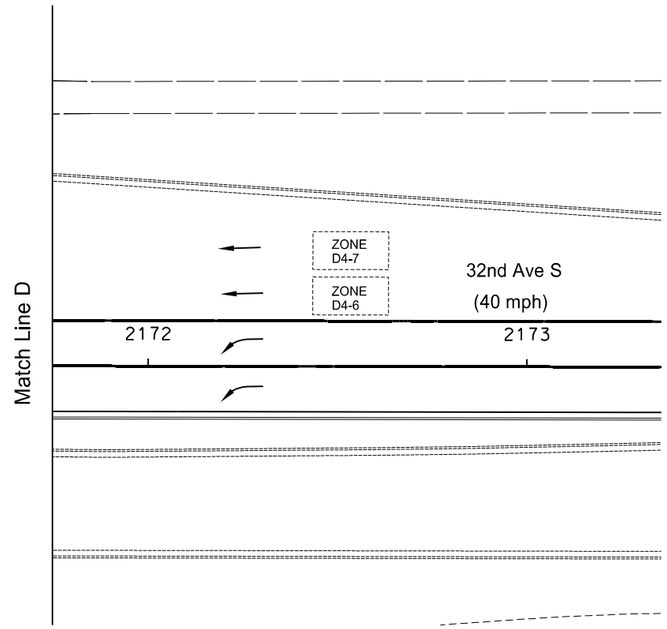
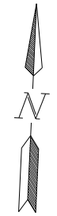
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	68







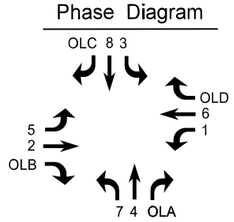




Legend

Video Detection Zone

Phase Diagram



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Traffic Signal System - Site 6
Traffic Signal Video Detection Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

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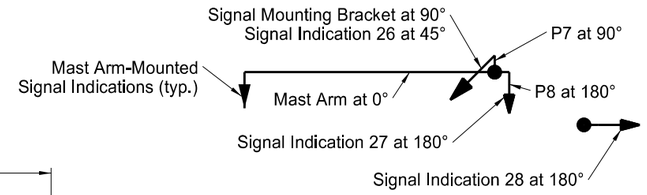
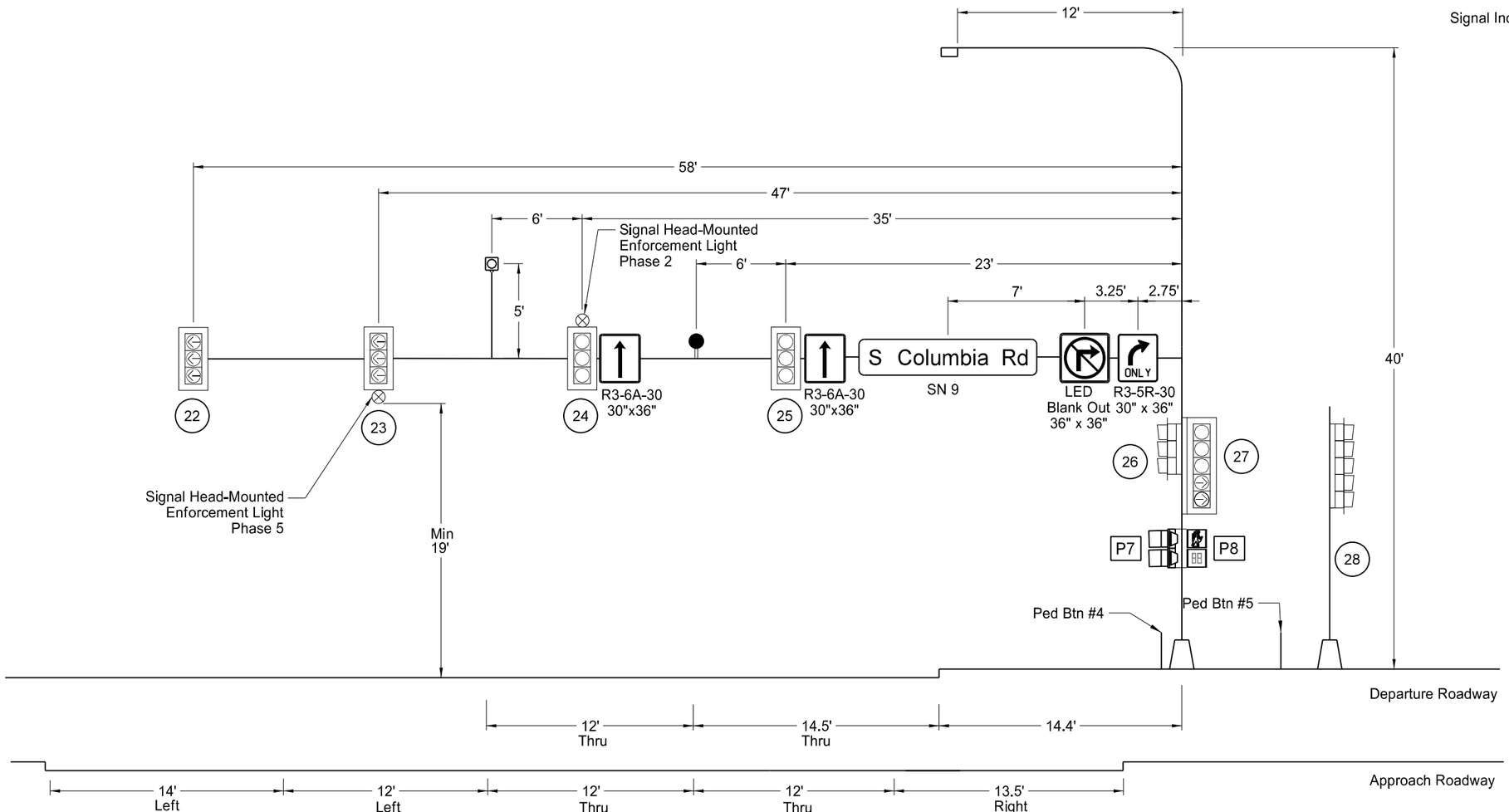
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	69

Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Eastbound 32nd Avenue South
(S9,S10)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- X — Vehicle Signal Head Number
- PX — Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 6
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

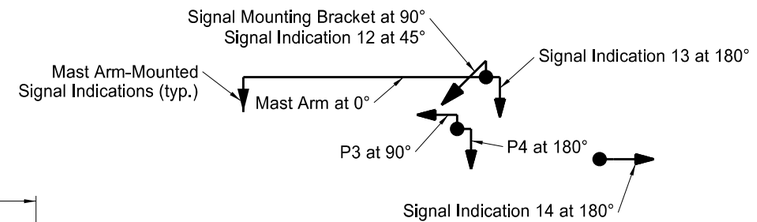
Columbia Road

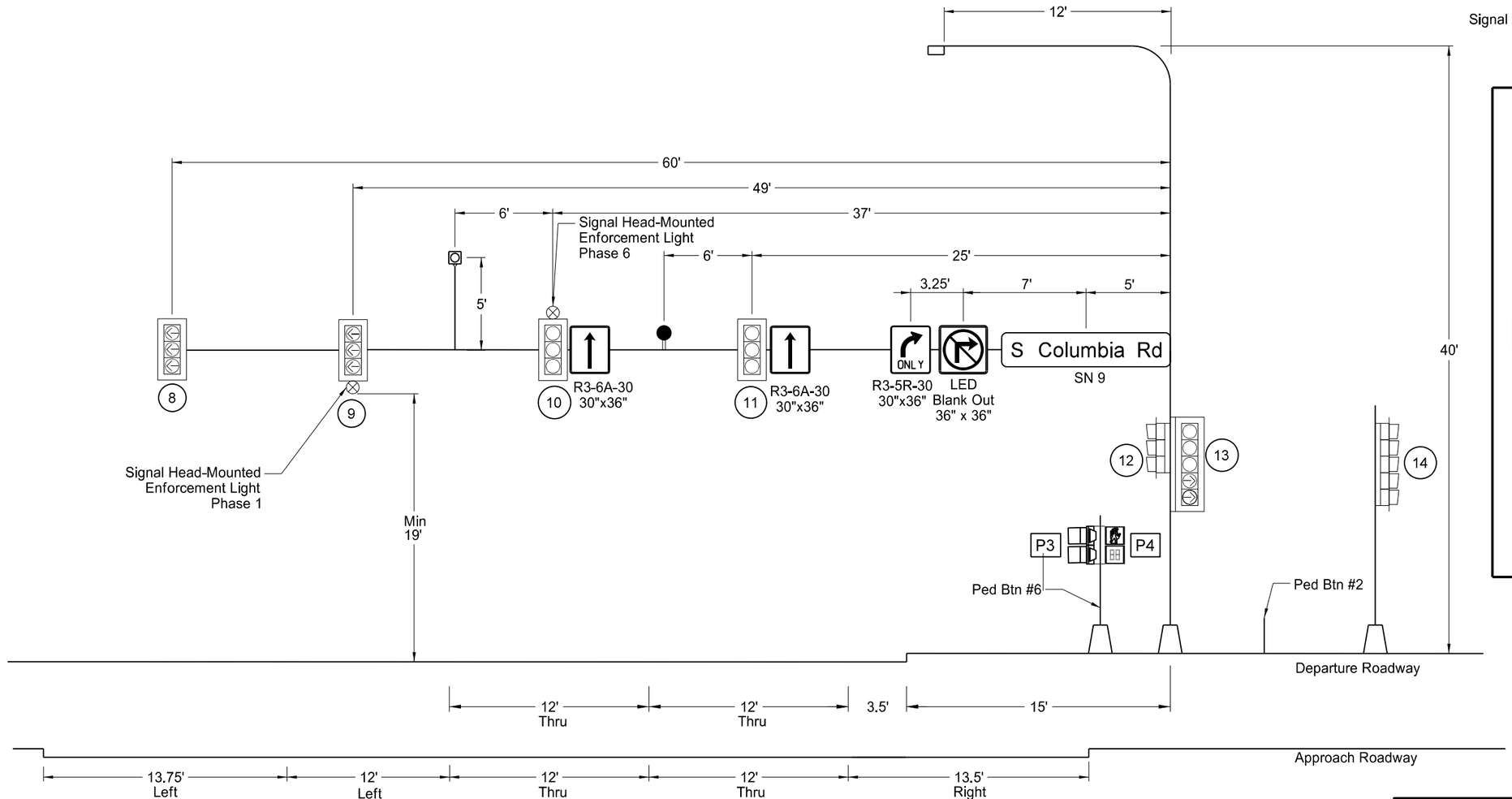
Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	70

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

Westbound 32nd Avenue South
(S4,S5,S6)

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Traffic Signal System - Site 6
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

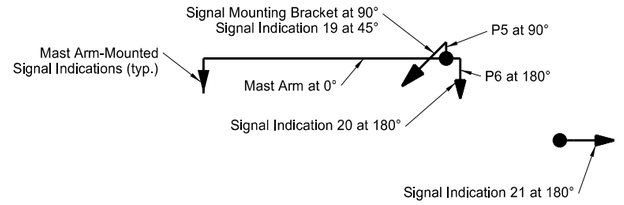
Columbia Road

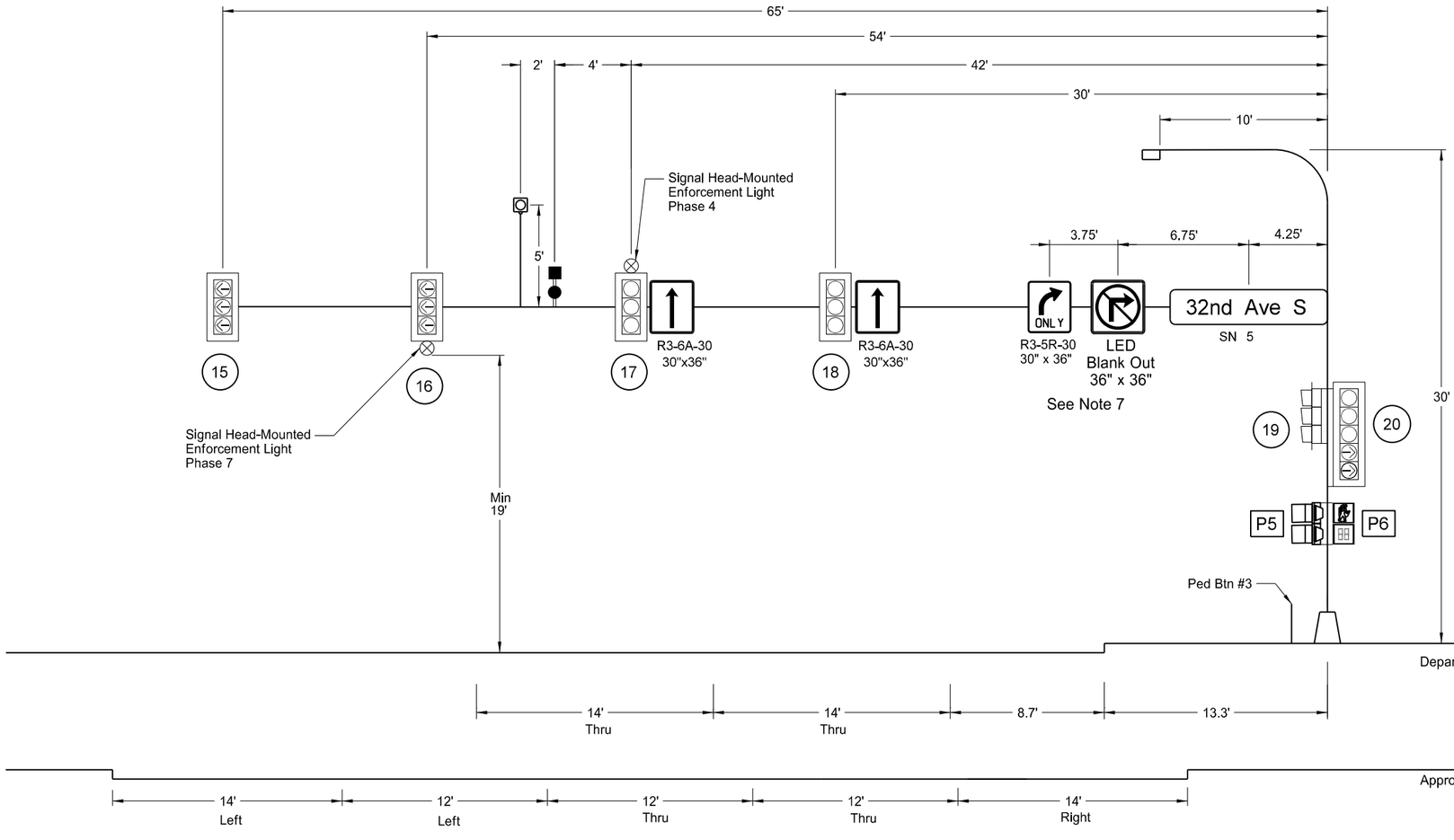
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	71

Notes:

1. Mount luminaire extension at 40'. Include a 10' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Determine the final location of the Emergency Vehicle Preemption GPS detector to provide a functional system.
5. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
6. See Section 110 for sign details.
7. Place signs R3-5R-30 and LED Blank Out in line with the center of the right turn lane and to the satisfaction of the engineer.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Northbound South Columbia Road
(S7,S8)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- X — Vehicle Signal Head Number
- PX — Pedestrian Head Number
- Emergency Vehicle Preemption GPS Detector and Light
- Enforcement Light

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Traffic Signal System - Site 6
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

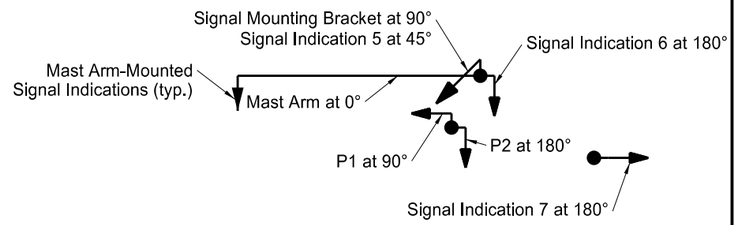
Columbia Road

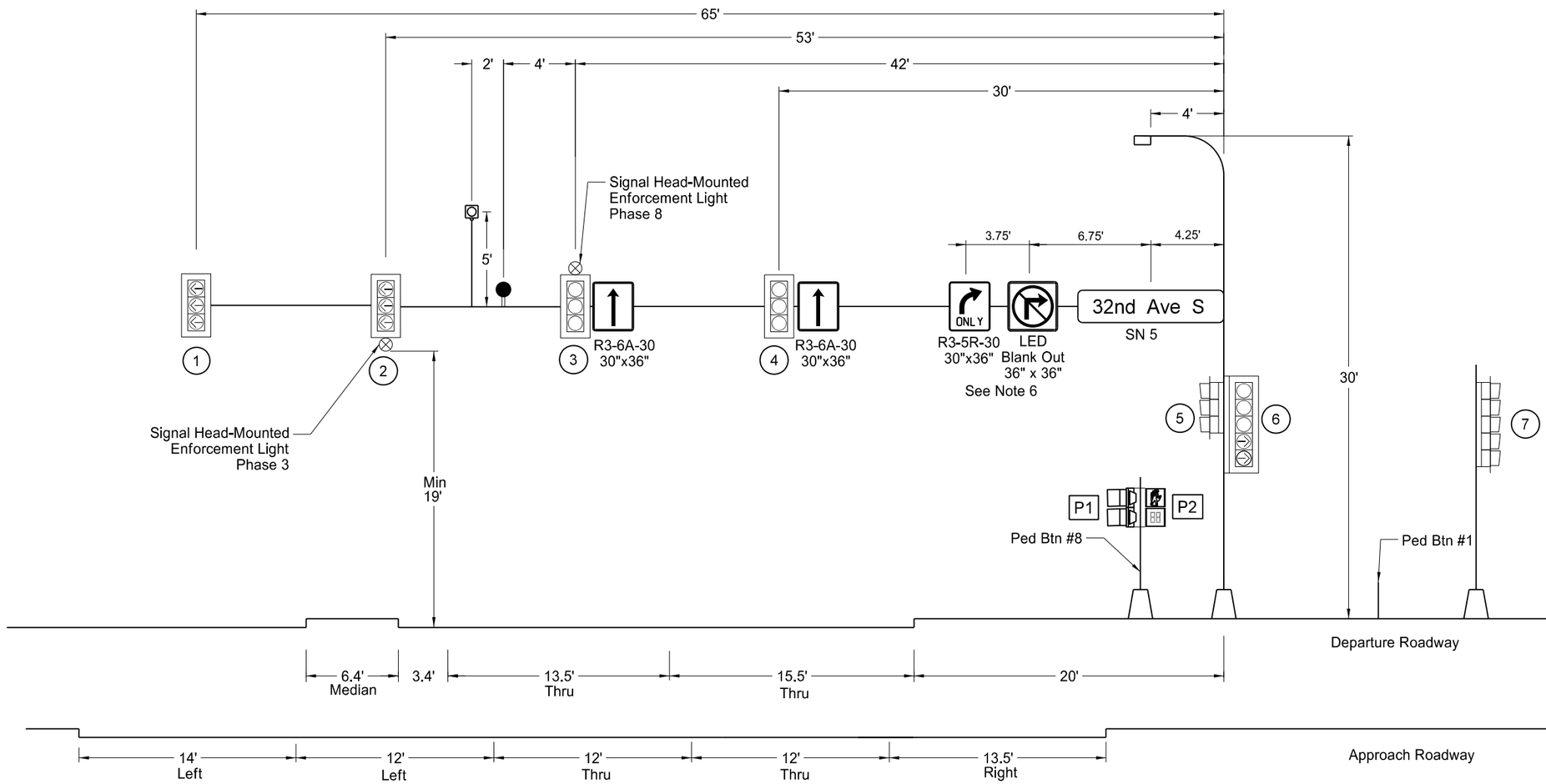
Notes:

1. Mount luminaire extension at 30'. Include a 4' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.
6. Place signs R3-5R-30 and LED Blank Out in line with the center of the right turn lane and to the satisfaction of the engineer.

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	72

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Southbound South Columbia Road
(S1,S2,S3)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- X — Vehicle Signal Head Number
- PX — Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 6
Signal Standard & Head Locations

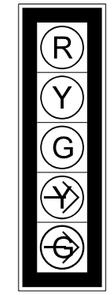
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	73

Conductor			Cable 1 (No.14 AWG 12)			Cable 2 (No.14 AWG 12)			Cable 3 (No.14 AWG 7)			Cable 4 (No.14 AWG 12)			Cable 5 (No.14 AWG 12)			Cable 6 (No.14 AWG 12)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		1,2	3	Green LT Arrow	5	1	Green LT Arrow	P1	2	Don't Walk			Spare	8,9	1	Green LT Arrow	12	7	Green LT Arrow
2	White				Neutral			Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		3,4	8	Red	6	8	Red	P1	2	Walk	7	2	Red	10,11	6	Red	13	6	Red
4	Green				Ground			Ground			Ground			Ground			Ground			Ground
5	Orange		3,4	8	Yellow	6	8	Yellow	P2	8	Don't Walk	7	2	Yellow	10,11	6	Yellow	13	6	Yellow
6	Blue		3,4	8	Green	6	8	Green	P2	8	Walk	7	2	Green	10,11	6	Green	13	6	Green
7	White	Black	1,2	3	Yellow LT Arrow	5	1	Yellow LT Arrow			Spare			Spare	8,9	1	Yellow LT Arrow	12	7	Yellow LT Arrow
8	Red	Black	1,2	3	Red LT Arrow	5	1	Red LT Arrow						Spare	8,9	1	Red LT Arrow	12	7	Red LT Arrow
9	Green	Black			Spare	6	5 OLC	Green RT Arrow				7	7 OLB	Green RT Arrow			Spare	13	3 OLD	Green RT Arrow
10	Orange	Black			Spare	6	5 OLC	Yellow RT Arrow				7	7 OLB	Yellow RT Arrow			Spare	13	3 OLD	Yellow RT Arrow
11	Blue	Black			Spare			Spare						Spare			Spare			Spare
12	Black	White			Spare			Spare						Spare			Spare			Spare

Conductor			Cable 7 (No.14 AWG 7)			Cable 8 (No.14 AWG 12)			Cable 9 (No.14 AWG 12)			Cable 10 (14 No.12 AWG)			Cable 11 (No.14 AWG 7)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		P3	8	Don't Walk			Spare	15,16	7	Green LT Arrow	19	5	Green LT Arrow	P5	6	Don't Walk
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		P3	8	Walk	14	8	Red	17,18	4	Red	20	4	Red	P5	6	Walk
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		P4	6	Don't Walk	14	8	Yellow	17,18	4	Yellow	20	4	Yellow	P6	4	Don't Walk
6	Blue		P4	6	Walk	14	8	Green	17,18	4	Green	20	4	Green	P6	4	Walk
7	White	Black			Spare			Spare	15,16	7	Yellow LT Arrow	19	5	Yellow LT Arrow			Spare
8	Red	Black						Spare	15,16	7	Red LT Arrow	19	5	Red LT Arrow			
9	Green	Black				14	5 OLC	Green RT Arrow			Spare	20	1 OLA	Green RT Arrow			
10	Orange	Black				14	5 OLC	Yellow RT Arrow			Spare	20	1 OLA	Yellow RT Arrow			
11	Blue	Black						Spare			Spare			Spare			
12	Black	White						Spare			Spare			Spare			



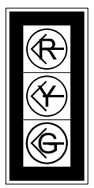
(12" Lenses)
Heads 6,7,13,14
20,21,27,28

Conductor			Cable 12 (No.14 AWG 12)			Cable 13 (No.14 AWG 12)			Cable 14 (14 No.12 AWG)			Cable 15 (No.14 AWG 7)			Cable 16 (No.14 AWG 12)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black				Spare	22,23	5	Green LT Arrow	26	3	Green LT Arrow	P7	4	Don't Walk			Spare
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		21	6	Red	24,25	2	Red	27	2	Red	P7	4	Walk	28	4	Red
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		21	6	Yellow	24,25	2	Yellow	27	2	Yellow	P8	2	Don't Walk	28	4	Yellow
6	Blue		21	6	Green	24,25	2	Green	27	2	Green	P8	2	Walk	28	4	Green
7	White	Black			Spare	22,23	5	Yellow LT Arrow	26	3	Yellow LT Arrow			Spare			Spare
8	Red	Black			Spare	22,23	5	Red LT Arrow	26	3	Red LT Arrow						Spare
9	Green	Black	21	3 OLD	Green RT Arrow			Spare	27	7 OLB	Green RT Arrow				28	1 OLA	Green RT Arrow
10	Orange	Black	21	3 OLD	Yellow RT Arrow			Spare	27	7 OLB	Yellow RT Arrow				28	1 OLA	Yellow RT Arrow
11	Blue	Black			Spare			Spare			Spare						Spare
12	Black	White			Spare			Spare			Spare						Spare

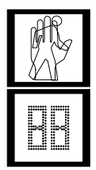
Notes:

1. Use LED indications for all heads.
2. Use 5" Louvered Black Plate with Type XI Yellow Reflective Border (typ.) on all heads.

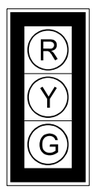
LED Blank Out Sign (36" x 36")
Use white LEDs for arrow
Use red LEDs for prohibition symbol



(12" Lenses)
Heads 1,2,5,8,9,12
15,16,19,22,23,26



(12" Lenses)
Heads P1, P2, P3,
P4, P5, P6, P7, P8



(12" Lenses)
Heads 3, 4,10,11,
17,18,24,25

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Traffic Signal System - Site 6
Signal Heads & Conductor Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	74

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Code	QTY	Type
1	Existing Feed Point to Controller	12	2"	22	E	1	Multi 3 No. 6 USE
2A	Controller to Pull Box 1	32	4"	41	A	1	No. 14 AWG 3 Conductor Cable
				41	B	1	Emergency Detector Cable
				164	C	4	Cable 4,5,6,8
				41	C	1	Cable 7
				123	C	3	Push Button
				41	D	1	Video Detector Cable
				82	F	2	No. 14 AWG 3 Conductor Cable
				41	K	1	Electronic Sign
2B	Controller to Pull Box 1	32	4"	41	A	1	No. 14 AWG 3 Conductor Cable
				41	B	1	Emergency Detector Cable
				123	C	3	Cable 9,10,12
				41	C	1	Cable 11
				82	C	2	Push Button
				41	D	1	Video Detector Cable
				82	F	2	No. 14 AWG 3 Conductor Cable
				41	K	1	Electronic Sign
3	Controller to Pull Box 6	58	4"	134	A	2	No. 14 AWG 3 Conductor Cable
				134	B	2	Emergency Detector Cable
				335	C	5	Cable 1,2,13,14,16
				134	C	2	Cable 3,15
				201	C	3	Push Button
				134	D	2	Video Detector Cable
				268	F	4	No. 14 AWG 3 Conductor Cable
				134	K	2	Electronic Sign
4	Pull Box 1 to Ped Push Btn. #1	23	2"	31	C	1	Push Button
5	Pull Box 1 to Signal Std. - S3	18	2"	38	C	1	Cable 4
6A	Pull Box 1 to Pull Box 2	133	4"	139	A	1	No. 14 AWG 3 Conductor Cable
				139	B	1	Emergency Detector Cable
				417	C	3	Cable 5,6,8
				139	C	1	Cable 7
				278	C	2	Push Button
				139	D	1	Video Detector Cable
				278	F	2	No. 14 AWG 3 Conductor Cable
				139	K	1	Electronic Sign
6B	Pull Box 1 to Pull Box 2	133	4"	139	A	1	No. 14 AWG 3 Conductor Cable
				139	B	1	Emergency Detector Cable
				417	C	3	Cable 9,10,12
				139	C	1	Cable 11
				278	C	2	Push Button
				139	D	1	Video Detector Cable
				278	F	2	No. 14 AWG 3 Conductor Cable
				139	K	1	Electronic Sign
6C	Pull Box 1 to Pull Box 2	133	4"	Empty conduit for future use			
7	Pull Box 2 to Signal Std. - S5	28	2"	45	C	1	Cable 7
				41	C	1	Push Button
8	Pull Box 2 to Signal Std. - S6	48	2"	68	C	1	Cable 8

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Code	QTY	Type
9	Pull Box 2 to Ped Push Btn. #2	43	2"	51	C	1	Push Button
10	Pull Box 2 to Signal Std. - S4	19	3"	78	A	1	No. 14 AWG 3 Conductor Cable
				78	B	1	Emergency Detector Cable
				214	C	2	Cable 5,6
				90	D	1	Video Detector Cable
				214	F	2	No. 14 AWG 3 Conductor Cable
				62	K	1	Electronic Sign
11	Pull Box 2 to Pull Box 3	66	4"	72	A	1	No. 14 AWG 3 Conductor Cable
				72	B	1	Emergency Detector Cable
				216	C	3	Cable 9,10,12
				72	C	1	Cable 11
				144	C	2	Push Button
				72	D	1	Video Detector Cable
				144	F	2	No. 14 AWG 3 Conductor Cable
				72	K	1	Electronic Sign
12	Pull Box 3 to Pull Box 4	140	4"	146	A	1	No. 14 AWG 3 Conductor Cable
				146	B	1	Emergency Detector Cable
				438	C	3	Cable 9,10,12
				146	C	1	Cable 11
				292	C	2	Push Button
				146	D	1	Video Detector Cable
				292	F	2	No. 14 AWG 3 Conductor Cable
				146	K	1	Electronic Sign
13	Pull Box 4 to Signal Std. - S7	22	3"	96	A	1	No. 14 AWG 3 Conductor Cable
				96	B	1	Emergency Detector Cable
				230	C	2	Cable 9,10
				39	C	1	Cable 11
				98	D	1	Video Detector Cable
				230	F	2	No. 14 AWG 3 Conductor Cable
				65	K	1	Electronic Sign
14	Pull Box 4 to Ped Push Btn. #3	28	2"	36	C	1	Push Button

Cable Code

A = Emergency Vehicle Indicator Lamp
B = Emergency Vehicle Detector Cable
C = Signal Control Cable
D = Video Detection Cable
E = Power Cable
F = Enforcement Light Cable
K = Electronic Sign Cable

Note:
All conduit and cable lengths are in feet.

Traffic Signal System - Site 6
Conduit Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	75

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Code	QTY	Type
15	Pull Box 4 to Signal Std. - S8	33	2"	53	C	1	Cable 12
				46	C	1	Push Button
16	Signal Std. - S9 to Pull Box 5	34	3"	92	A	1	No. 14 AWG 3 Conductor Cable
				92	B	1	Emergency Detector Cable
				240	C	2	Cable 13,14
				51	C	1	Cable 15
				103	D	1	Video Detector Cable
				240	F	2	No. 14 AWG 3 Conductor Cable
				72	K	1	Electronic Sign
17	Ped Push Btn. #4 to Pull Box 5	32	2"	40	C	1	Push Button
18	Ped Push Btn. #5 to Pull Box 5	26	2"	34	C	1	Push Button
19	Signal Std. - S10 to Pull Box 5	23	2"	43	C	1	Cable 16
20	Pull Box 5 to Pull Box 6	141	3"	147	A	1	No. 14 AWG 3 Conductor Cable
				147	B	1	Emergency Detector Cable
				441	C	3	Cable 13,14,16
				147	C	1	Cable 15
				294	C	2	Push Button
				147	D	1	Video Detector Cable
				294	F	2	No. 14 AWG 3 Conductor Cable
				147	K	1	Electronic Sign
21	Signal Std. - S2 to Pull Box 6	10	2"	27	C	1	Cable 3
				23	C	1	Push Button
22	Signal Std. - S1 to Pull Box 6	14	3"	88	A	1	No. 14 AWG 3 Conductor Cable
				88	B	1	Emergency Detector Cable
				214	C	2	Cable 1,2
				90	D	1	Video Detector Cable
				214	F	2	No. 14 AWG 3 Conductor Cable
				57	K	1	Electronic Sign

Cable Code

A = Emergency Vehicle Indicator Lamp
B = Emergency Vehicle Detector Cable
C = Signal Control Cable
D = Video Detection Cable
E = Power Cable
F = Enforcement Light Cable
K = Electronic Sign Cable

Note:
All conduit and cable lengths are in feet.

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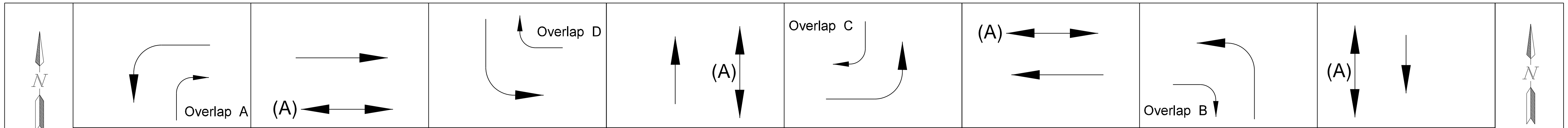
Traffic Signal System - Site 6
Conduit Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	76



Head #	Phase 1 R/W	Clear to 2	3	4	5	6	7	8	Phase 2 R/W	Clear to 3	4	5	6	7	8	1
1																
2																
3																
4																
5	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
6																
7									G	Y	Y	(B)	(B)	Y	Y	Y
8	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
9	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
10																
11																
12																
13																
14																
15																
16																
17																
18																
19																
20	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								
21																
22																
23																
24									G	Y	Y	(B)	(B)	Y	Y	Y
25									G	Y	Y	(B)	(B)	Y	Y	Y
26																
27									G	Y	Y	(B)	(B)	Y	Y	Y
28	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								

Head #	Phase 3 R/W	Clear to 4	5	6	7	8	1	2	Phase 4 R/W	Clear to 5	6	7	8	1	2	3
1	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
2	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								
14																
15																
16																
17									G	Y	Y	(B)	(B)	Y	Y	Y
18									G	Y	Y	(B)	(B)	Y	Y	Y
19																
20									G	Y	Y	(B)	(B)	Y	Y	Y
21	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								
22																
23																
24																
25																
26	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
27																
28									G	Y	Y	(B)	(B)	Y	Y	Y

Head #	Phase 5 R/W	Clear to 6	7	8	1	2	3	4	Phase 6 R/W	Clear to 7	8	1	2	3	4	5
1																
2																
3																
4																
5																
6	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								
7																
8																
9																
10									G	Y	Y	(B)	(B)	Y	Y	Y
11									G	Y	Y	(B)	(B)	Y	Y	Y
12																
13									G	Y	Y	(B)	(B)	Y	Y	Y
14	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								
15																
16																
17																
18																
19	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
20																
21									G	Y	Y	(B)	(B)	Y	Y	Y
22	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
23	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
24																
25																
26																
27																
28																

Head #	Phase 7 R/W	Clear to 8	1	2	3	4	5	6	Phase 8 R/W	Clear to 1	2	3	4	5	6	7
1																
2																
3									G	Y	Y	(B)	(B)	Y	Y	Y
4									G	Y	Y	(B)	(B)	Y	Y	Y
5																
6									G	Y	Y	(B)	(B)	Y	Y	Y
7	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								
8																
9																
10																
11																
12	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
13																
14									G	Y	Y	(B)	(B)	Y	Y	Y
15	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
16	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y								
17																
18																
19																
20																
21																
22																
23																
24																
25																
26																
27	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								
28																

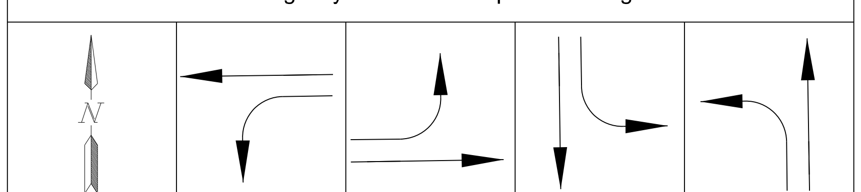
Blank Squares Denote Red Indication
(A) = Pedestrian movements, upon activation.
(B) = When one phase is on alone a nonconflicting phase may start timing concurrently without a clearance interval (See Chart A).

——► Protected Movement - - -► Permitted Movement ◄—► Pedestrian Actuated Movement

Chart A
Non-Conflicting Phases

On Phase	Non-Conflicting Phase Allowed to Time Concurrently
1	5 or 6
2	5 or 6
3	7 or 8
4	7 or 8
5	1 or 2
6	1 or 2
7	3 or 4
8	3 or 4

Emergency Vehicle Preemption Phasing



Direction	Westbound	Eastbound	Southbound	Northbound
Dwell Phases	1,6	2,5	3,8	4,7
Dwell Overlaps	-	-	-	-

Chart D
No Turn on Red Sign Activation Overlaps

Overlap	Direction of vehicular travel - Signal Std.	Conflicting Left Turn Phase	Parallel Pedestrian Phase	Perpendicular Pedestrian Phase
I	Southbound - S1	7	8 Ped	6 Ped
J	Westbound - S4	5	6 Ped	4 Ped
K	Northbound - S7	3	4 Ped	2 Ped
L	Eastbound - S9	1	2 Ped	8 Ped

Chart B
Overlaps

Overlap	Included Phases	Ped Protect Phases
A	1, 4	4 Ped
B	7, 2	2 Ped
C	5, 8	8 Ped
D	3, 6	6 Ped

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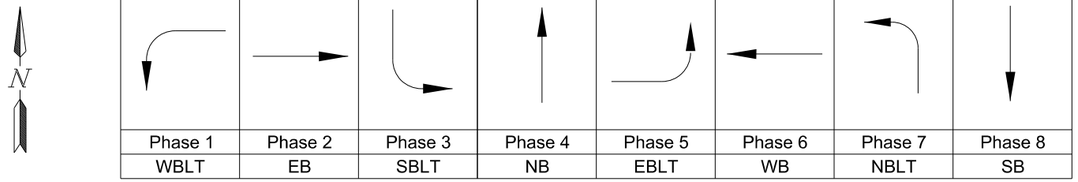
Traffic Signal System - Site 6
Signal Controller Phasing

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	77



	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
	WBLT	EB	SBLT	NB	EBLT	WB	NBLT	SB
BASIC INTERVALS (OR FUNCTIONS)								
Minimum Initial	7.0	15.0	7.0	10.0	7.0	15.0	7.0	10.0
Vehicle Extension	3.0	5.0	3.0	5.0	3.0	5.0	3.0	5.0
Maximum Green (Max 1)	24.0	30.0	23.0	32.0	22.0	33.0	30.0	32.0
Yellow Change	3.5	4.0	3.5	4.0	3.5	4.0	3.5	4.0
Red Clearance	2.5	2.0	2.5	1.5	2.5	2.0	2.5	1.5
Walk	-	7.0	-	7.0	-	7.0	-	7.0
Pedestrian Clearance	-	32.0	-	28.0	-	32.0	-	29.0
Delayed Green (Leading Pedestrian Interval)	-	6.0	-	6.0	-	6.0	-	6.0
VOLUME DENSITY TIMING FUNCTIONS								
VARIABLE INITIAL TIMING OPTIONS								
Actuations Before Added Initial	-	-	-	-	-	-	-	-
Added Initial per Actuation	-	-	-	-	-	-	-	-
Maximum Initial	-	-	-	-	-	-	-	-
GAP REDUCTION OPTIONS								
Time Before Reduction	-	20.0	-	-	-	20.0	-	-
Time to Reduce to Minimum Gap	-	20.0	-	-	-	20.0	-	-
Minimum Gap	-	2.5	-	-	-	2.5	-	-
OTHER CONTROLLER FUNCTIONS								
Locking Memory	-	x	-	x	-	x	-	x
Non-Locking Memory	x	-	x	-	x	-	x	-
Phase recall	-	x	-	-	-	x	-	-
Red Revert	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Backup Prevent Phases	-	-	-	-	-	-	-	-
No Serve Phases	-	-	-	-	-	-	-	-
Flashing-Normal & Conflict Monitor	R	R	R	R	R	R	R	R

Notes:
1. Operate all left turn phases in protected mode.

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Traffic Signal System - Site 6
Timing Settings

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	78

SPEC	CODE	ITEM DESCRIPTION	UNIT	TOTAL
770	0445	MULTIPLE UNDERGROUND CABLE 3NO6 STYLE USE	LF	30
770	0464	MULTIPLE UNDERGROUND CABLE 3NO4-1NO6 STYLE USE	LF	800
770	4210	LED LUMINAIRE	EA	4
772	0020	CONCRETE FOUNDATION-TRAFFIC SIGNALS	EA	10
772	0100	PULL BOX	EA	6
772	0240	2IN DIAMETER RIGID CONDUIT	LF	390
772	0270	3IN DIAMETER RIGID CONDUIT	LF	260
772	0290	4IN DIAMETER RIGID CONDUIT	LF	770
772	0375	EMERGENCY VEHICLE DETECTOR CABLE	LF	1220
772	0432	NO14 AWG 2 CONDUCTOR CABLE	LF	2000
772	0433	NO14 AWG 3 CONDUCTOR CABLE	LF	4950
772	0437	NO14 AWG 7 CONDUCTOR CABLE	LF	1030
772	0442	NO14 AWG 12 CONDUCTOR CABLE	LF	3660
772	0601	TYPE II SIGNAL STANDARD	EA	6
772	1282	COMBO 58FT MA SIG & LT STD-TYPE C	EA	1
772	1295	COMBO 60FT MA SIG & LT STD-TYPE C	EA	1
772	1810	1-WAY 3 SEC HEAD W/12IN LENS-POST MTD	EA	4
772	1812	1-WAY 3 SEC HEAD W/12IN LENS-MA MTD	EA	16
772	1830	1-WAY 5 SEC HEAD W/12IN LENS-POST MTD	EA	4
772	1831	1-WAY 5 SEC HEAD W/12IN LENS-PEDESTAL MTD	EA	4
772	2060	PEDESTRIAN COUNTDOWN SIGNAL HEAD-POST MTD	EA	4
772	2061	PEDESTRIAN COUNTDOWN SIGNAL HEAD-PEDESTAL MTD	EA	4
772	2070	LAW ENFORCEMENT CONFIRMATION LIGHT	EA	8
772	2200	PEDESTRIAN PUSHBUTTON POST	EA	5
772	2215	PEDESTRIAN PUSHBUTTON & SIGN	EA	8
772	2260	VIDEO DETECTION CABLE	LF	1240
772	2265	VIDEO DETECTION SYSTEM	EA	1
772	2556	BATTERY BACKUP SYSTEM	EA	1
772	2610	EMERGENCY VEHICLE PREEMPTION UNIT	EA	4
772	2621	EMERGENCY VEHICLE PRE-EMPTION PHASE SELECTOR	EA	1
772	3125	REMOVE TRAFFIC SIGNAL SYSTEM	EA	1
		COMBO 65FT MA SIG & LT STD-TYPE C	EA	2
		36"X36" LED SIGN - "NO TURN ON RED"	EA	4
		CONTROLLER AND CABINET	EA	1
772	9816	TRAFFIC SIGNAL SYSTEM - SITE 6	EA	1
		The items appear above for informational purposes; provide all labor and equipment necessary for the signal system to be fully operational as shown in the Plans. Include items in the corresponding price bid for "TRAFFIC SIGNAL SYSTEM - SITE 6"		

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Traffic Signal System - Site 6
Estimated Traffic Signal Quantities

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

Columbia Road

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	79

Legend

- Existing Signal Standard
- Existing Pull Box
- Existing Controller and Cabinet
- Existing Signal Mast Arm
- Existing Signal Head
- Existing Ped. Push Button Station
- Existing Feed Point

N

R/W

F O

E

Remove 5-Section Signal Head

Remove Ped Pushbutton Remove Ped Head

32nd Ave S (40 mph)

2180 2181 2182 2183 2184 2185

Sta. 2182+73.01
6.09' RT
Salvage/Remove PPP

32nd Ave S (40 mph)

Sta. 2182+21.39
57.73' RT
Salvage/Remove PPP

Remove Two Ped Pushbuttons Remove Two Ped Heads

Sta. 2183+05.08
64.80 RT
Salvage/Remove Signal Controller and Cabinet, video detection equipment, and EVP equipment

Sta. 2181+56.93
64.15 RT
Remove Signal Std. Pedestal

Abandon approximately 31' of existing 2" conduit

Sta. 2181+82.27
78.28 RT
Remove Exist. PB
Remove Ped Head

Abandon approximately 38' of existing 4" conduit

S 24th St (15 mph)

10' Utility Easement

Sta. 2182+96.94
62.38 RT
Salvage/Remove Exist. Battery Backup & Video Cabinet

Note:
All stations and offsets are referenced from SCL81 alignment.

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Revise Traffic Signal System - Site 7
Traffic Signal Removal

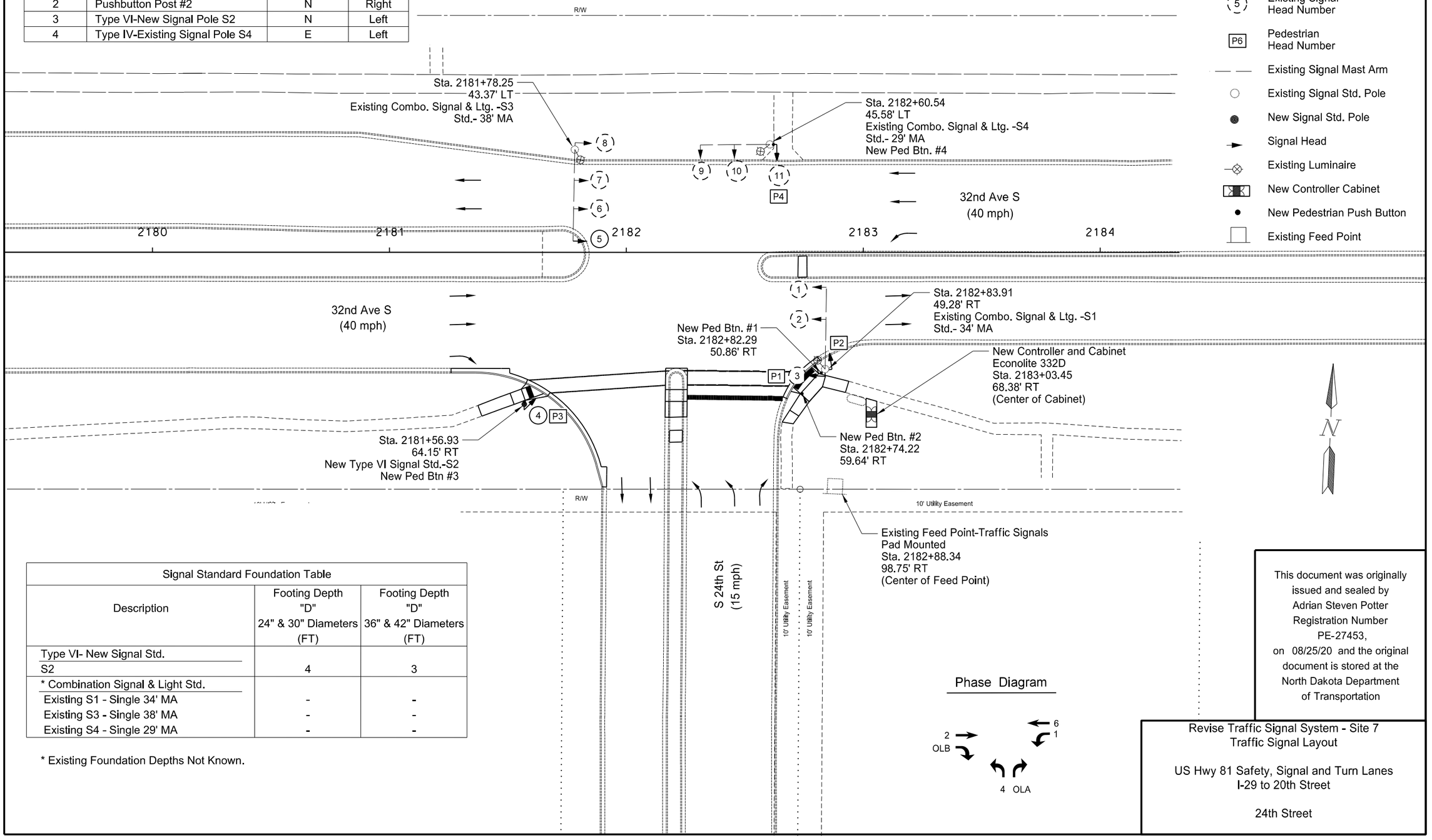
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

24th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	80

Pedestrian Pushbutton Schedule			
Pushbutton Number (New)	Pushbutton Location	Pushbutton & Signal Location on Pole	Direction of Arrow on Sign
1	Pushbutton Post #1	W	Left
2	Pushbutton Post #2	N	Right
3	Type VI-New Signal Pole S2	N	Left
4	Type IV-Existing Signal Pole S4	E	Left

Note:
All stations and offsets are referenced from SCL81 alignment.



Legend

- (5) New Signal Head Number
- (5) Existing Signal Head Number
- [P6] Pedestrian Head Number
- Existing Signal Mast Arm
- Existing Signal Std. Pole
- New Signal Std. Pole
- Signal Head
- Existing Luminaire
- New Controller Cabinet
- New Pedestrian Push Button
- Existing Feed Point

Signal Standard Foundation Table		
Description	Footing Depth "D" 24" & 30" Diameters (FT)	Footing Depth "D" 36" & 42" Diameters (FT)
Type VI- New Signal Std.		
S2	4	3
* Combination Signal & Light Std.		
Existing S1 - Single 34' MA	-	-
Existing S3 - Single 38' MA	-	-
Existing S4 - Single 29' MA	-	-

* Existing Foundation Depths Not Known.

Phase Diagram

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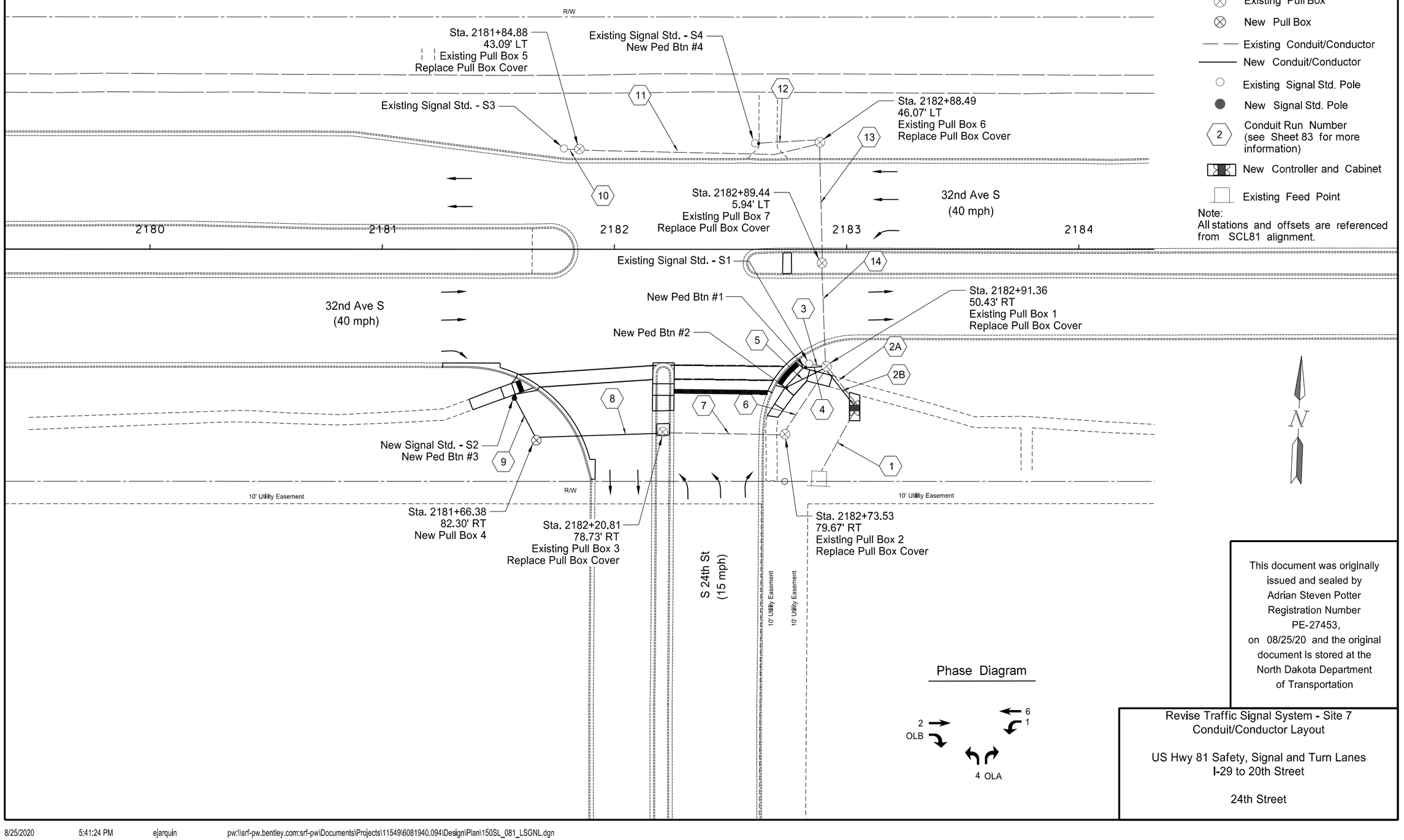
Revise Traffic Signal System - Site 7
Traffic Signal Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

24th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	81



Legend

- Existing Pull Box
- New Pull Box
- Existing Conduit/Conductor
- New Conduit/Conductor
- Existing Signal Std. Pole
- New Signal Std. Pole
- 2 — Conduit Run Number (see Sheet 83 for more information)
- New Controller and Cabinet
- Existing Feed Point

Note:
All stations and offsets are referenced from SCL81 alignment.

N

Phase Diagram

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Revise Traffic Signal System - Site 7
Conduit/Conductor Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

24th Street

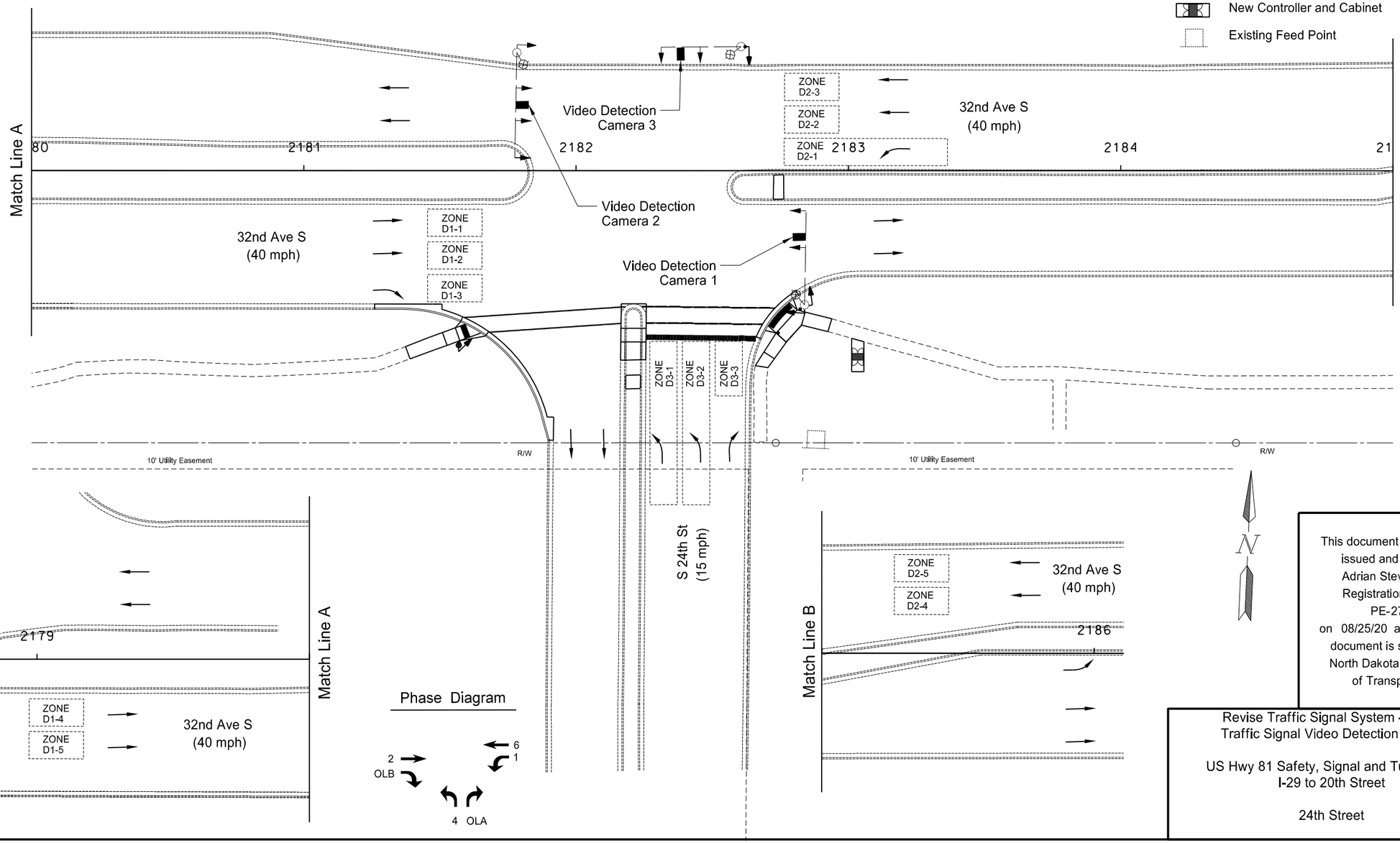
Zone	Type	Phase	Approximate Distance from Stop Bar to Detection Zone
1-1,1-2,1-3	Calling	2	0'
1-4,1-5	Passage	2	250'
2-1	Presence	1	0'
2-2,2-3	Calling	6	0'
2-4,2-5	Passage	6	250'
3-1,3-2	Presence	4	0'
3-3	Calling	4	0'

Note:
All stations and offsets are referenced from SCL81 alignment.

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	82

Legend

- New Video Detection Camera
- Video Detection Zone
- Existing Signal Mast Arm
- Existing Signal Std. Pole
- Signal Head
- Existing Luminaire
- New Controller and Cabinet
- Existing Feed Point



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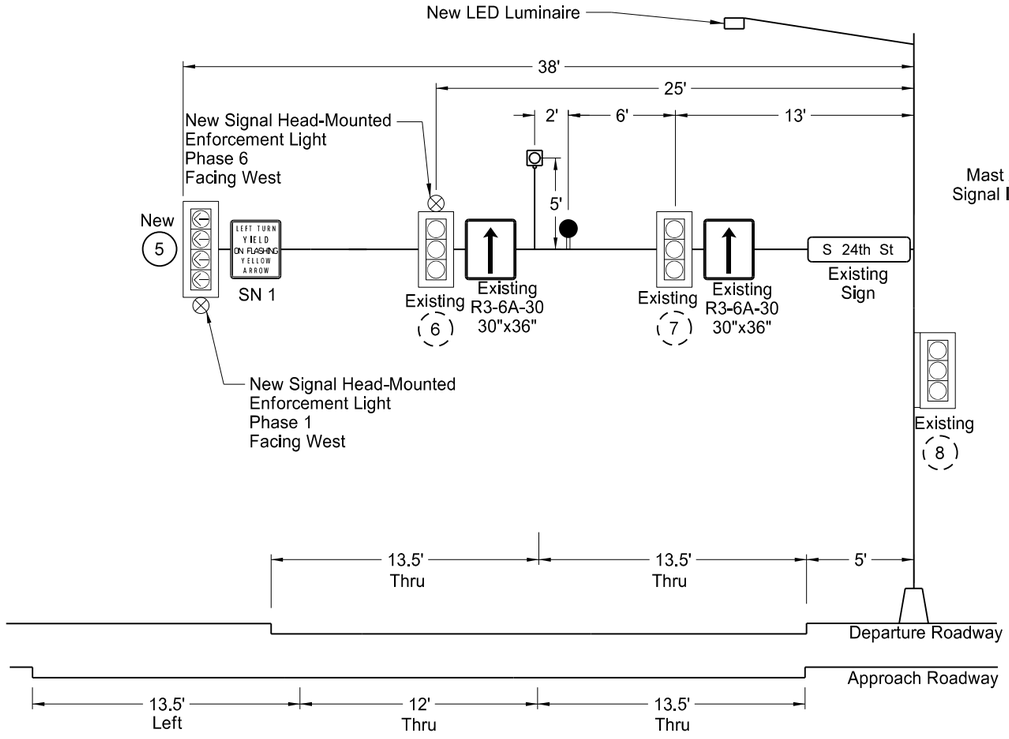
Revise Traffic Signal System - Site 7
Traffic Signal Video Detection Layout

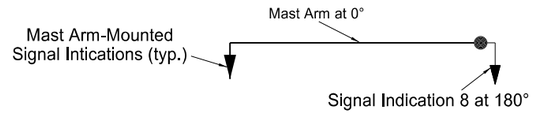
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

24th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	83



Pole-Mounted Signal
Indication Orientation Detail
Not to Scale

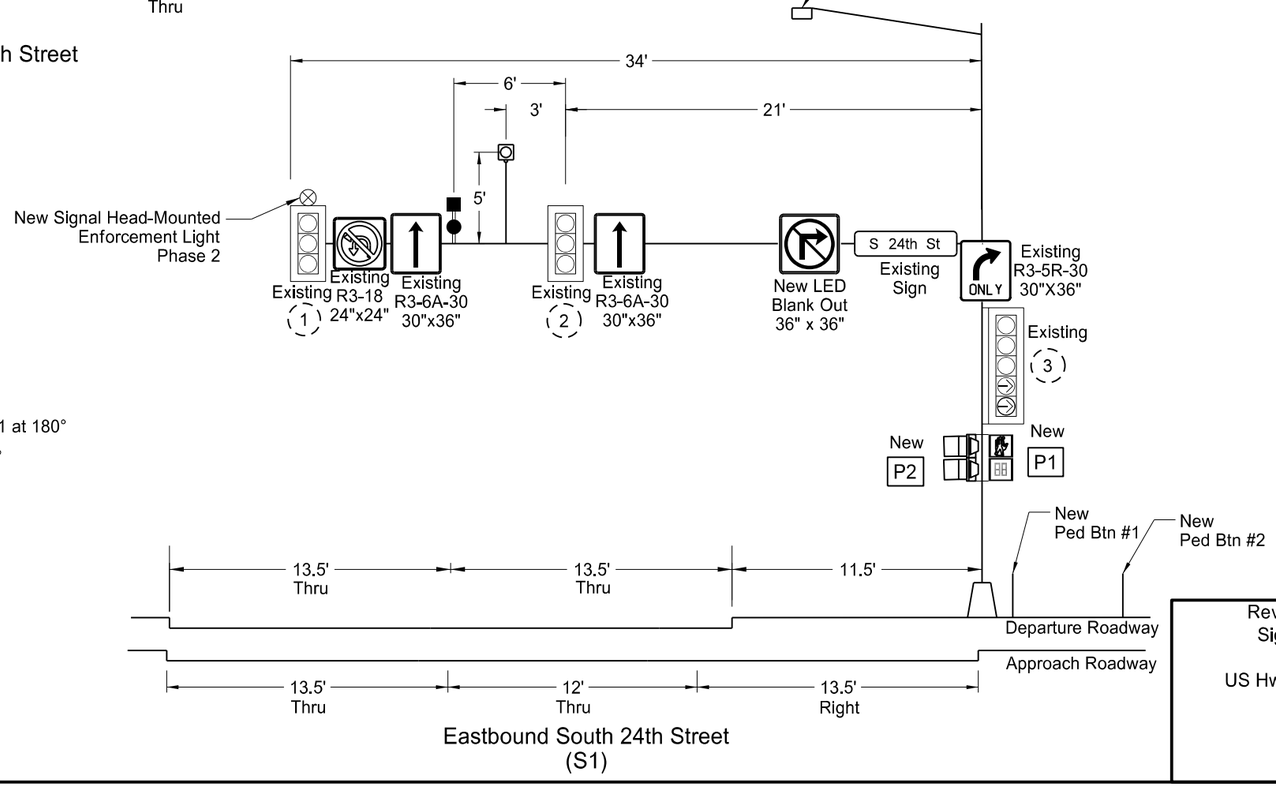


Notes:

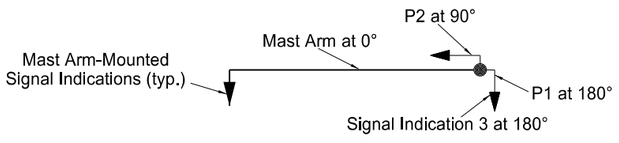
1. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole
2. Furnish and Install LED Luminaire.
3. See Section 110 for sign details.

Legend

- Transformer Base
- New Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- PX Pedestrian Head Number
- New Emergency Vehicle Preemption Indicator Light
- New Emergency Vehicle Preemption GPS Detector and Light
- Enforcement Light



Pole-Mounted Signal
Indication Orientation Detail
Not to Scale



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Revise Traffic Signal System - Site 7
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

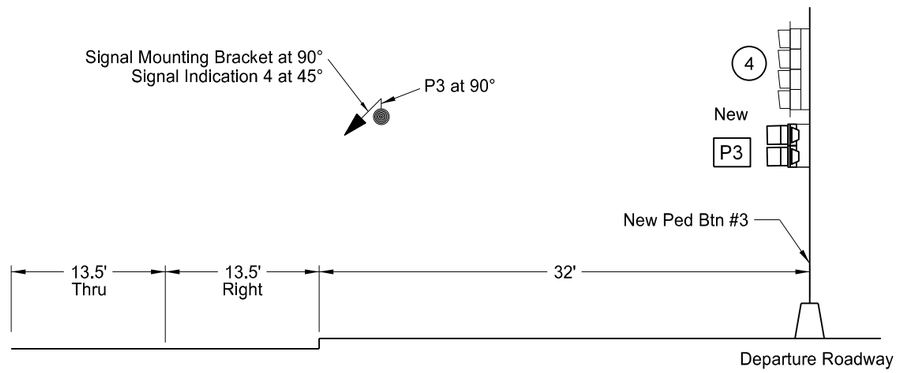
24th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	84

Notes:

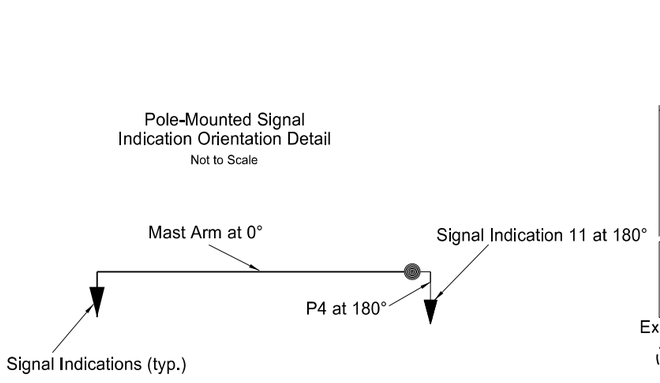
1. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole
2. Furnish and Install LED Luminaire.
3. See Section 110 for sign details.

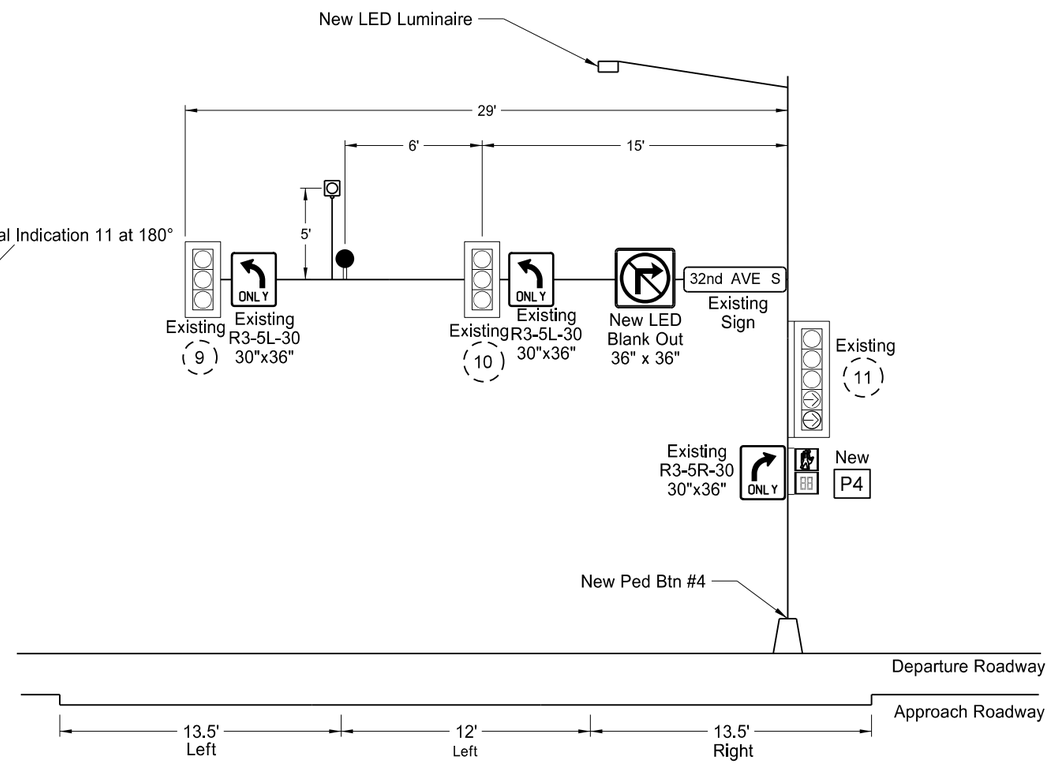
Pole-Mounted Signal
Indication Orientation Detail
Not to Scale



Southbound South 24th Street
(S2)

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Northbound South 24th Street
(S4)

Legend

- Transformer Base
- New Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- New Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Revise Traffic Signal System - Site 7
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

24th Street

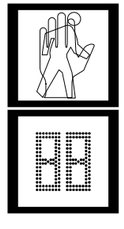
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	85

Conductor			Existing Cable 1 (12 No.12 AWG)			Existing Cable 2 (12 No.12 AWG)			Existing Cable 3 (12 No.12 AWG)			Existing Cable 4 (12 No.12 AWG)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black				Spare	9,10	7	Green	3	7 OLB	Green Right Arrow			Spare
2	White				Neutral			Neutral			Neutral			Neutral
3	Red		6,7,8	6	Red	9,10,11	7	Red	1,2,3	2	Red	P2	7	Walk
4	Green				Ground			Ground			Ground			Ground
5	Orange		6,7,8	6	Yellow	9,10,11	7	Yellow	1,2,3	2	Yellow	P2	7	Don't Walk
6	Blue		6,7,8	6	Green	11	1 OLA	Green	1,2,3	2	Green	P1	2	Walk
7	White	Black			Spare			Spare	3	7 OLB	Yellow RIght Arrow	P1	2	Don't Walk
8	Red	Black	5	1	Red Left Arrow	11	1 OLA	Green Right Arrow			Spare			Spare
9	Green	Black			Spare	11	1 OLA	Yellow Right Arrow			Spare			Spare
10	Orange	Black	5	1	Flashing Yellow Left Arrow	P4	7	Walk			Spare			Spare
11	Blue	Black	5	1	Green Left Arrow			Neutral			Spare			Spare
12	Black	White	5	1	Yellow Left Arrow	P4	7	Don't Walk			Spare			Spare

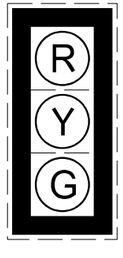
Conductor			New Cable 5 (14 No.12 AWG)		
Run	Base	Tracer	Head	Phase	Indication
1	Black				Spare
2	White				Neutral
3	Red		4	1	Red Left Arrow
4	Green				Ground
5	Orange		4	1	Flashing Yellow Left Arrow
6	Blue		4	1	Green Left Arrow
7	White	Black	4	1	Yellow Left Arrow
8	Red	Black			Spare
9	Green	Black			Spare
10	Orange	Black	P3	2	Walk
11	Blue	Black			Neutral
12	Black	White	P3	2	Don't Walk

Notes:

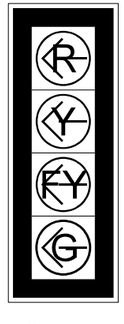
1. Use LED indications on new 4-section Flashing Yellow Arrow heads.
2. Use 5" Louvered Black Plate on new 4-section Flashing Yellow Arrow heads.



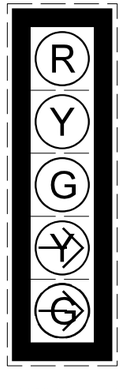
(12" Lenses)
New Heads P1, P2, P3, P4



(12" Lenses)
Existing Heads 1, 2, 6, 7, 8, 9, 10



(12" Lenses)
New Heads 4, 5



(12" Lenses)
Existing Heads 3, 11

LED Blank Out Sign (36" x 36")
Use white LEDs for arrow
Use red LEDs for prohibition symbol

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Revise Traffic Signal System - Site 7
Signal Heads & Conductor Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

24th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	86

Conduit Run	Location	Conduit Run		Cable Run			
		Length	Size	Length	Code	QTY	Type
1	Existing Feed Point to Controller	(EX)	(EX)	(EX)	E	2	No. 6 RHW (EX)
				(EX)	E	1	No. 6 THW (EX)
2A	Controller to Existing Pull Box 1	22 (EX)	4" (EX)	93	A	3	No. 14 AWG 3 Conductor Cable
				93	B	3	Emergency Detector Cable
				88	C	4	Existing Cables 1,2,3,4
				22	C	1	Push Button (EX)
				124	C	4	New Push Button
				93	F	3	No. 14 AWG 3 Conductor Cable
				62	K	2	Electronic Sign
2B	Controller to Existing Pull Box 1	22	4"	31	C	1	New Cable 5
				93	D	3	Video Detector Cable
3	Existing Pull Box 1 to Existing Signal Std. - S1	5 (EX)	4" (EX)	60	A	1	No. 14 AWG 3 Conductor Cable
				60	B	1	Emergency Detector Cable
				10	C	2	Existing Cable 3,4
				57	D	1	Video Detector Cable
				67	F	1	No. 14 AWG 3 Conductor Cable
				43	K	1	Electronic Sign
4	Existing Pull Box 1 to New Ped Push Button 1	9	2"	17	C	1	New Push Button
5	Existing Pull Box 1 to New Ped Push Button 2	20	2"	28	C	1	New Push Button
6	Existing Pull Box 1 to Existing Pull Box 2	35 (EX)	2" (EX)	41	C	1	New Cable 5
				41	C	1	New Push Button
7	Existing Pull Box 2 to Existing Pull Box 3	45 (EX)	4" (EX)	51	C	1	New Cable 5
				51	C	1	New Push Button
8	Existing Pull Box 3 to New Pull Box 4	53	4"	59	C	1	New Cable 5
				59	C	1	New Push Button
9	New Pull Box 4 to New Signal Std. - S2	20	2"	40	C	1	New Cable 5
				28	C	1	New Push Button
10	Existing Pull Box 5 to Existing Signal Std. - S3	5 (EX)	3" (EX)	52	A	1	No. 14 AWG 3 Conductor Cable
				52	B	1	Emergency Detector Cable
				5	C	1	Existing Cable 1
				54	D	1	Video Detector Cable
				71	F	2	No. 14 AWG 3 Conductor Cable

Conduit Run	Location	Conduit Run		Cable Run			
		Length	Size	Length	Code	QTY	Type
11	Existing Pull Box 6 to Existing Pull Box 5	105 (EX)	3" (EX)	111	A	1	No. 14 AWG 3 Conductor Cable
				111	B	1	Emergency Detector Cable
				105	C	1	Existing Cable 1
				111	D	1	Video Detector Cable
				222	F	2	No. 14 AWG 3 Conductor Cable
12	Existing Pull Box 6 to Existing Signal Std. - S4	28 (EX)	3" (EX)	81	A	1	No. 14 AWG 3 Conductor Cable
				81	B	1	Emergency Detector Cable
				28	C	1	Existing Cable 2
				28	C	1	Push Button (EX)
				81	D	1	Video Detector Cable
				66	K	1	Electronic Sign
13	Existing Pull Box 7 to Existing Pull Box 6	47 (EX)	4" (EX)	106	A	2	No. 14 AWG 3 Conductor Cable
				106	B	2	Emergency Detector Cable
				94	C	2	Existing Cables 1,2
				47	C	1	Push Button (EX)
				106	D	2	Video Detector Cable
				106	F	2	No. 14 AWG 3 Conductor Cable
				53	K	1	Electronic Sign
14	Existing Pull Box 1 to Existing Pull Box 7	46 (EX)	4" (EX)	104	A	2	No. 14 AWG 3 Conductor Cable
				104	B	2	Emergency Detector Cable
				92	C	2	Existing Cables 1,2
				46	C	1	Push Button (EX)
				104	D	2	Video Detector Cable
				104	F	2	No. 14 AWG 3 Conductor Cable
				52	K	1	Electronic Sign

Cable Code

(EX)= Existing Conductor/Cable Runs
A = Emergency Vehicle Indicator Lamp
B = GPS Emergency Vehicle Detector Cable
C = Signal Control Cable
D = Video Detection Cable
E = Power Cable
F = Enforcement Light Cable
K = Electronic Sign

Note:
All conduit and cable lengths are in feet.

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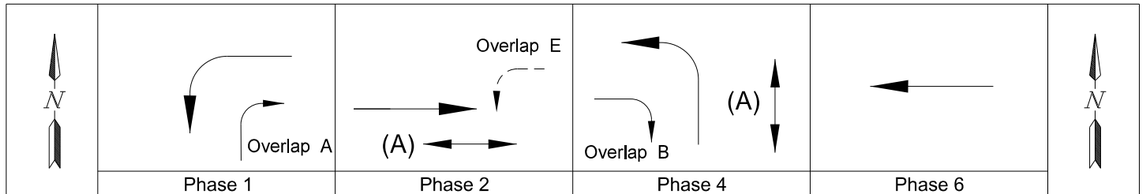
Revise Traffic Signal System - Site 7
Conduit Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

24th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	87



Head #	Phase 1 R/W	Phase 1 Clear to Phase 2	Phase 1 Clear to Phase 4	Phase 1 Clear to Phase 6	Phase 2 R/W	Phase 2 Clear to Phase 4	Phase 2 Clear to Phase 5	Phase 2 Clear to Phase 6	Phase 2 Clear to Phase 7	Phase 2 Clear to Phase 8	Phase 2 Clear to Phase 1	Phase 4 R/W	Phase 4 Clear to Phase 5	Phase 4 Clear to Phase 6	Phase 4 Clear to Phase 7	Phase 4 Clear to Phase 8	Phase 4 Clear to Phase 1	Phase 4 Clear to Phase 2	Phase 4 Clear to Phase 3	Phase 6 R/W	Phase 6 Clear to Phase 7	Phase 6 Clear to Phase 8	Phase 6 Clear to Phase 1	Phase 6 Clear to Phase 2	Phase 6 Clear to Phase 3	Phase 6 Clear to Phase 4	Phase 6 Clear to Phase 5	Head #
1					G	Y		(B)			Y																	1
2					G	Y		(B)			Y																	2
3					G	Y		(B)			Y	~~G~~		~~Y~~			(B)	~~Y~~										3
4	~~G~~	~~Y~~		~~Y~~	(B)	(C)	(D)	(B)			(C)																	4
5	~~G~~	~~Y~~		~~Y~~	(B)	(C)	(D)	(B)			(C)																	5
6																				G			(B)	(B)		Y		6
7																				G			(B)	(B)		Y		7
8																				G			(B)	(B)		Y		8
9												G		Y			Y	Y										9
10	~~G~~	~~Y~~		~~Y~~	(B)							G		Y			Y	Y										10
11	G	Y		Y	(B)							G		Y			Y	Y										11

Blank Squares Denote Red Indication

(A) = Pedestrian movements, upon activation.

(B) = When one phase is on alone a nonconflicting phase may start timing concurrently without a clearance interval (See Chart A).

(C) = Flashing yellow left turn arrow (protected/permissive mode and permissive only mode).

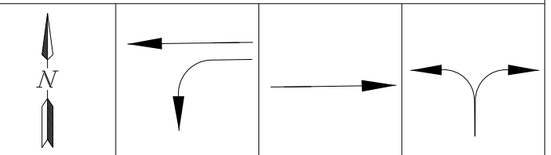
(D) = Solid yellow left turn arrow (protected/permissive mode and permissive only mode).

Protected Movement

Permitted Movement

Pedestrian Actuated Movement

Emergency Vehicle Preemption Phasing



Direction	Westbound	Eastbound	Northbound
Dwell Phases	1,6	2	4
Dwell Overlaps	-	-	-

Chart A

Non-Conflicting Phases

On Phase	Non-Conflicting Phase Allowed to Time Concurrently
1	6
2	6
4	-
6	1 or 2

Chart B

Overlaps

Overlap	Included Phases	Ped Protect Phases
A	1	-
B	4	-
C	-	-
D	-	-

Chart C

Special Overlaps

(Flashing Yellow Left Turn Arrows)

Overlap	Protected Phase	Permissive Phase
E	1	2
F	-	-
G	-	-
H	-	-

Chart D

No Turn on Red Sign Activation Overlaps

Overlap	Direction of vehicular travel - Signal Std.	Conflicting Left Turn Phase	Parallel Pedestrian Phase	Perpendicular Pedestrian Phase
I	Northbound - S4	-	4 Ped	2 Ped
J	Eastbound - S1	Phase 1	2 Ped	-

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Revise Traffic Signal System - Site 7
Signal Controller Phasing

US Hwy 81 Safety, Traffic and Turn Lanes
I-29 to 20th Street

24th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	88

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
	WBLT	EB		NBLT		WB		
BASIC INTERVALS (OR FUNCTIONS)								
Minimum Initial	5	15	-	8	-	15	-	-
Vehicle Extension	1.5	5.0	-	5.0	-	5.0	-	-
Maximum Green (Max 1)	13.0	34.8	-	24.0	-	53.0	-	-
Yellow Change	3.5	4.0	-	3.5	-	4.0	-	-
Red Clearance	2.0	1.0	-	2.0	-	1.0	-	-
Walk	-	7.0	-	7.0	-	-	-	-
Pedestrian Clearance	-	28.0	-	24.0	-	-	-	-
Delayed Green (Leading Pedestrian Interval)	-	6.0	-	6.0	-	-	-	-
VOLUME DENSITY TIMING FUNCTIONS								
VARIABLE INITIAL TIMING OPTIONS								
Actuations Before Added Initial	-	-	-	-	-	-	-	-
Added Initial per Actuation	-	-	-	-	-	-	-	-
Maximum Initial	-	-	-	-	-	-	-	-
GAP REDUCTION OPTIONS								
Time Before Reduction	-	20.0	-	-	-	20.0	-	-
Time to Reduce to Minimum Gap	-	20.0	-	-	-	20.0	-	-
Minimum Gap	-	2.5	-	-	-	2.5	-	-
OTHER CONTROLLER FUNCTIONS								
Locking Memory	-	x	-	-	-	x	-	-
Non-Locking Memory	x	-	-	x	-	-	-	-
Phase recall	-	-	-	-	-	-	-	-
Red Revert	2.0	2.0	-	2.0	-	2.0	-	-
Backup Prevent Phases	-	-	-	-	-	-	-	-
No Serve Phases	-	-	-	-	-	-	-	-
Flashing-Normal & Conflict Monitor	R	R	-	R	-	R	-	-

Notes:
1. Operate all left turn phases as either leading or lagging phases.
2. Operate all left turn phases either in protected, protected/permissive, or permissive mode.

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Revise Traffic Signal System - Site 7
Signal Timing Settings

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

24th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	89

SPEC	CODE	ITEM DESCRIPTION	UNIT	TOTAL
770	4210	LED LUMINAIRE	EA	3
772	0020	CONCRETE FOUNDATION-TRAFFIC SIGNALS	EA	1
772	0100	PULL BOX	EA	1
772	0240	2IN DIAMETER RIGID CONDUIT	LF	70
772	0290	4IN DIAMETER RIGID CONDUIT	LF	90
772	0375	EMERGENCY VEHICLE DETECTOR CABLE	LF	610
772	0420	NO14 AWG 2 CONDUCTOR CABLE	LF	230
772	0433	NO14 AWG 3 CONDUCTOR CABLE	LF	1550
772	0442	NO14 AWG 12 CONDUCTOR CABLE	LF	230
772	1820	1-WAY 4 SEC HEAD W/12IN LENS-POST MTD	EA	1
772	1822	1-WAY 4 SEC HEAD W/12IN LENS-MA MTD	EA	1
772	2060	PEDESTRIAN COUNTDOWN SIGNAL HEAD-POST MTD	EA	3
772	2061	PEDESTRIAN COUNTDOWN SIGNAL HEAD-PEDESTAL MTD	EA	1
772	2070	LAW ENFORCEMENT CONFIRMATION LIGHT	EA	3
772	2200	PEDESTRIAN PUSHBUTTON POST	EA	2
772	2215	PEDESTRIAN PUSHBUTTON & SIGN	EA	4
772	2260	VIDEO DETECTION CABLE	LF	610
772	2265	VIDEO DETECTION SYSTEM	EA	1
772	2556	BATTERY BACKUP SYSTEM	EA	1
772	2610	EMERGENCY VEHICLE PREEMPTION UNIT	EA	4
772	2621	EMERGENCY VEHICLE PRE-EMPTION PHASE SELECTOR	EA	1
772	3122	REMOVE CONTROLLER AND CABINET	EA	1
772	3140	REMOVE VEHICULAR HEAD	EA	1
772	3145	REMOVE PEDESTRIAN HEADS	EA	3
772	3147	REMOVE PEDESTRIAN PUSHBUTTON	EA	4
772	3165	REMOVE CONCRETE FOUNDATION	EA	1
		ABANDON CONDUIT	LF	70
		REMOVE PEDESTRIAN PUSHBUTTON POST	EA	2
		NEW CONTROLLER AND CABINET	EA	1
		36" x 36" LED SIGN - "NO TURN ON RED"	EA	2
		REPAINT SIGNAL STANDARD & MAST ARM	EA	3
		NEW PULL BOX COVER	EA	6
772	2913	REVISE TRAFFIC SIGNAL SYSTEM - SITE 7	EA	1
		The items appear above for informational purposes; provide all labor and equipment necessary for the signal system to be fully operational as shown in the Plans. Include items in the corresponding price bid for "REVISE TRAFFIC SIGNAL SYSTEM - SITE 7"		

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Revise Traffic Signal System - Site 7
Estimated Traffic Signal Quantities

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

24th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	90

Notes:
1. All stations and offsets are referenced from SCL81 alignment.
2. Abandon all conduit and remove all cable related to existing traffic signal syatem.

Legend
- Existing Signal Standard
- Existing Pull Box
- Existing Controller and Cabinet
- Existing Signal Mast Arm
- Existing Signal Head
- Existing Feed Point

Sta. 2195+06.01
46.80' LT
Remove Signal Std. Pole

Sta. 2194+99.38
46.55' LT
Remove Exist. PB

Sta. 2194+98.84
5.90' LT
Remove Exist. PB

Sta. 2195+90.23
60.25' LT
Remove Signal Std. Pole

Sta. 2196+19.84
43.10' LT
Remove Exist. PB

Sta. 2196+11.58
5.58' RT
Remove Exist. PB

S 20th St
(25 mph)

32nd Ave S
(40 mph)

2193 2194 2195 2196 2197 2198

32nd Ave S
(40 mph)

Sta. 2195+18.40
5.90' LT
Salvage/Remove PPP

Sta. 2194+99.05
41.31' RT
Remove Exist. PB

Sta. 2196+00.41
6.19' RT
Salvage/Remove PPP

Sta. 2196+15.00
42.23' RT
Remove Signal Std. Pole

Sta. 2196+00.88
55.92' RT
Salvage/Remove PPP

Sta. 2195+17.85
56.70' RT
Salvage/Remove PPP

10' Utility Easement

Sta. 2196+05.35
79.85' RT
Remove Exist. PB

Sta. 2195+25.92
67.57' RT
Remove Signal Std. Pole

S 20th St
(30 mph)

Sta. 2196+06.88
86.29' RT
Remove Exist.
Controller and Cabinet

N

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Traffic Signal System - Site 8
Traffic Signal Removal

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

20th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	91

Signal Standard Foundation Table		
Description	Footing Depth "D" 24" & 30" Diameters (FT)	Footing Depth "D" 36" & 42" Diameters (FT)
Type IV Signal Std.		
S2 - Single 57' MA	18,17	17,17
S4 - Single 52' MA	17,16	16,16
S5 - Single 53' MA	17,16	16,16
Type II Signal Std.		
S3	4	3
Combination Signal & Light Std. 40' Mounting Height		
S1 - Single 52' MA	18,17	16,16

Legend
- (5) Signal Head Number
- P6 Pedestrian Head Number
- Signal Mast Arm
- Controller and Cabinet
- Existing Feed Point
- Luminaire Unit

Note:
All stations and offsets are referenced from SCL81 alignment.

S 20th St (25 mph)

Sta. 2196+10.34
71.54' LT
Conc. Signal Fnd. -S5
Std.- 53' MA
Ped Btn #8

Sta. 2195+14.40
61.57' LT
Ped Btn #4

Sta. 2195+02.56
53.00' LT
Conc. Signal Fnd. -S4
Std.- 52' MA
Ped Btn #7

Sta. 2196+12.28
60.66' LT
Ped Btn #5

32nd Ave S
(40 mph)

2193 2194 2195 2196 2197 2198

Sta. 2195+01.72
57.54' RT
Ped Btn #3

Sta. 2194+97.06
57.54' RT
Conc. Signal Fnd. -S3

Sta. 2196+10.75
53.13' RT
Conc. Signal Fnd. -S1
Std.- 52' MA
Ped Btn #6

Sta. 2195+99.99
56.96' RT
Ped Btn #1

Existing Feed Point
Sta. 2196+47.62
102.57' RT
(Center of Feed Point)

Sta. 2195+07.70
64.01' RT
Ped Btn #2

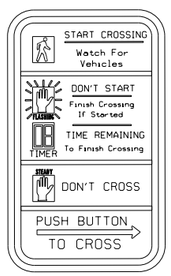
10' Utility Easement

Sta. 2195+01.58
83.88' RT
Conc. Signal Fnd. -S2
Std.- 57' MA

Controller and Cabinet
Econolite 332D
Sta. 2196+16.63
84.79' RT
(Center of Cabinet)

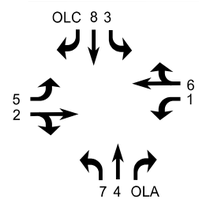
S 20th St (30 mph)

Pedestrian Pushbutton Schedule			
Pushbutton Number	Pushbutton Location	Pushbutton & Signal Location on Pole	Direction of Arrow on Sign
1	Pushbutton Post 1	N	Right
2	Pushbutton Post 2	N	Left
3	Pushbutton Post 3	E	Right
4	Pushbutton Post 4	S	Right
5	Pushbutton Post 5	W	Right
6	Type IV Signal Pole S1	W	Left
7	Type IV Signal Pole S4	E	Left
8	Type IV Signal Pole S5	S	Left



R10-3e-9

Phase Diagram



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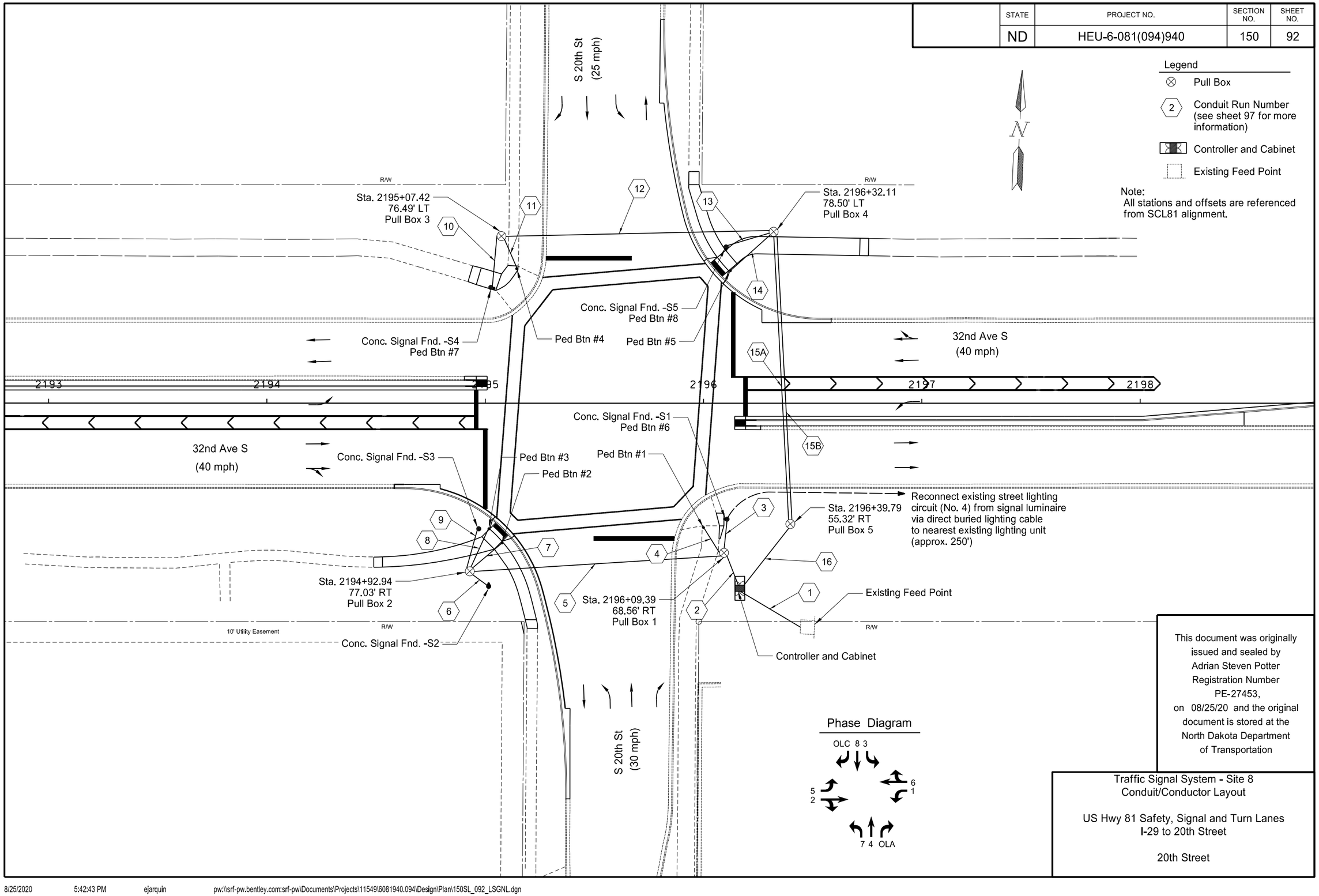
Traffic Signal System - Site 8
Traffic Signal Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

20th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	92



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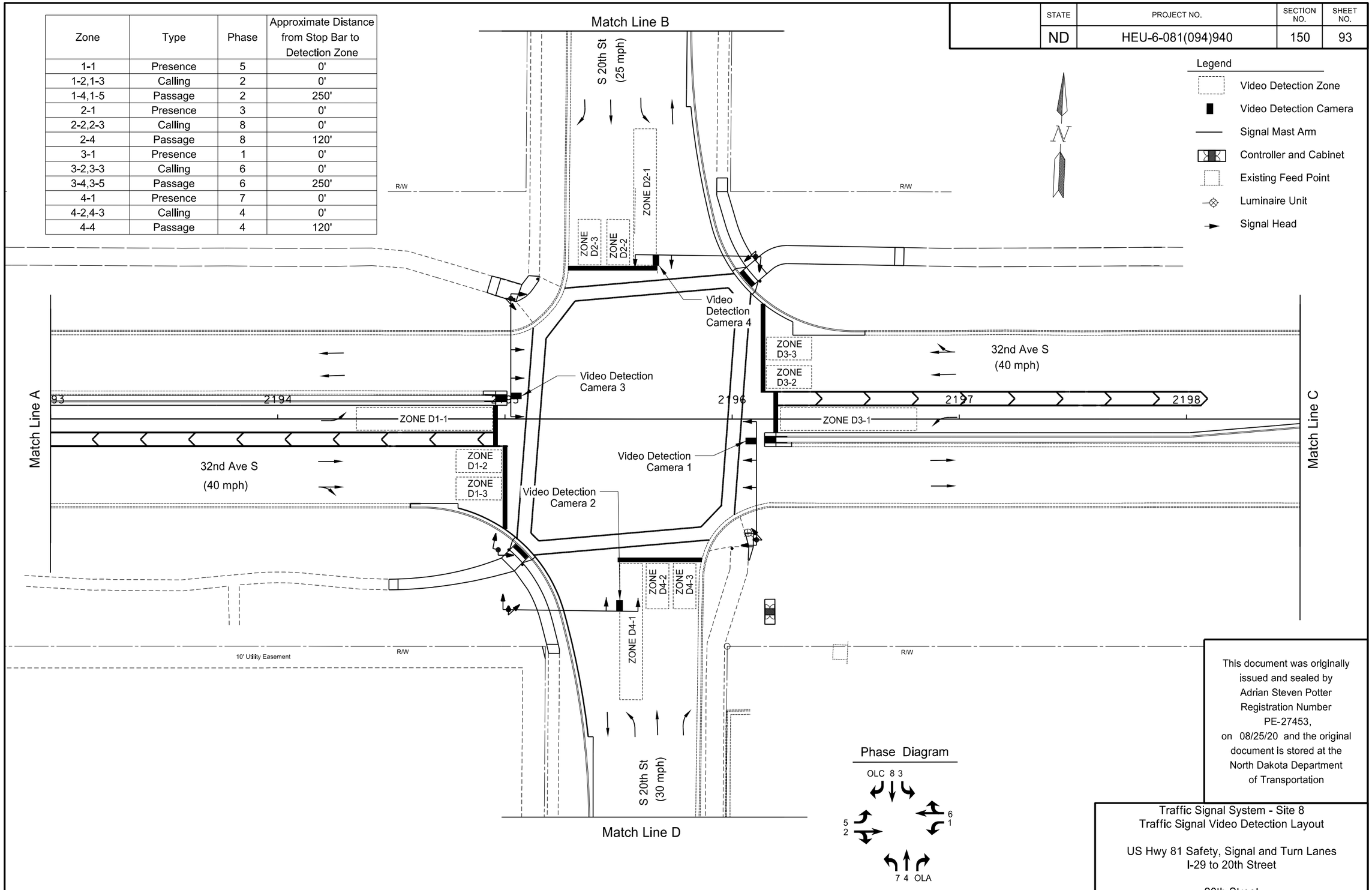
Traffic Signal System - Site 8
Conduit/Conductor Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

20th Street

Zone	Type	Phase	Approximate Distance from Stop Bar to Detection Zone
1-1	Presence	5	0'
1-2,1-3	Calling	2	0'
1-4,1-5	Passage	2	250'
2-1	Presence	3	0'
2-2,2-3	Calling	8	0'
2-4	Passage	8	120'
3-1	Presence	1	0'
3-2,3-3	Calling	6	0'
3-4,3-5	Passage	6	250'
4-1	Presence	7	0'
4-2,4-3	Calling	4	0'
4-4	Passage	4	120'

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	93



Legend

- Video Detection Zone
- Video Detection Camera
- Signal Mast Arm
- Controller and Cabinet
- Existing Feed Point
- Luminaire Unit
- Signal Head

Phase Diagram

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Traffic Signal System - Site 8
Traffic Signal Video Detection Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

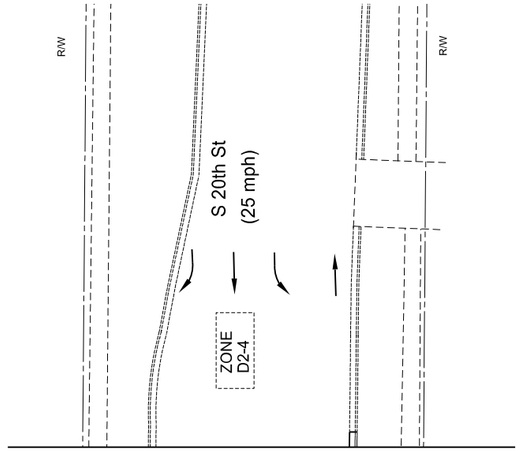
20th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	94

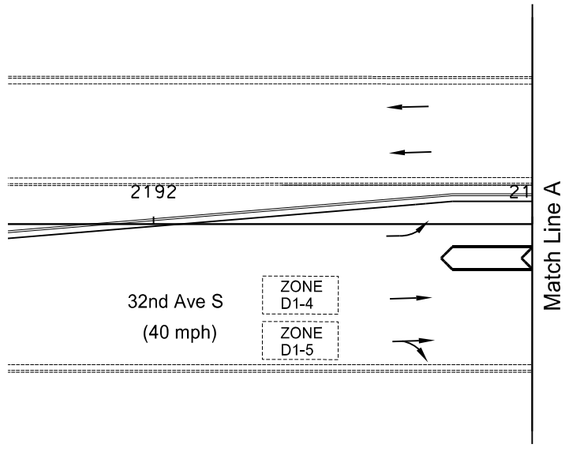
Legend

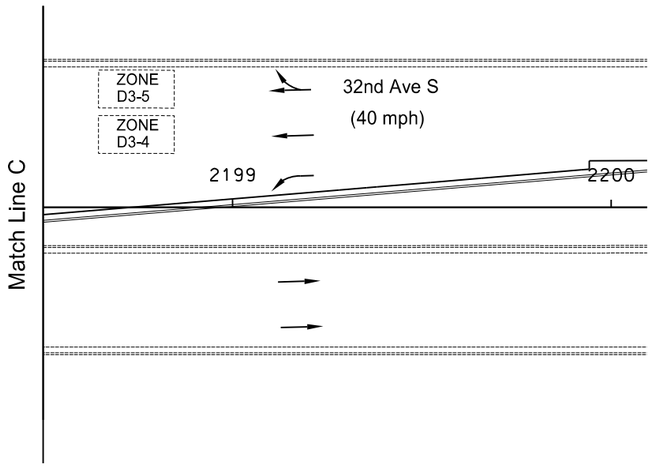
Video Detection Zone

N

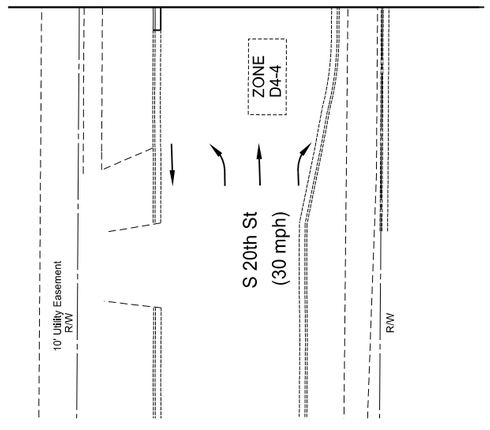


Match Line B

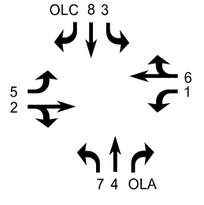




Match Line D



Phase Diagram



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Traffic Signal System - Site 8
Traffic Signal Video Detection Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

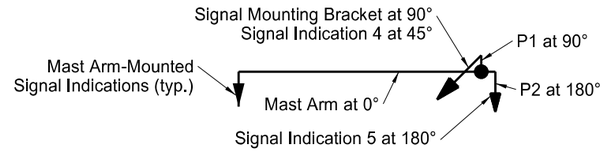
20th Street

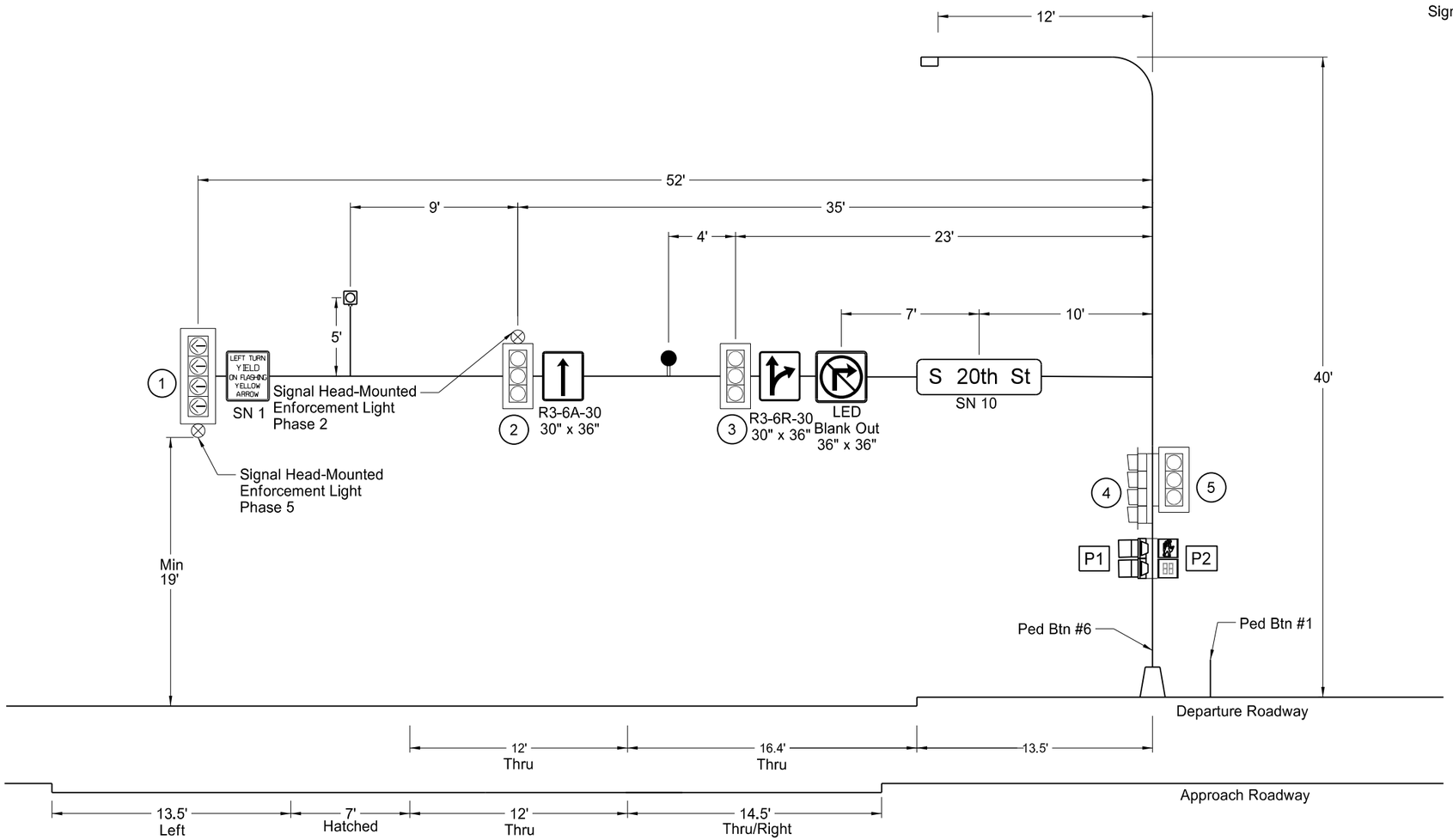
Notes:

1. Mount luminaire extension at 40'. Include a 12' mast arm.
2. Furnish and install LED luminaire.
3. Determine the final location of the video detection camera to provide a functional system.
4. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
5. See Section 110 for sign details.

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	95

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Eastbound 32nd Avenue South
(S1)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- X — Vehicle Signal Head Number
- PX — Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 8
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

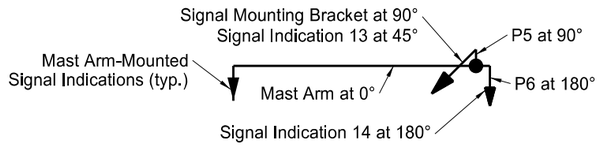
20th Street

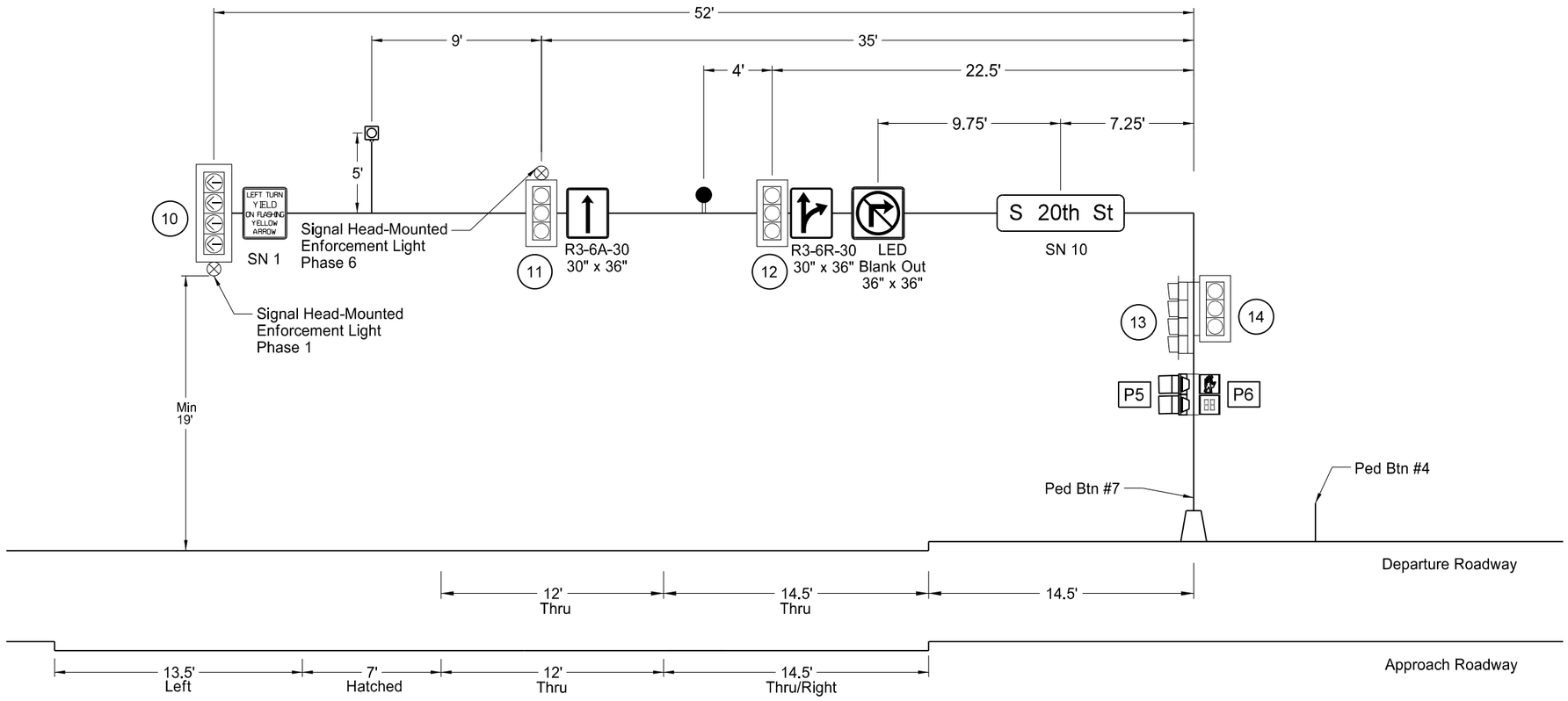
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	96

Notes:

1. Determine the final location of the video detection camera to provide a functional system.
2. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
3. See Section 110 for sign details.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Westbound 32nd Avenue South
(S4)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- [PX] Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 8
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

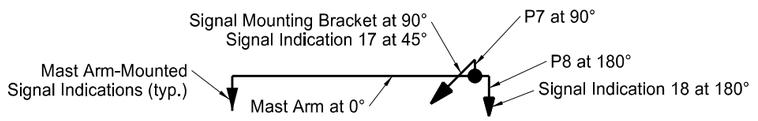
20th Street

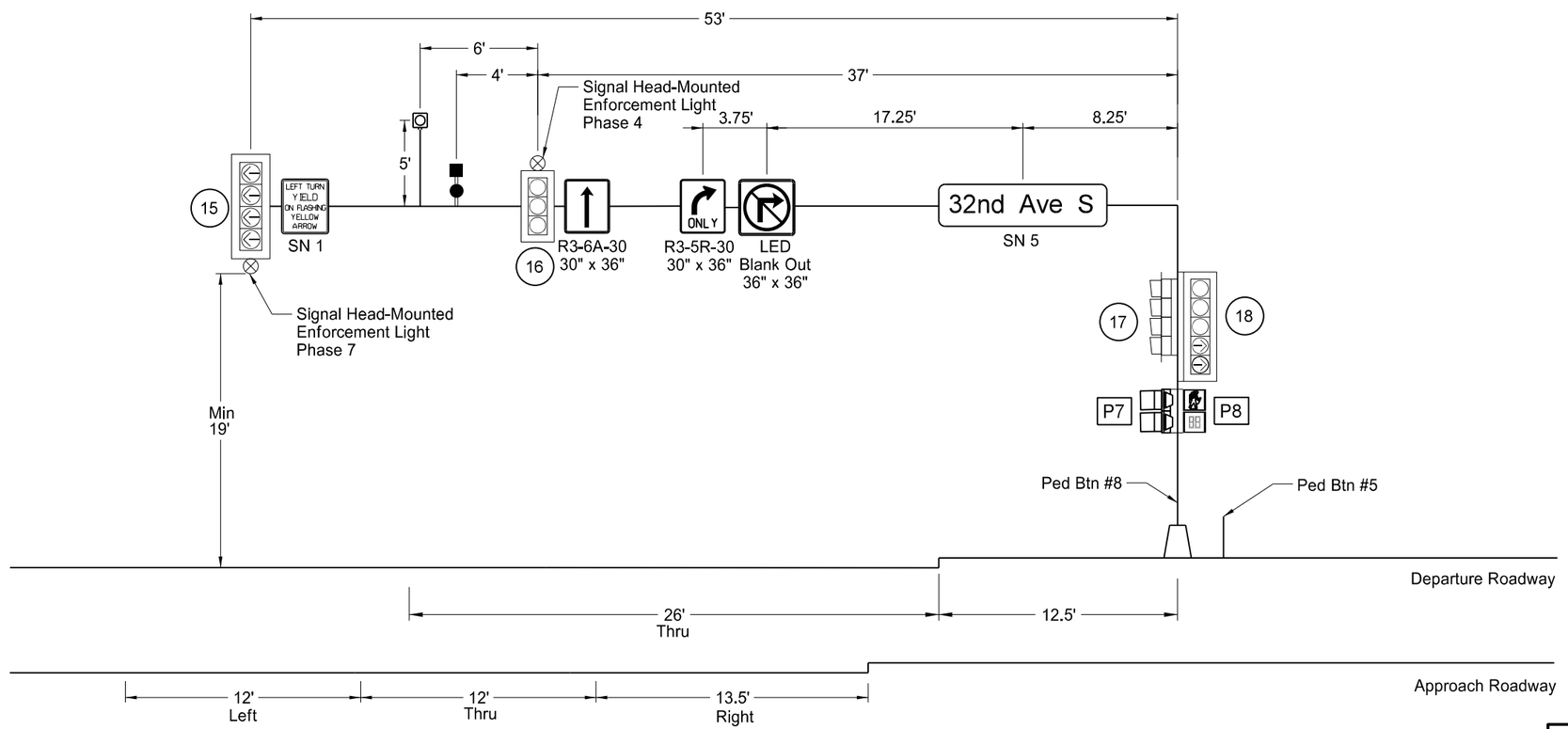
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	97

Notes:

1. Determine the final location of the video detection camera to provide a functional system.
2. Determine the final location of the Emergency Vehicle Preemption GPS detector to provide a functional system.
3. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.
4. See Section 110 for sign details.

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Northbound South 20th Street
(S5)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- Vehicle Signal Head Number
- PX — Pedestrian Head Number
- Emergency Vehicle Preemption GPS Detector and Light
- Enforcement Light

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Traffic Signal System - Site 8
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

20th Street

Notes:

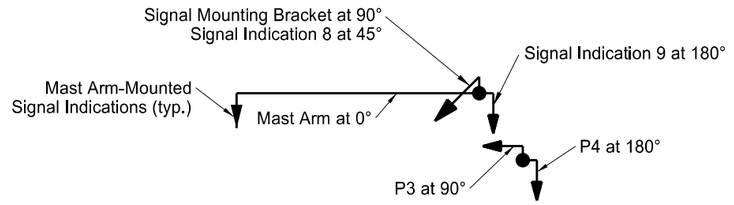
1. Determine the final location of the video detection camera to provide a functional system.

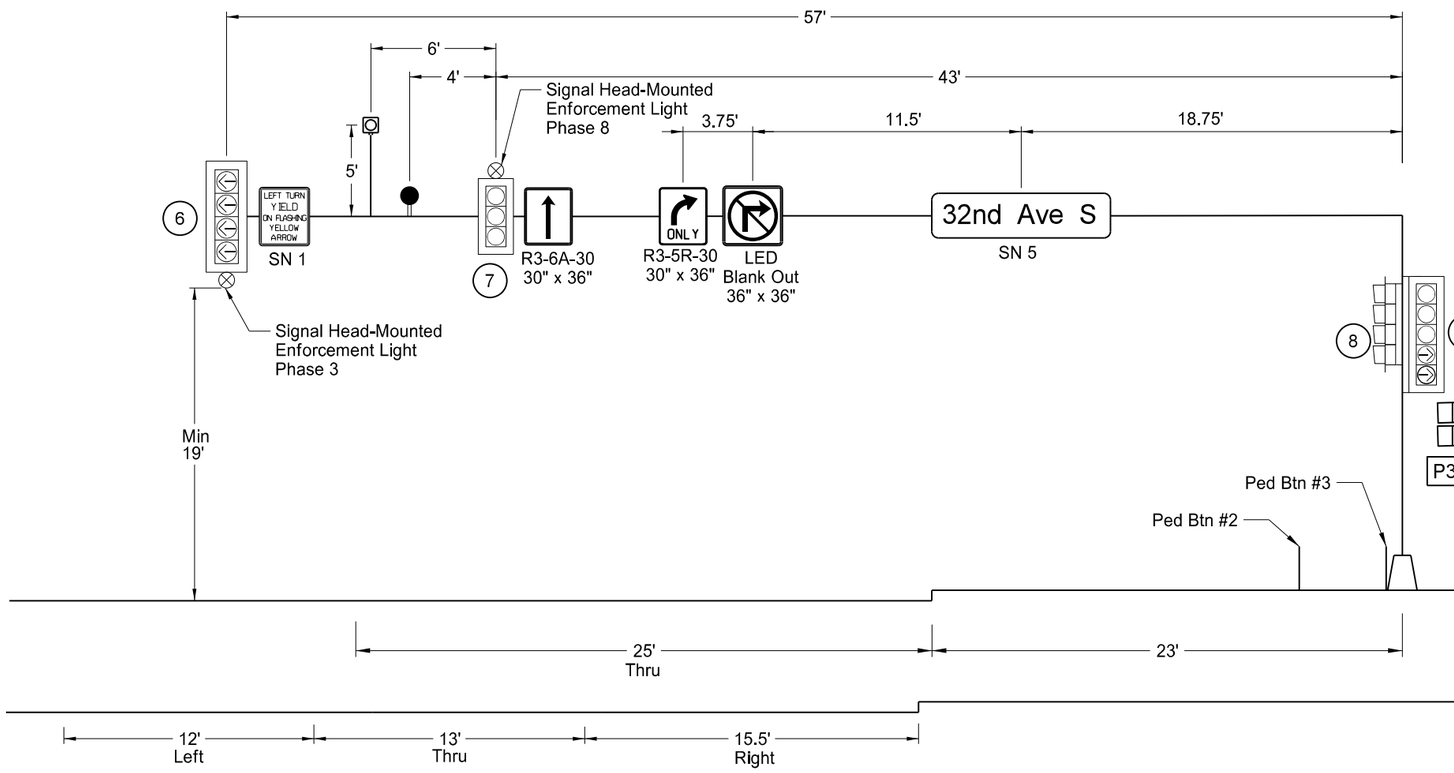
2. Place support brackets for pole mounted signal heads so they do not restrict access to mast arm handhole.

3. See Section 110 for sign details.

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	98

Pole-Mounted Signal
Indication Orientation Detail
Not to Scale





Southbound South 20th Street
(S2,S3)

Legend

- Transformer Base
- Video Detection Camera
- Traffic Signal Head
- Pedestrian Signal Head
- (X) Vehicle Signal Head Number
- PX Pedestrian Head Number
- Emergency Vehicle Preemption Indicator Light
- Enforcement Light

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Traffic Signal System - Site 8
Signal Standard & Head Locations

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

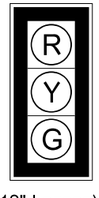
20th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	99

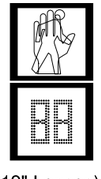
Conductor			Cable 1 (No.14 AWG 12)			Cable 2 (No.14 AWG 12)			Cable 3 (No.14 AWG 7)			Cable 4 (No.14 AWG 12)			Cable 5 (No.14 AWG 12)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		2,3	2	Green	5	2	Green	P1	4	Don't Walk	7	8	Green	8	1	Green LT Arrow
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		2,3	2	Red	5	2	Red	P1	4	Walk	7	8	Red	8	1	Red LT Arrow
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		2,3	2	Yellow	5	2	Yellow	P2	2	Don't Walk	7	8	Yellow	8	1	Yellow LT Arrow
6	Blue				Spare			Spare	P2	2	Walk			Spare	8	1	Flashing Yellow LT Arrow
7	White	Black			Spare			Spare			Spare			Spare			Spare
8	Red	Black	1	5	Red LT Arrow	4	3	Red LT Arrow				6	3	Red LT Arrow	9	8	Red
9	Green	Black			Spare			Spare						Spare	9	8	Green
10	Orange	Black	1	5	Yellow LT Arrow	4	3	Yellow LT Arrow				6	3	Yellow LT Arrow	9	5 OLB	Yellow RT Arrow
11	Blue	Black	1	5	Flashing Yellow LT Arrow	4	3	Flashing Yellow LT Arrow				6	3	Flashing Yellow LT Arrow	9	8	Yellow
12	Black	White	1	5	Green LT Arrow	4	3	Green LT Arrow				6	3	Green LT Arrow	9	5 OLB	Green RT Arrow

Conductor			Cable 6 (No.14 AWG 7)			Cable 7 (14 No.12 AWG)			Cable 8 (14 No.12 AWG)			Cable 9 (No.14 AWG 7)			Cable 10 (14 No.12 AWG)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication	Head	Phase	Indication
1	Black		P3	2	Don't Walk	11,12	6	Green	14	6	Green	P5	8	Don't Walk	16	4	Green
2	White				Neutral			Neutral			Neutral			Neutral			Neutral
3	Red		P3	2	Walk	11,12	6	Red	14	6	Red	P5	8	Walk	16	4	Red
4	Green				Ground			Ground			Ground			Ground			Ground
5	Orange		P4	8	Don't Walk	11,12	6	Yellow	14	6	Yellow	P6	6	Don't Walk	16	4	Yellow
6	Blue		P4	8	Walk			Spare			Spare	P6	6	Walk			Spare
7	White	Black			Spare			Spare			Spare			Spare			Spare
8	Red	Black				10	1	Red LT Arrow	13	7	Red LT Arrow				15	7	Red LT Arrow
9	Green	Black						Spare			Spare						Spare
10	Orange	Black				10	1	Yellow LT Arrow	13	7	Yellow LT Arrow				15	7	Yellow LT Arrow
11	Blue	Black				10	1	Flashing Yellow LT Arrow	13	7	Flashing Yellow LT Arrow				15	7	Flashing Yellow LT Arrow
12	Black	White				10	1	Green LT Arrow	13	7	Green LT Arrow				15	7	Green LT Arrow

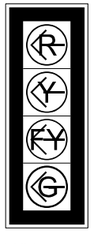
Conductor			Cable 11 (No.14 AWG 12)			Cable 12 (No.14 AWG 7)		
Run	Base	Tracer	Head	Phase	Indication	Head	Phase	Indication
1	Black		17	5	Green LT Arrow	P7	6	Don't Walk
2	White				Neutral			Neutral
3	Red		17	5	Red LT Arrow	P7	6	Walk
4	Green				Ground			Ground
5	Orange		17	5	Yellow LT Arrow	P8	4	Don't Walk
6	Blue		17	5	Flashing Yellow LT Arrow	P8	4	Walk
7	White	Black			Spare			Spare
8	Red	Black	18	4	Red			
9	Green	Black	18	4	Green			
10	Orange	Black	18	1 OLA	Yellow RT Arrow			
11	Blue	Black	18	4	Yellow			
12	Black	White	18	1 OLA	Green RT Arrow			



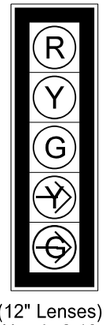
(12" Lenses)
Heads 2,3,5,7,11
12,14,16



(12" Lenses)
Heads P1, P2, P3,
P4, P5, P6, P7, P8



(12" Lenses)
Heads 1,4,6,8,10
13,15,17



(12" Lenses)
Heads 9,18

LED Blank Out Sign (36" x 36")
Use white LEDs for arrow
Use red LEDs for prohibition symbol

Notes:

1. Use LED indications for all heads.
2. Use 5" Louvered Black Plate with Type XI Yellow Reflective Border (typ.) on all heads.

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Traffic Signal System - Site 8
Signal Heads & Conductor Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

20th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	100

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Code	QTY	Type
1	Existing Feed Point to Controller	36	2"	46	E	1	Mult 3 No 6 USE
2	Controller to Pull Box 1	20	4"	58	A	2	No. 14 AWG 3 Conductor Cable
				58	B	2	Emergency Detector Cable
				116	C	4	Cable 1,2,4,5,
				58	C	2	Cable 3,6
				116	C	4	Push Button
				58	D	2	Video Detector Cable
				116	F	4	No. 14 AWG 3 Conductor Cable
				58	K	2	Electronic Sign
3	Pull Box 1 to Signal Std. - S1	16	3"	71	A	1	No. 14 AWG 3 Conductor Cable
				71	B	1	Emergency Detector Cable
				192	C	2	Cable 1,2
				37	C	1	Cable 3
				24	C	1	Push Button
				88	D	1	Video Detector Cable
				192	F	2	No. 14 AWG 3 Conductor Cable
				59	K	1	Electronic Sign
4	Pull Box 1 to Ped Push Btn. #1	15	2"	23	C	1	Push Button
5	Pull Box 1 to Pull Box 2	117	3"	123	A	1	No. 14 AWG 3 Conductor Cable
				123	B	1	Emergency Detector Cable
				246	C	2	Cable 4,5
				123	C	1	Cable 6
				246	C	2	Push Button
				123	D	1	Video Detector Cable
				246	F	2	No. 14 AWG 3 Conductor Cable
				123	K	1	Electronic Sign
6	Pull Box 2 to Signal Std. - S2	11	3"	86	A	1	No. 14 AWG 3 Conductor Cable
				86	B	1	Emergency Detector Cable
				192	C	2	Cable 4,5
				88	D	1	Video Detector Cable
				192	F	2	No. 14 AWG 3 Conductor Cable
				69	K	1	Electronic Sign
7	Pull Box 2 to Ped Push Btn. #2	20	2"	28	C	1	Push Button
8	Pull Box 2 to Ped Push Btn. #3	22	2"	30	C	1	Push Button
9	Pull Box 2 to Signal Std. - S3	20	2"	37	C	1	Cable 6
10	Signal Std. - S4 to Pull Box 3	24	3"	79	A	1	No. 14 AWG 3 Conductor Cable
				79	B	1	Emergency Detector Cable
				208	C	2	Cable 7,8
				41	C	1	Cable 9
				32	C	1	Push Button
				96	D	1	Video Detector Cable
				208	F	2	No. 14 AWG 3 Conductor Cable
				67	K	1	Electronic Sign

Conduit Run	Location	Conduit Run Length	Conduit Run Size	Cable Run Length	Code	QTY	Type
11	Ped Push Btn. #4 to Pull Box 3	17	2"	25	C	1	Push Button
12	Pull Box 3 to Pull Box 4	125	3"	131	A	1	No. 14 AWG 3 Conductor Cable
				131	B	1	Emergency Detector Cable
				262	C	2	Cable 7,8
				131	C	1	Cable 9
				262	C	2	Push Button
				131	D	1	Video Detector Cable
				262	F	2	No. 14 AWG 3 Conductor Cable
				131	K	1	Electronic Sign
13	Signal Std. - S5 to Pull Box 4	23	3"	99	A	1	No. 14 AWG 3 Conductor Cable
				99	B	1	Emergency Detector Cable
				222	C	2	Cable 10,11
				40	C	1	Cable 12
				36	C	1	Push Button
				101	D	1	Video Detector Cable
				222	F	2	No. 14 AWG 3 Conductor Cable
				83	K	1	Electronic Sign
14	Ped Push Btn. #5 to Pull Box 4	27	2"	35	C	1	Push Button
15A	Pull Box 4 to Pull Box 5	134	4"	280	A	2	No. 14 AWG 3 Conductor Cable
				280	B	2	Emergency Detector Cable
				560	C	4	Cable 7,8,10,11
				280	C	2	Cable 9,12
				560	C	4	Push Button
				280	D	2	Video Detector Cable
				560	F	4	No. 14 AWG 3 Conductor Cable
				280	K	2	Electronic Sign
15B	Pull Box 4 to Pull Box 5	134	4"	Empty conduit for future use			
16	Pull Box 5 to Controller	40	4"	98	A	2	No. 14 AWG 3 Conductor Cable
				98	B	2	Emergency Detector Cable
				196	C	4	Cable 7,8,10,11
				98	C	2	Cable 9,12
				196	C	4	Push Button
				98	D	2	Video Detector Cable
				196	F	4	No. 14 AWG 3 Conductor Cable
				98	K	2	Electronic Sign

Cable Code

A = Emergency Vehicle Indicator Lamp
B = Emergency Vehicle Detector Cable
C = Signal Control Cable
D = Video Detection Cable
E = Power Cable
F = Enforcement Light Cable
K = Electronic Sign Cable

Note:
All conduit and cable are in feet.

Note:
All conduit and cable lengths are in feet.

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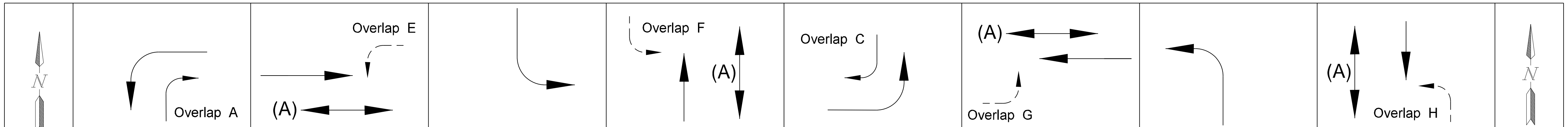
Traffic Signal System - Site 8
Conduit Schedule

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

20th Street



Head #	Phase 1								Phase 2							
	R/W	Clear to Phase 2	3	4	5	6	7	8	R/W	Clear to Phase 3	4	5	6	7	8	1
1																
2									G	Y	Y	(B)	(B)	Y	Y	Y
3									G	Y	Y	(B)	(B)	Y	Y	Y
4																
5									G	Y	Y	(B)	(B)	Y	Y	Y
6																
7																
8	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
9																
10	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
11																
12																
13																
14																
15									G	Y	Y	(B)	(B)	Y	Y	Y
16																
17																
18	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								

Head #	Phase 3								Phase 4							
	R/W	Clear to Phase 4	5	6	7	8	1	2	R/W	Clear to Phase 5	6	7	8	1	2	3
1																
2																
3																
4	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
5																
6	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
7																
8																
9																
10																
11																
12																
13																
14																
15																
16									G	Y	Y	(B)	(B)	Y	Y	Y
17																
18									G	Y	Y	(B)	(B)	Y	Y	Y

Head #	Phase 5								Phase 6							
	R/W	Clear to Phase 6	7	8	1	2	3	4	R/W	Clear to Phase 7	8	1	2	3	4	5
1	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
2																
3																
4																
5																
6																
7																
8																
9	G→	Y→	Y→	Y→	(B)	(B)	Y→	Y→								
10																
11									G	Y	Y	(B)	(B)	Y	Y	Y
12									G	Y	Y	(B)	(B)	Y	Y	Y
13																
14									G	Y	Y	(B)	(B)	Y	Y	Y
15																
16																
17	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
18																

Head #	Phase 7								Phase 8							
	R/W	Clear to Phase 8	1	2	3	4	5	6	R/W	Clear to Phase 1	2	3	4	5	6	7
1																
2																
3																
4																
5																
6																
7									G	Y	Y	(B)	(B)	Y	Y	Y
8																
9									G	Y	Y	(B)	(B)	Y	Y	Y
10																
11																
12																
13	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
14																
15	←G	←Y	←Y	←Y	(B)	(B)	←Y	←Y	(C)	(D)	(D)	(B)	(B)	(D)	(D)	(C)
16																
17																
18																

Blank Squares Denote Red Indication

(A) = Pedestrian movements, upon activation.

(B) = When one phase is on alone, a nonconflicting phase may start timing concurrently without a clearance interval (See Chart A).

(C) = Flashing yellow left turn arrow (protected/permissive mode and permissive only mode).

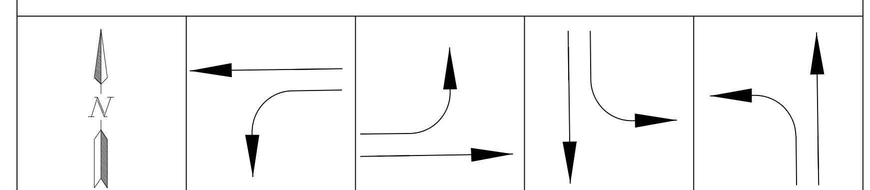
(D) = Solid yellow left turn arrow (protected/permissive mode and permissive only mode).

Protected Movement

Permitted Movement

Pedestrian Actuated Movement

Emergency Vehicle Preemption Phasing



Direction	Westbound	Eastbound	Southbound	Northbound
Dwell Phases	1,6	2,5	3,8	4,7
Dwell Overlaps	OLI	OLK	OLL	OLJ

Chart A
Non-Conflicting Phases

On Phase	Non-Conflicting Phase Allowed to Time Concurrently
1	5 or 6
2	5 or 6
3	7 or 8
4	7 or 8
5	1 or 2
6	1 or 2
7	3 or 4
8	3 or 4

Chart B
Overlaps

Overlap	Included Phases	Ped Protect Phases
A	1	-
B	-	-
C	5	-
D	-	-

Chart C
Special Overlaps
(Flashing Yellow Left Turn Arrows)

Overlap	Protected Phase	Permissive Phase
E	1	2
F	3	4
G	5	6
H	7	8

Chart D
No Turn on Red Sign Activation Overlaps

Overlap	Direction of vehicular travel - Signal Std.	Conflicting Left Turn Phase	Parallel Pedestrian Phase	Perpendicular Pedestrian Phase
I	Eastbound - S1	1	2 Ped	8 Ped
J	Southbound - S2	7	8 Ped	6 Ped
K	Westbound - S4	5	6 Ped	4 Ped
L	Northbound - S5	3	4 Ped	2 Ped

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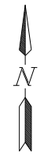
Traffic Signal System - Site 8
Signal Controller Phasing

US Hwy 81 Safety, Traffic and Turn Lanes
I-29 to 20th Street

20th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	102



	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
	WBLT	EB	SBLT	NB	EBLT	WB	NBLT	SB
BASIC INTERVALS (OR FUNCTIONS)								
Minimum Initial	5.0	15.0	5.0	10.0	5.0	15.0	5.0	10.0
Vehicle Extension	1.5	5.0	1.5	5.0	1.5	5.0	1.5	5.0
Maximum Green (Max 1)	18.0	45.0	18.0	20.0	18.0	45.0	18.0	20.0
Yellow Change	3.5	4.0	3.5	3.5	3.5	4.0	3.5	3.0
Red Clearance	1.5	1.0	1.5	2.0	1.5	1.0	1.5	2.5
Walk	-	7.0	-	7.0	-	7.0	-	7.0
Pedestrian Clearance	-	21.0	-	28.0	-	20.0	-	27.0
Delayed Green (Leading Pedestrian Interval)	-	6.0	-	6.0	-	6.0	-	6.0
VOLUME DENSITY TIMING FUNCTIONS								
VARIABLE INITIAL TIMING OPTIONS								
Actuations Before Added Initial	-	-	-	-	-	-	-	-
Added Initial per Actuation	-	-	-	-	-	-	-	-
Maximum Initial	-	-	-	-	-	-	-	-
GAP REDUCTION OPTIONS								
Time Before Reduction	-	20.0	-	-	-	20.0	-	-
Time to Reduce to Minimum Gap	-	20.0	-	-	-	20.0	-	-
Minimum Gap	-	2.5	-	-	-	2.5	-	-
OTHER CONTROLLER FUNCTIONS								
Locking Memory	-	x	-	x	-	x	-	x
Non-Locking Memory	x	-	x	-	x	-	x	-
Phase recall	-	x	-	-	-	x	-	-
Red Revert	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Backup Prevent Phases	-	-	-	-	-	-	-	-
No Serve Phases	-	-	-	-	-	-	-	-
Flashing-Normal & Conflict Monitor	R	R	R	R	R	R	R	R

Notes:
1. Operate all left turn phases as either leading or lagging phases.
2. Operate all left turn phases either in protected, protected/permissive, or permissive mode.

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Traffic Signal System - Site 8
Signal Timing Settings

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

20th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	150	103

SPEC	CODE	ITEM DESCRIPTION	UNIT	TOTAL
770	0445	MULTIPLE UNDERGROUND CABLE 3NO6 STYLE USE	LF	50
770	0464	MULTIPLE UNDERGROUND CABLE 3NO4-1NO6 STYLE USE	LF	310
770	4210	LED LUMINAIRE	EA	1
772	0020	CONCRETE FOUNDATION-TRAFFIC SIGNALS	EA	5
772	0100	PULL BOX	EA	5
772	0240	2IN DIAMETER RIGID CONDUIT	LF	200
772	0270	3IN DIAMETER RIGID CONDUIT	LF	350
772	0290	4IN DIAMETER RIGID CONDUIT	LF	350
772	0375	EMERGENCY VEHICLE DETECTOR CABLE	LF	1070
772	0432	NO14 AWG 2 CONDUCTOR CABLE	LF	1620
772	0433	NO14 AWG 3 CONDUCTOR CABLE	LF	4190
772	0437	NO14 AWG 7 CONDUCTOR CABLE	LF	850
772	0442	NO14 AWG 12 CONDUCTOR CABLE	LF	2200
772	0652	TYPE IV SIGNAL STD 52FT MA	EA	1
772	0653	TYPE IV SIGNAL STD 53FT MA	EA	1
772	0657	TYPE IV SIGNAL STD 57FT MA	EA	1
772	0601	TYPE II SIGNAL STANDARD	EA	1
772	1223	COMBO 52FT MA SIG & LT STD-TYPE C	EA	1
772	1810	1-WAY 3 SEC HEAD W/12IN LENS-POST MTD	EA	2
772	1812	1-WAY 3 SEC HEAD W/12IN LENS-MA MTD	EA	6
772	1821	1-WAY 4 SEC HEAD W/12IN LENS-POST MTD	EA	4
772	1822	1-WAY 4 SEC HEAD W/12IN LENS-MA MTD	EA	4
772	1830	1-WAY 5 SEC HEAD W/12IN LENS-POST MTD	EA	2
772	2060	PEDESTRIAN COUNTDOWN SIGNAL HEAD-POST MTD	EA	6
772	2061	PEDESTRIAN COUNTDOWN SIGNAL HEAD-PEDESTAL MTD	EA	2
772	2070	LAW ENFORCEMENT CONFIRMATION LIGHT	EA	8
772	2200	PEDESTRIAN PUSHBUTTON POST	EA	5
772	2215	PEDESTRIAN PUSHBUTTON & SIGN	EA	8
772	2260	VIDEO DETECTION CABLE	LF	1070
772	2265	VIDEO DETECTION SYSTEM	EA	1
772	2556	BATTERY BACKUP SYSTEM	EA	1
772	2610	EMERGENCY VEHICLE PREEMPTION UNIT	EA	4
772	2621	EMERGENCY VEHICLE PRE-EMPTION PHASE SELECTOR	EA	1
772	3125	REMOVE TRAFFIC SIGNAL SYSTEM	EA	1
		36"X36" LED SIGN - "NO TURN ON RED"	EA	4
		CONTROLLER AND CABINET	EA	1
772	9818	TRAFFIC SIGNAL SYSTEM - SITE 8	EA	1
		The items appear above for informational purposes; provide all labor and equipment necessary for the signal system to be fully operational as shown in the Plans. Include items in the corresponding price bid for "TRAFFIC SIGNAL SYSTEM - SITE 8"		

Traffic Signal System - Site 8
Estimated Traffic Signal Quantities

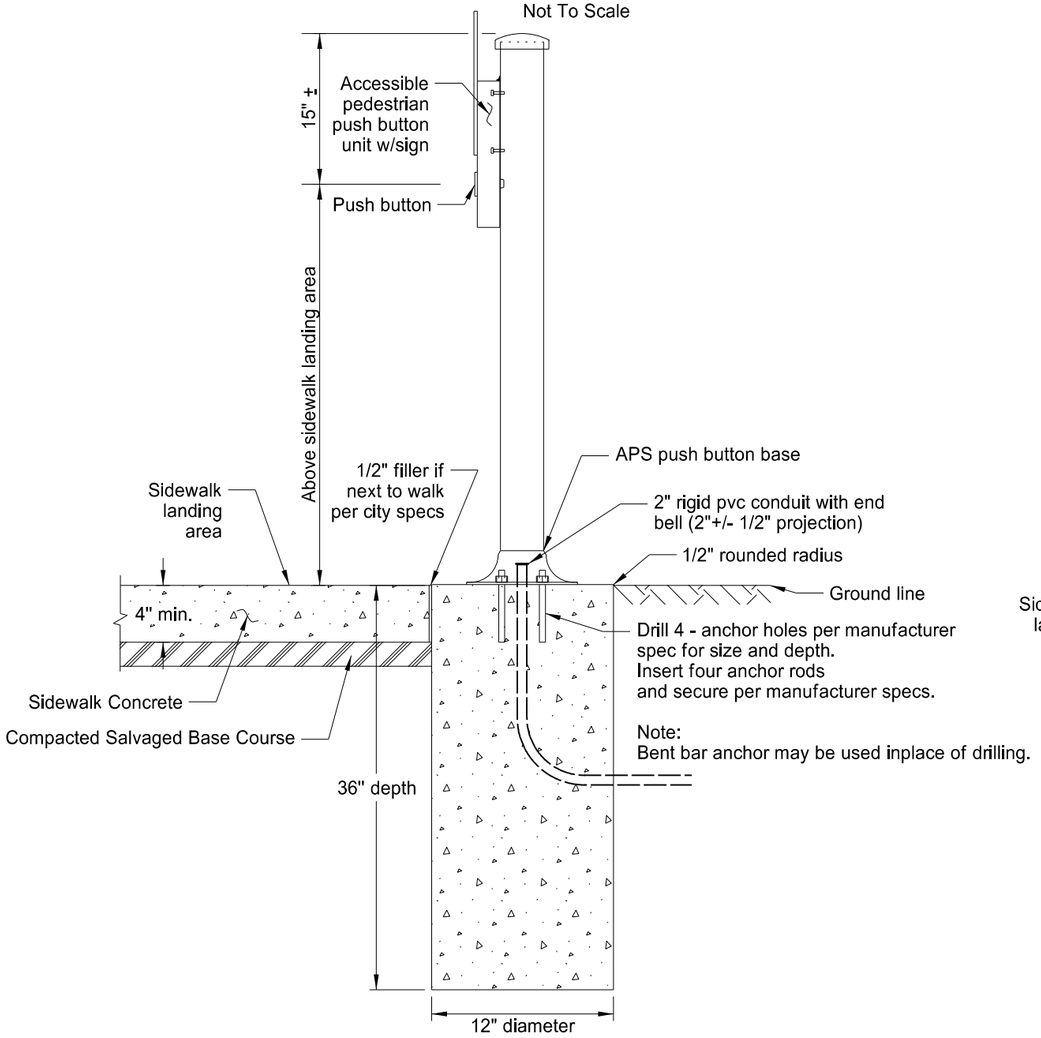
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

20th Street

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	104

APS Push Button Station - Foundation Mount

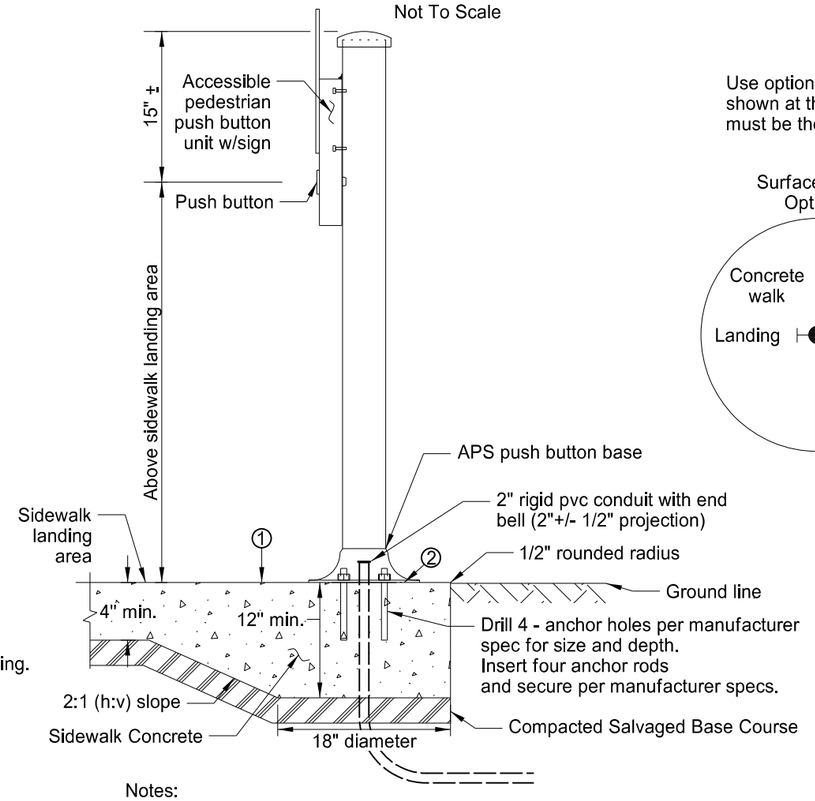
Not To Scale



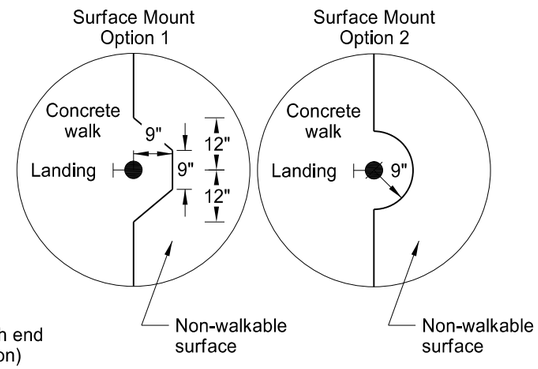
Note:
Bent bar anchor may be used inplace of drilling.

APS Push Button Station - Surface Mount
(May Be Used With Approval By The Engineer)

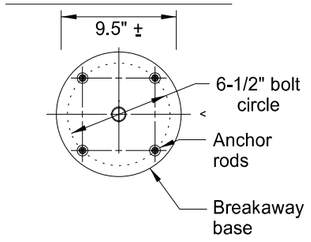
Not To Scale



Use option 1 or 2 when the APS push button is shown at the edge of walk. Option used (or selected) must be the same throughout the entire project.



Anchor Rod Placement



Notes:

Placement and orientation of the push button station is critical. Mount the button so that the face is parallel with the associated crosswalk. Screw in shaft to a tightened position before mounting accessible pedestrian push button unit to the shaft.

Plumb the push button station with leveling shims.

Use 18" x 6" fiber forming tube for the lower half of the foundation when conditions do not allow for the 18" x 6" hole to stand open.

① The push button station foundation is monolithic (poured at one time) with the sidewalk. Provide a 2:1 (h:v) slope grade where the 4" min sidewalk depth transitions to the 12" min foundation depth. Maintain the compacted aggregate base and thickness used for the sidewalk throughout the slope and foundation grading. Provide 2:1 (h:v) slope grading 360 degrees for the transition from the sidewalk to the foundation when the foundation is not located near edge of sidewalk and is surrounded by concrete walk.

② Ensure concrete control joints and edge of concrete walk are a minimum 9" from the center of the push button foundation. (see option 1 or 2).

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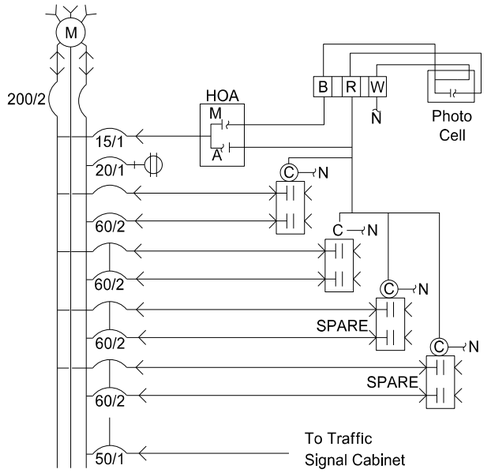
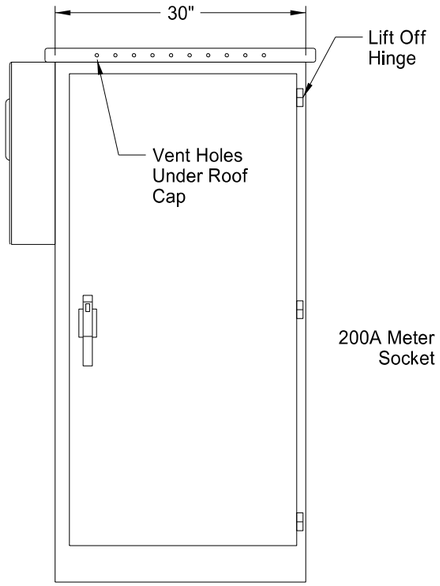
Push Button Foundation &
Cabinet Foundation & Working Slab Detail
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

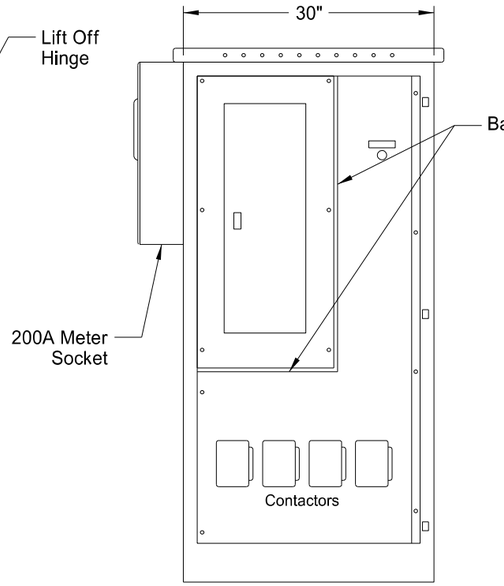
	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
	ND	HEU-6-081(094)940	150	105



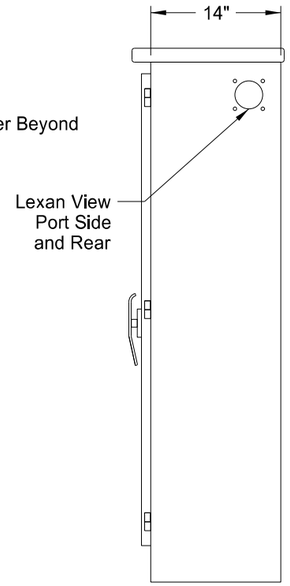
Wiring Diagram



FRONT VIEW



Front View Door Removed



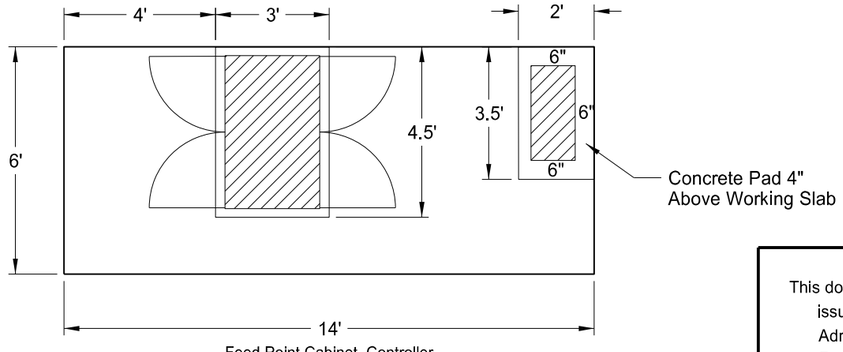
Side View

Notes:

1. Combination Feed Point to be used when Traffic Signals and Street Lights are to utilize same Feed Point.
2. Cabinet fabricated from 14 Gauge #304 Stainless Steel.
3. Padlockable Vault Type Handle to be Stainless Steel with Three Point Latch.
4. Lift Off Hinges - Southco #98-10-500-50, Sugatsume or Equal.
5. Inner Dead Front to be Hinged.
6. Cabinet to be Suitable for Service Entrance.
7. Assembly to be UL508 Listed.
8. Bill of Material:

- 200A, 1PH., 3W., 120/240V Load Center
  - 1 - 200A 2P Main Circuit Breaker
  - 1 - 15A 1P Branch Breaker
  - 1 - 20A 1P Branch Breaker
  - 1 - 50A 1P Branch Breaker
  - 4 - 60A 2P Branch Breaker
  - 4 - 60A 2P Mercury Contactors
    Mercury Displacement #260N0102AH
- Test Switch - Allen Bradley #800T-H2A, Square D or Equal
- 200A 2P By-Pass Meter Socket - Street Lights
- Photocell Base - Area Lighting Research AW2A-NB, Intermatic, Paragon, Tork or Equal
- Photocell - DTL #DP124-0.8-TJUJ50, Intermatic, Paragon, Tork or Equal

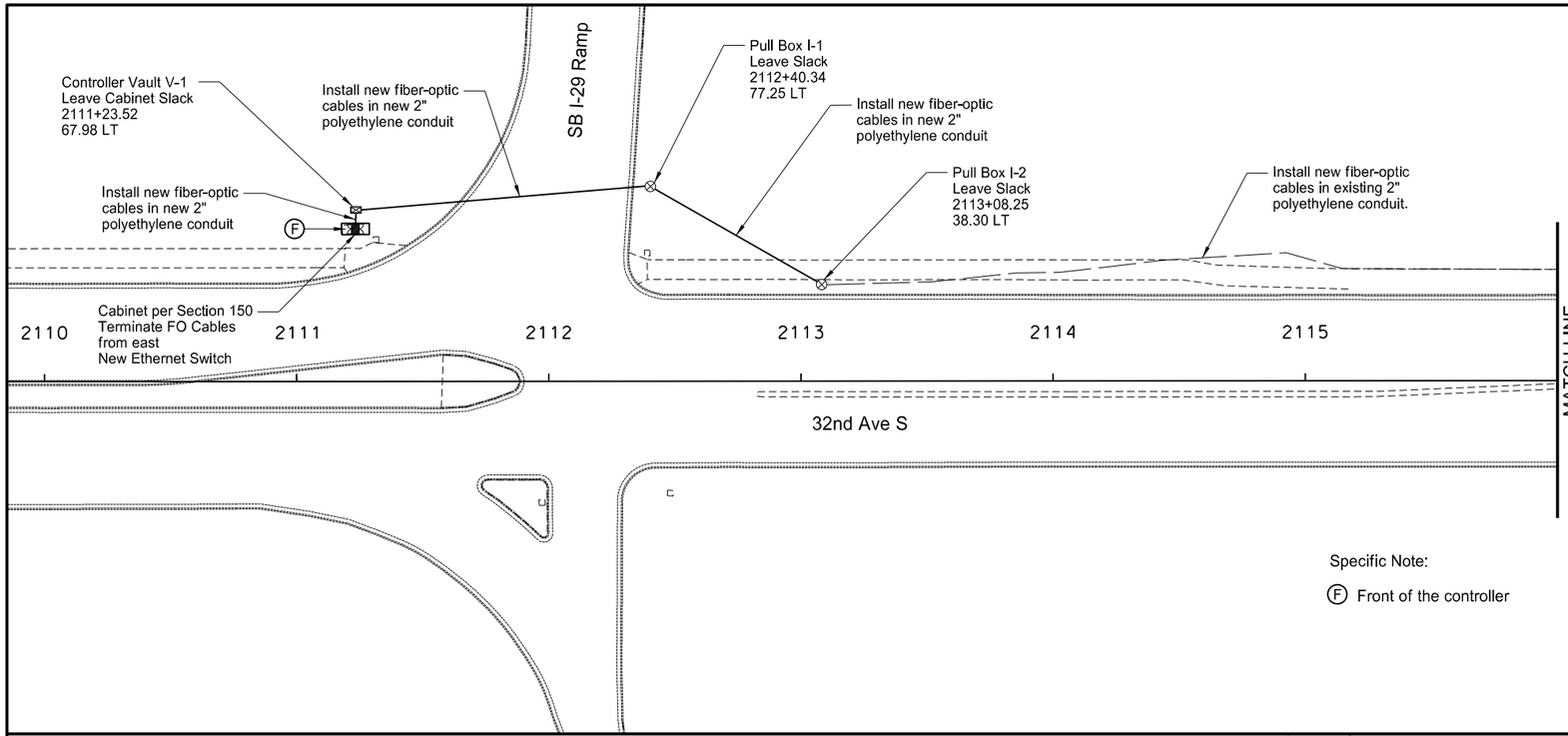
Combination Feed Point Type IV - Pad Mounted Detail



Feed Point Cabinet, Controller
Cabinet Foundation, and Working Slab

Combination Feed Point Detail
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	160	1



Specific Note:

Ⓕ Front of the controller

PULL BOX		
I-1 to I-2	2	EA
V-1	1	EA

2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2111+31.43 (Cabinet) to Sta. 2116+00.00	203	LF

FIBER OPTIC LINE		
Sta. 2111+31.43 (Cabinet) to Sta. 2116+00.00	578	LF

TRACER CONDUCTOR		
Sta. 2111+31.43 (Cabinet) to Sta. 2116+00.00	498	LF

Notes:
1. All items and quantities are for estimating purposes only.
2. Include all work in "IT System" bid item.
3. Include 15' of fiber cable slack in pull boxes and 50' in controller vaults adjacent to the cabinet.
4. Deliver all salvaged existing fiber-optic cables to the City of Grand Forks electrician. Protect fiber terminations.
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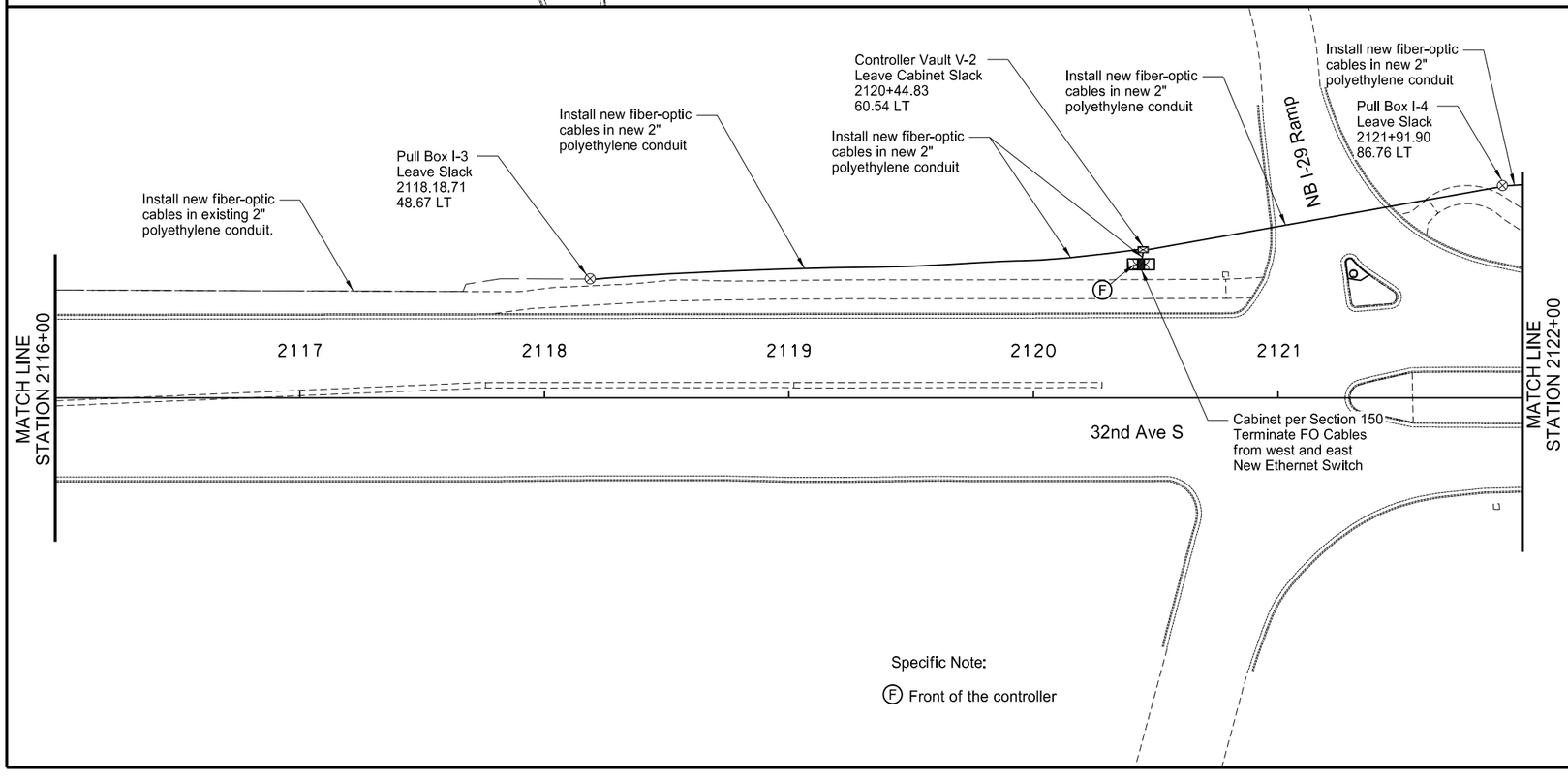

Specific Note:

Ⓕ Front of the controller

PULL BOX		
I-3 to I-4	2	EA
V-2	1	EA

2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2116+00.00 to Sta. 2122+00.00	395	LF

FIBER OPTIC LINE		
Sta. 2116+00.00 to Sta. 2122+00.00	696	LF

TRACER CONDUCTOR		
Sta. 2116+00.00 to Sta. 2122+00.00	616	LF

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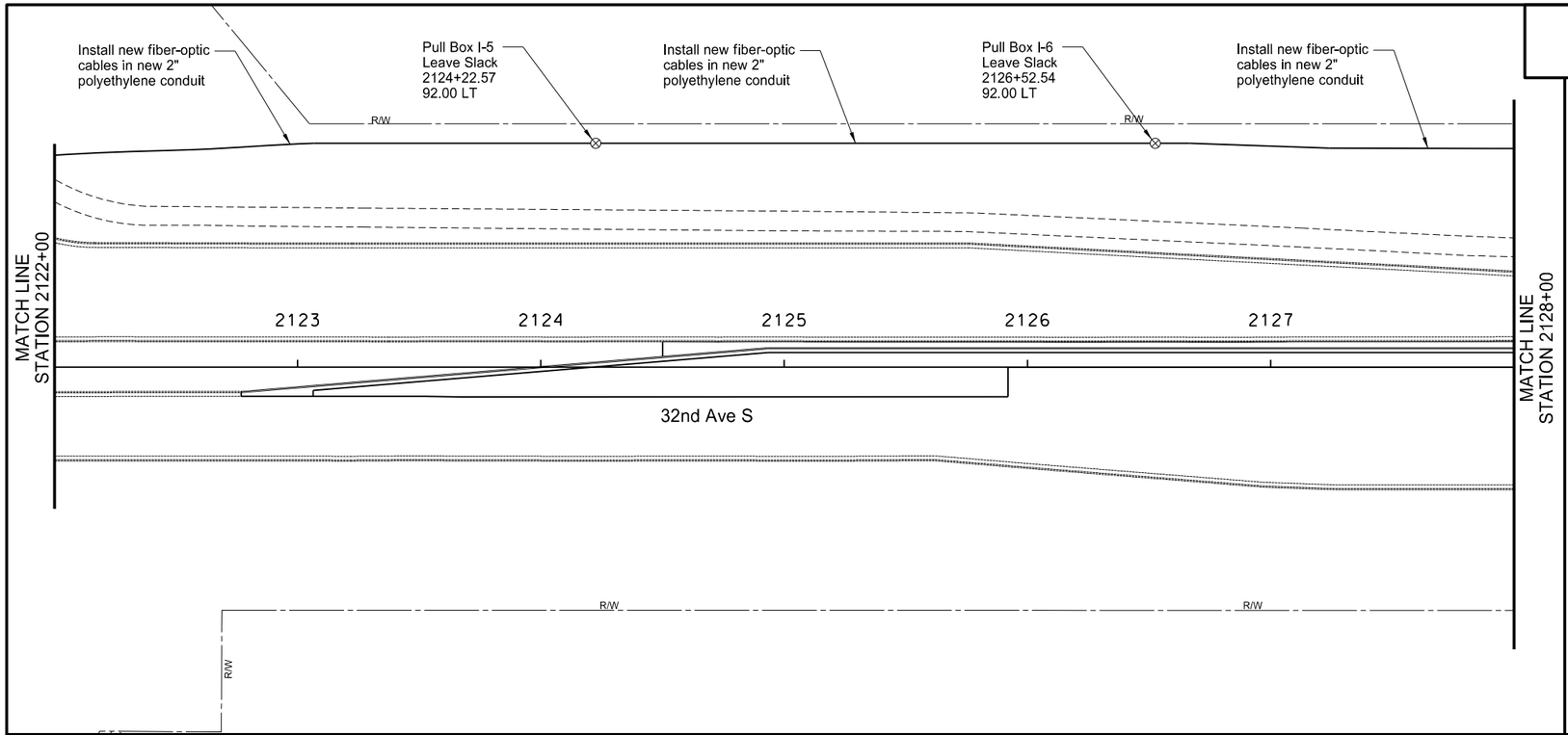
Interconnect Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

2111+31.43 to 2116+00
2116+00 to 2122+00

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	160	2



PULL BOX		
I-5 to I-6	2	EA
2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2122+00.00 to Sta. 2128+00.00	605	LF
FIBER OPTIC LINE		
Sta. 2122+00.00 to Sta. 2128+00.00	635	LF
TRACER CONDUCTOR		
Sta. 2122+00.00 to Sta. 2128+00.00	605	LF

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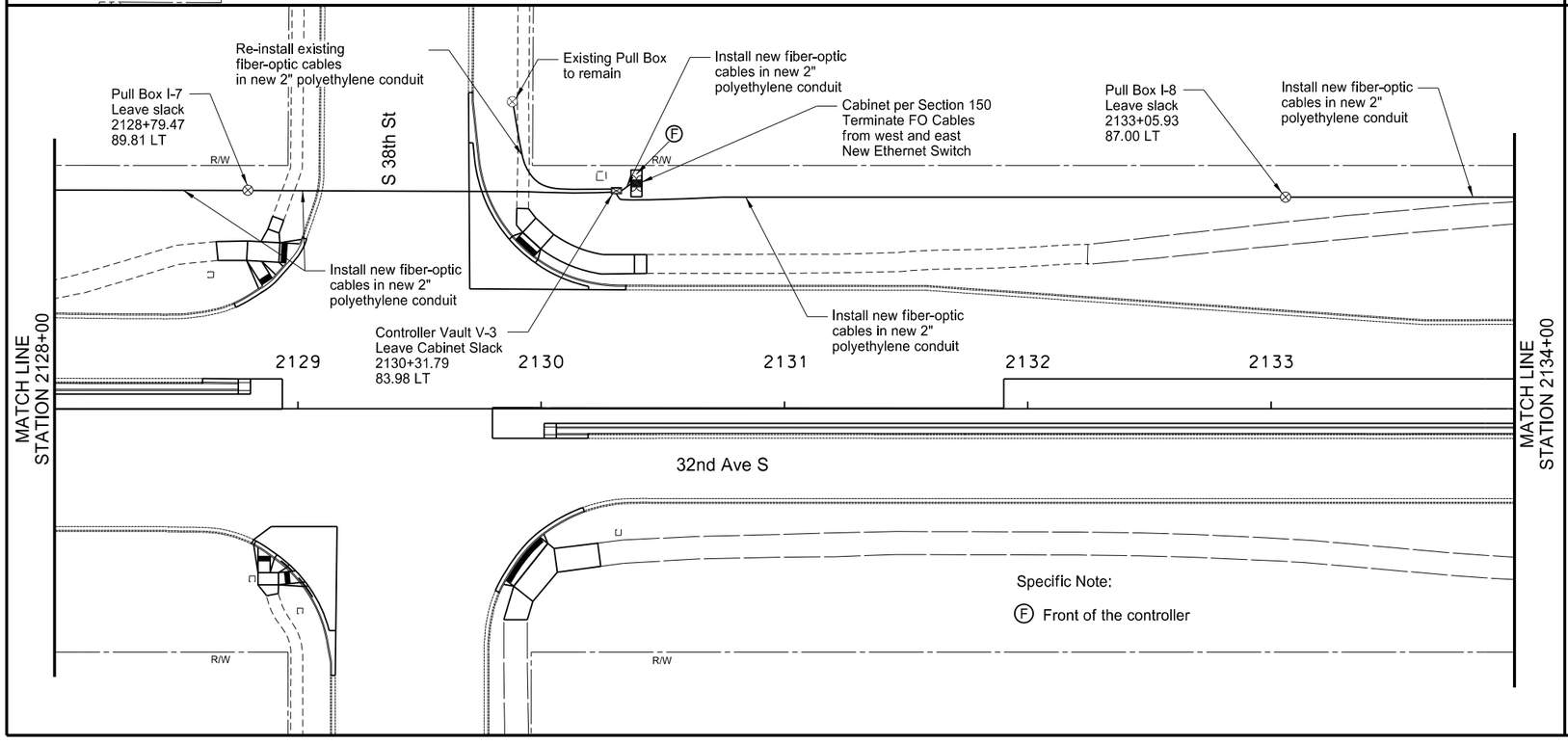

PULL BOX		
I-7 to I-8	2	EA
V-3	1	EA
2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2128+00.00 to Sta. 2134+00.00	677	LF
FIBER OPTIC LINE		
Sta. 2128+00.00 to Sta. 2134+00.00	692	LF
TRACER CONDUCTOR		
Sta. 2128+00.00 to Sta. 2134+00.00	612	LF

Specific Note:

Ⓕ Front of the controller

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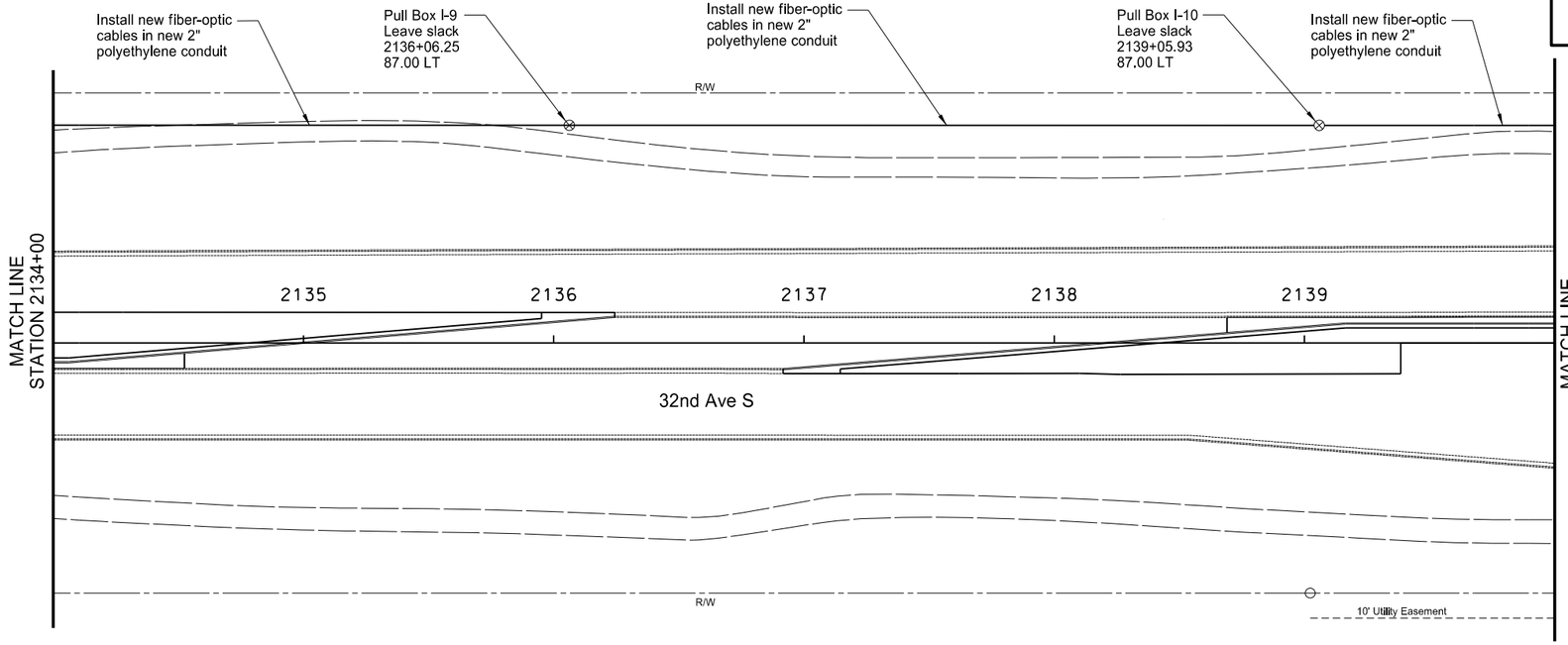
Interconnect Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

2122+00 to 2128+00
2128+00 to 2134+00

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	160	3



PULL BOX		
I-9 to I-10	2	EA
2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2134+00.00 to Sta. 2140+00.00	600	LF
FIBER OPTIC LINE		
Sta. 2134+00.00 to Sta. 2140+00.00	630	LF
TRACER CONDUCTOR		
Sta. 2134+00.00 to Sta. 2140+00.00	600	LF

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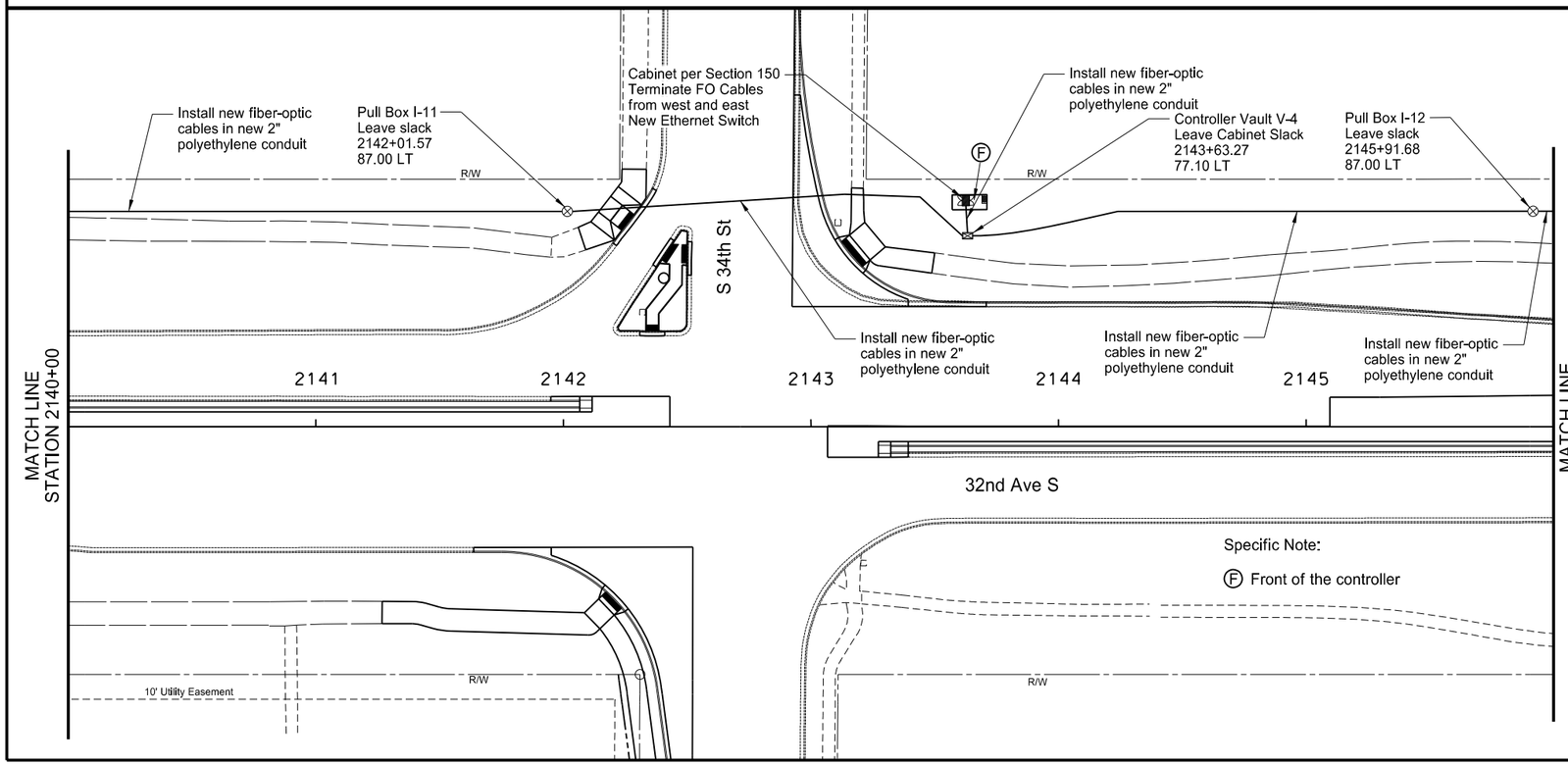

PULL BOX		
I-11 to I-12	2	EA
V-4	1	EA
2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2140+00.00 to Sta. 2146+00.00	622	LF
FIBER OPTIC LINE		
Sta. 2140+00.00 to Sta. 2146+00.00	702	LF
TRACER CONDUCTOR		
Sta. 2140+00.00 to Sta. 2146+00.00	622	LF

Specific Note:

Ⓕ Front of the controller

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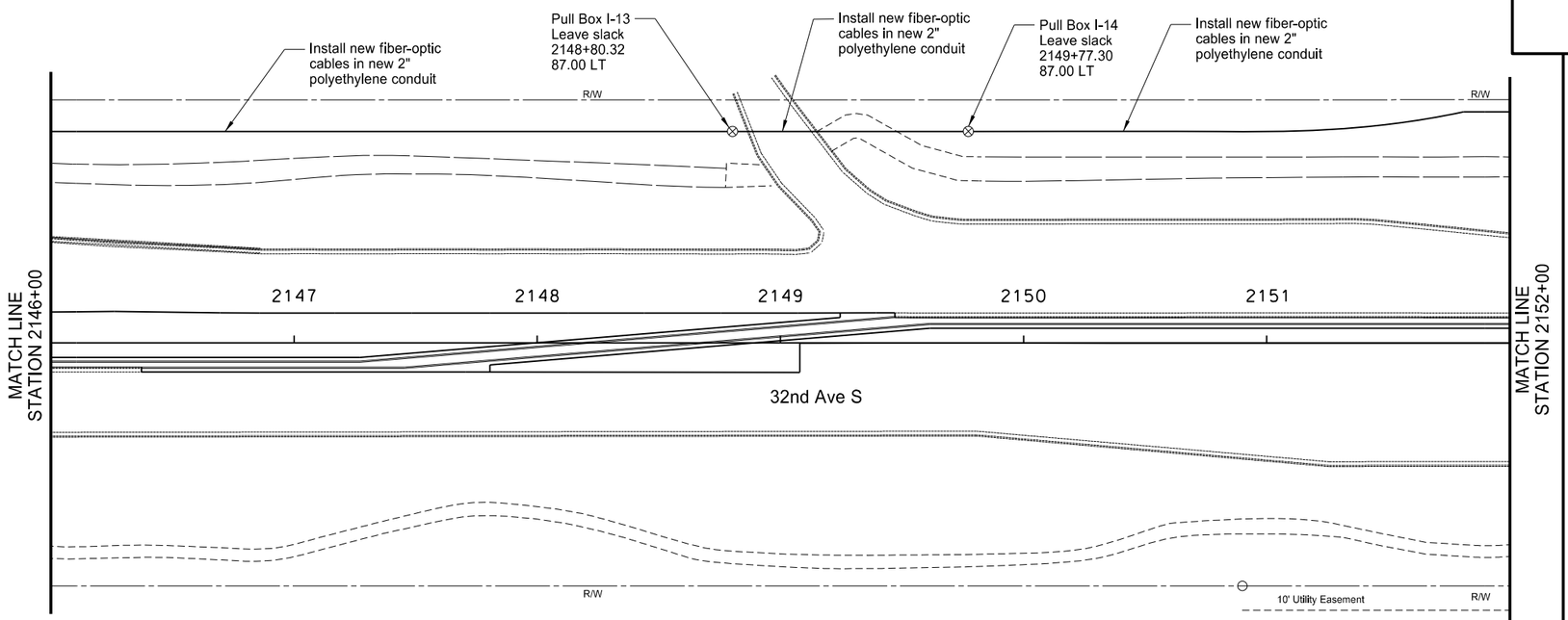
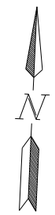
Interconnect Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

2134+00 to 2140+00
2140+00 to 2146+00

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	160	4





PULL BOX		
I-13 to I-14	2	EA
2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2146+00.00 to Sta. 2152+00.00	605	LF
FIBER OPTIC LINE		
Sta. 2146+00.00 to Sta. 2152+00.00	635	LF
TRACER CONDUCTOR		
Sta. 2146+00.00 to Sta. 2152+00.00	605	LF

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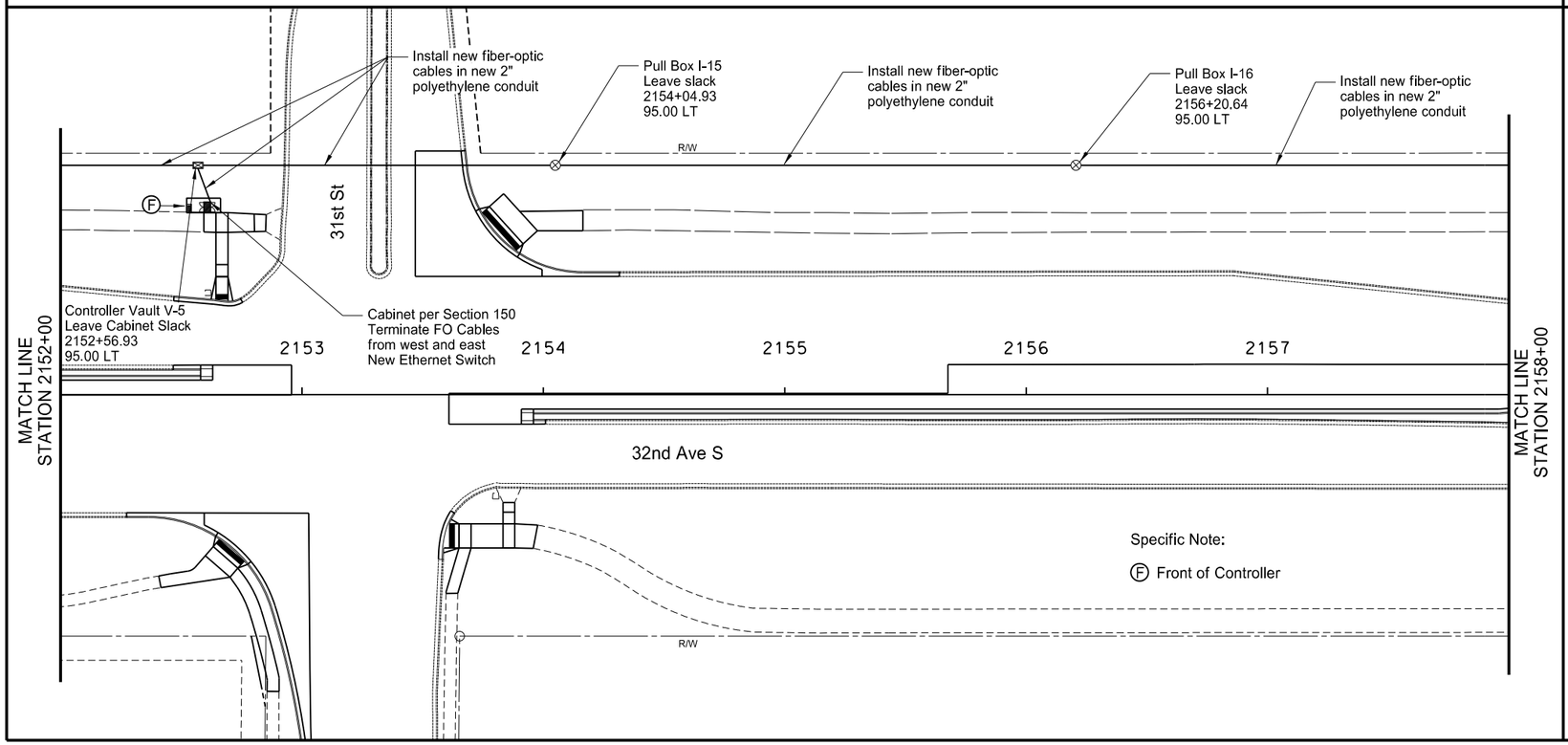

PULL BOX		
I-15 to I-16	2	EA
V-5	1	EA
2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2152+00.00 to Sta. 2158+00.00	618	LF
FIBER OPTIC LINE		
Sta. 2152+00.00 to Sta. 2158+00.00	698	LF
TRACER CONDUCTOR		
Sta. 2152+00.00 to Sta. 2158+00.00	618	LF

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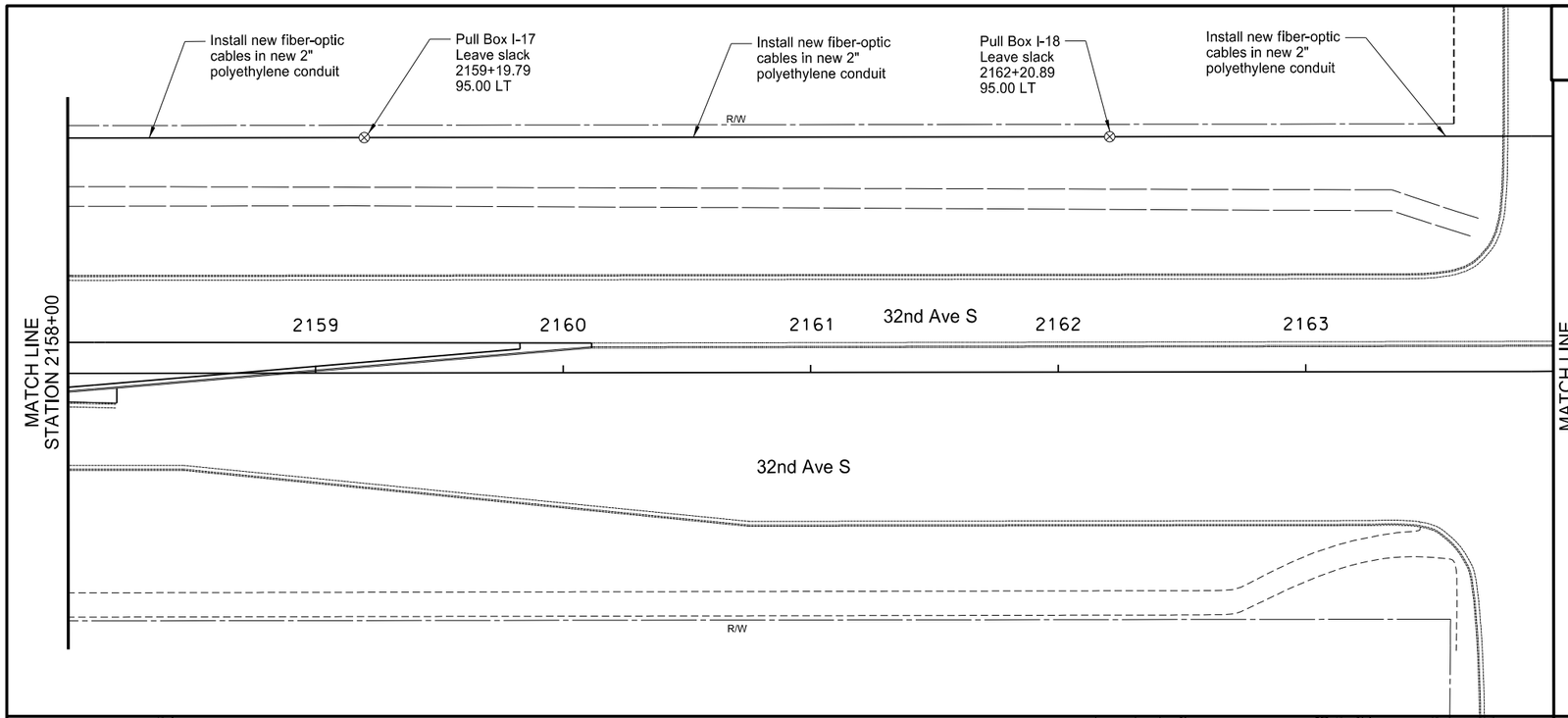
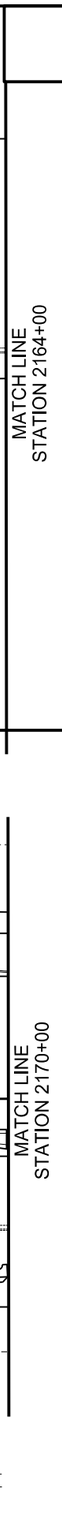
Interconnect Layout

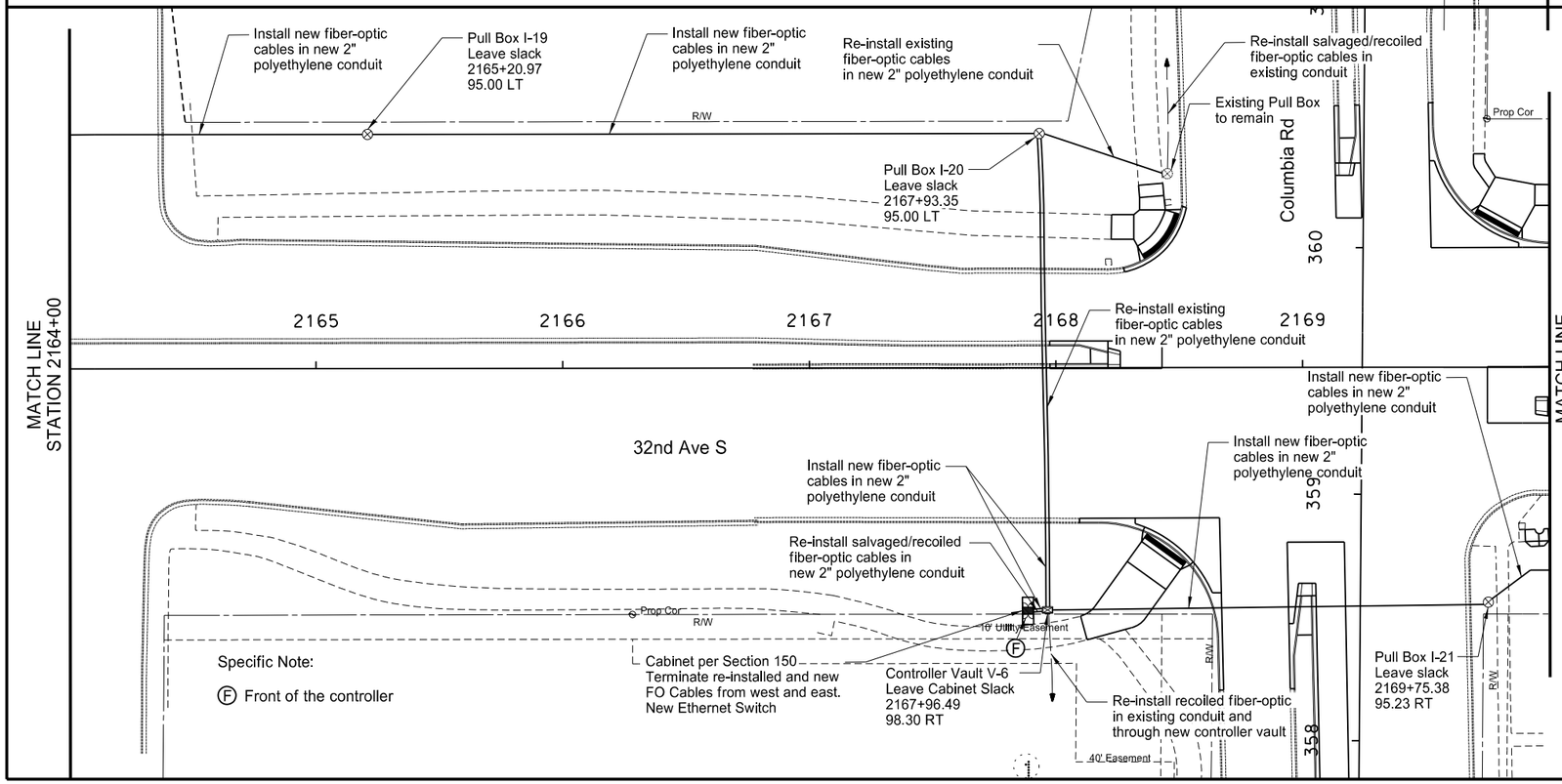
US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

2146+00 to 2152+00
2152+00 to 2158+00

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	160	5







PULL BOX		
I-17 to I-18	2	EA

2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2158+00.00 to Sta. 2164+00.00	600	LF

FIBER OPTIC LINE		
Sta. 2158+00.00 to Sta. 2164+00.00	630	LF

TRACER CONDUCTOR		
Sta. 2158+00.00 to Sta. 2164+00.00	600	LF

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PULL BOX		
I-19 to I-21	3	EA
V-6	1	EA

2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2164+00.00 to Sta. 2170+00.00	1060	LF

FIBER OPTIC LINE		
Sta. 2164+00.00 to Sta. 2170+00.00	899	LF

TRACER CONDUCTOR		
Sta. 2164+00.00 to Sta. 2170+00.00	804	LF

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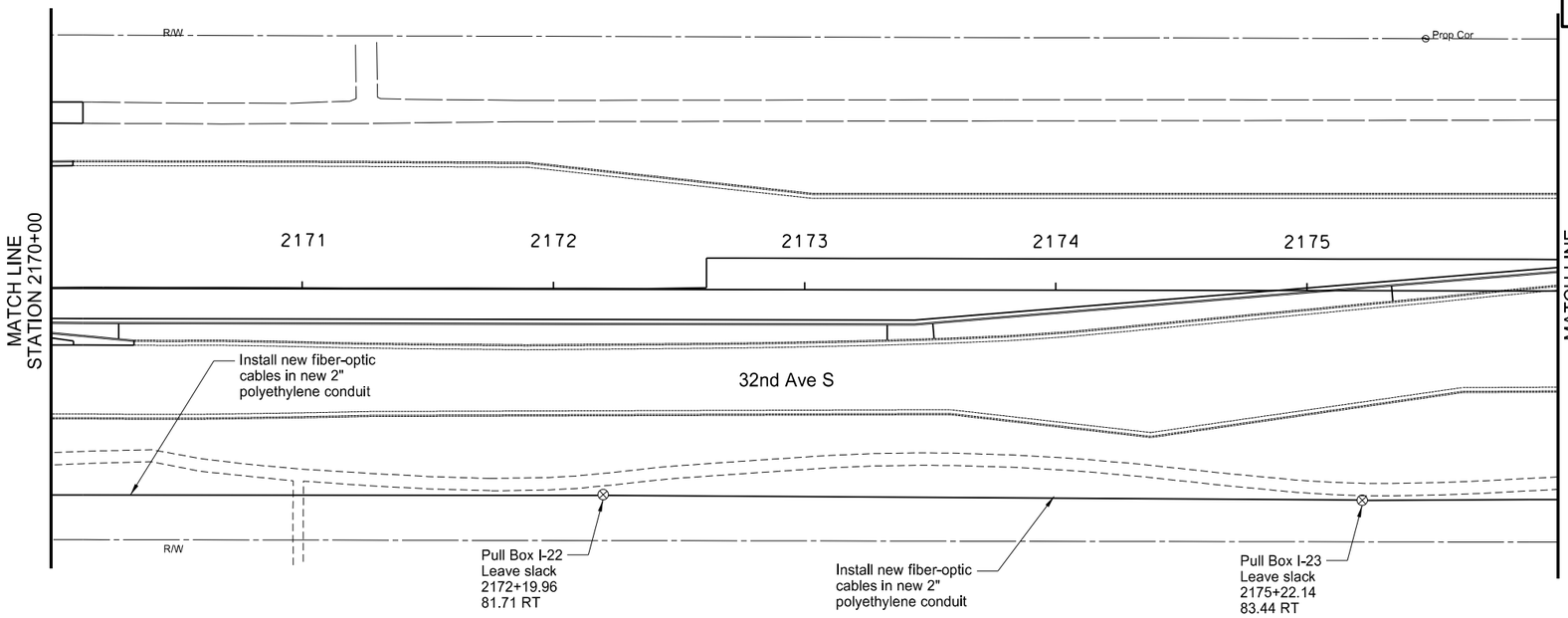
Interconnect Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

2158+00 to 2164+00
2164+00 to 2170+00

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	160	6



PULL BOX		
I-22 to I-23	2	EA

2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2170+00.00 to Sta. 2176+00.00	600	LF

FIBER OPTIC LINE		
Sta. 2170+00.00 to Sta. 2176+00.00	630	LF

TRACER CONDUCTOR		
Sta. 2170+00.00 to Sta. 2176+00.00	600	LF

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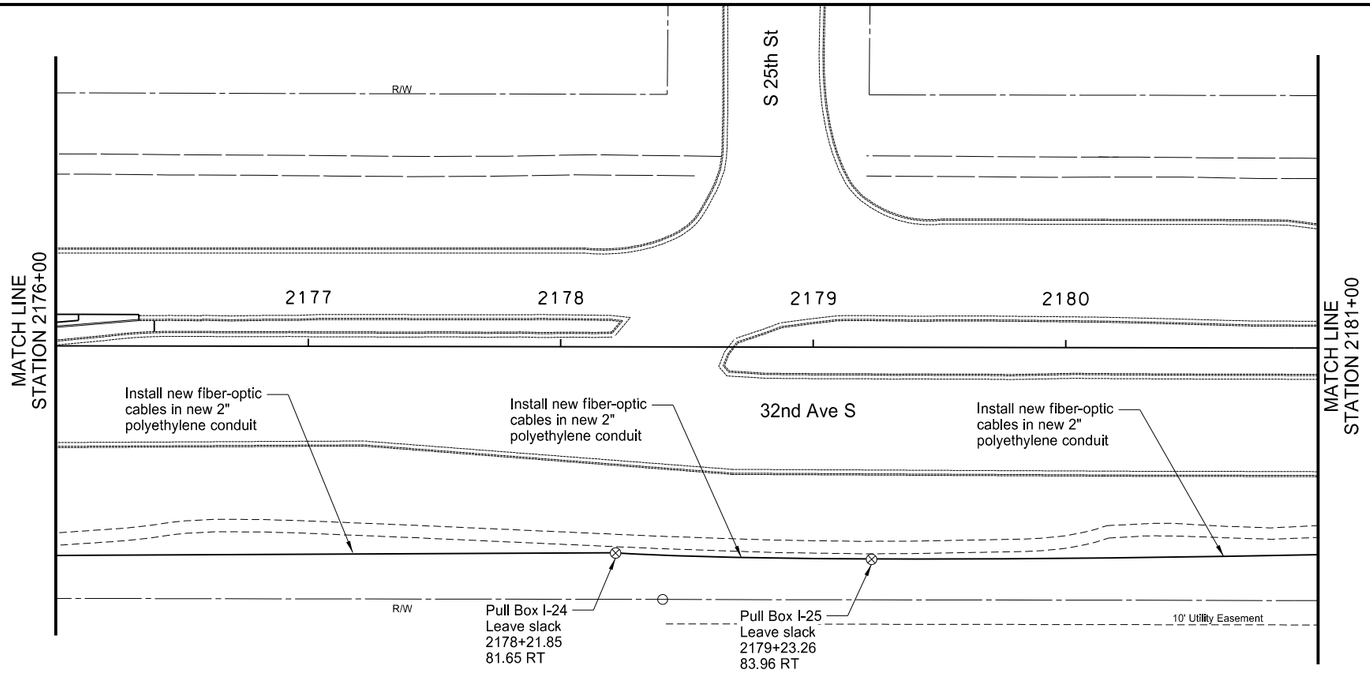

PULL BOX		
I-24 to I-25	2	EA

2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2176+00.00 to Sta. 2181+00.00	500	LF

FIBER OPTIC LINE		
Sta. 2176+00.00 to Sta. 2181+00.00	530	LF

TRACER CONDUCTOR		
Sta. 2176+00.00 to Sta. 2181+00.00	500	LF

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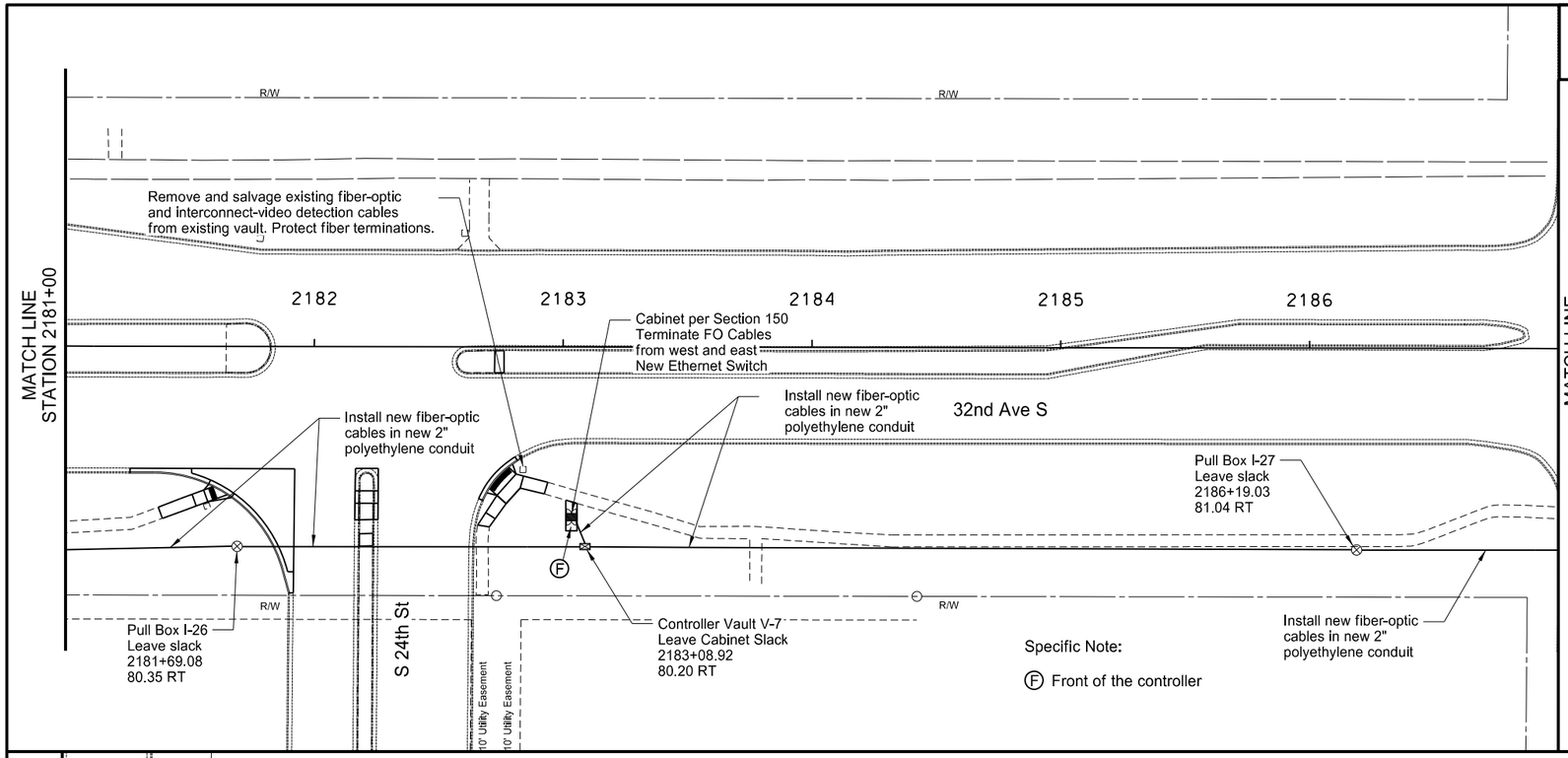
Interconnect Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

2170+00 to 2176+00
2176+00 to 2181+00

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	160	7



MATCH LINE
STATION 2187+00

N

PULL BOX		
I-26 to I-27	2	EA
V-7	1	EA
2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2181+00.00 to Sta. 2187+00.00	615	LF
FIBER OPTIC LINE		
Sta. 2181+00.00 to Sta. 2187+00.00	695	LF
TRACER CONDUCTOR		
Sta. 2181+00.00 to Sta. 2187+00.00	615	LF

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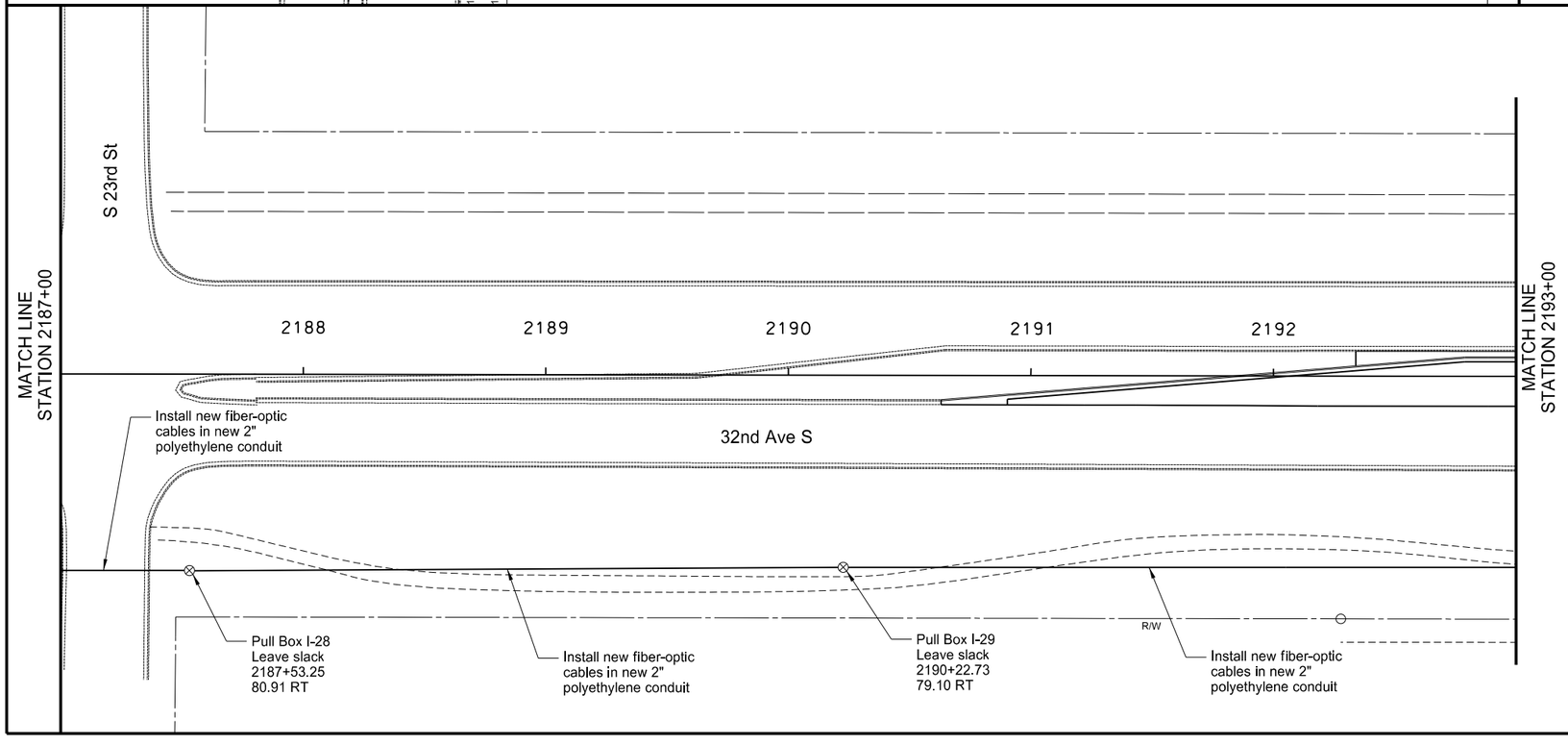

PULL BOX		
I-28 to I-29	2	EA
2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2187+00.00 to Sta. 2193+00.00	600	LF
FIBER OPTIC LINE		
Sta. 2187+00.00 to Sta. 2193+00.00	630	LF
TRACER CONDUCTOR		
Sta. 2187+00.00 to Sta. 2193+00.00	600	LF

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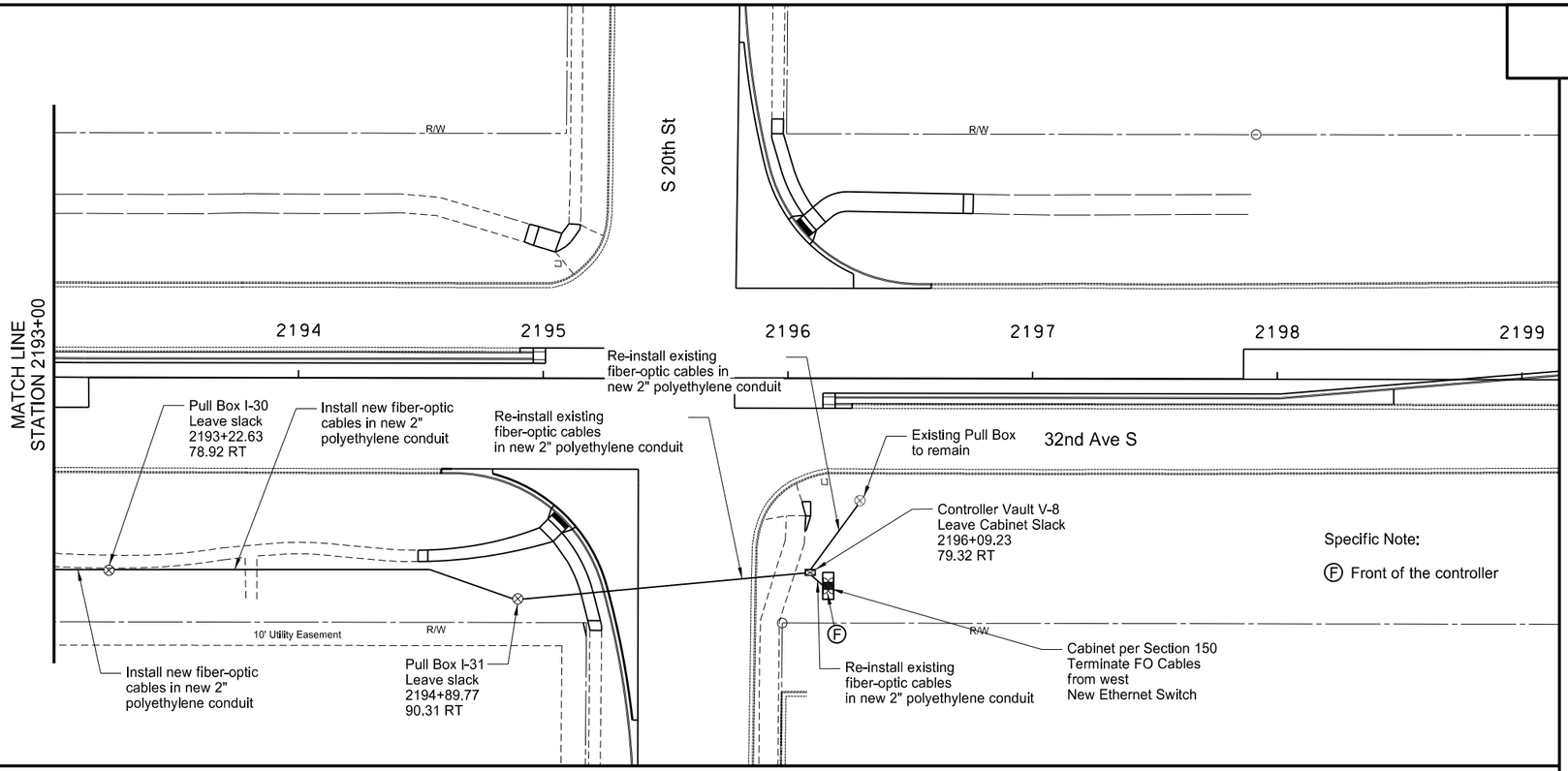
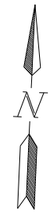
Interconnect Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

2181+00 to 2187+00
2187+00 to 2193+00

STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	HEU-6-081(094)940	160	8





PULL BOX		
I-30 to I-31	2	EA
V-8	1	EA
2IN DIAMETER POLYETHYLENE CONDUIT		
Sta. 2193+00.00 to Sta. 2196+15.78 (Cabinet)	358	LF
FIBER OPTIC LINE		
Sta. 2193+00.00 to Sta. 2196+15.78 (Cabinet)	402	LF
TRACER CONDUCTOR		
Sta. 2193+00.00 to Sta. 2196+15.78 (Cabinet)	322	LF

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ESTIMATED IT SYSTEM QUANTITIES		
ITEM DESCRIPTION	UNIT	TOTAL
2IN DIAMETER POLYETHYLENE CONDUIT	LF	8660
TRACER WIRE	LF	8820
FIBER OPTIC CABLE (12 PAIR SINGLE-MODE AND 12 PAIR MULTI-MODE)	LF	9690
PULL BOX	EA	31
CONTROLLER VAULT	EA	8
ETHERNET SWITCH	EA	8
772-9200-IT SYSTEM	EA	1

Items shown above are for informational purposes; contractor shall provide all labor and equipment necessary for the fiber interconnect system to be fully operational as shown in the Plans. Items shall be included in the corresponding price bid for "IT SYSTEM"

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Interconnect Layout

US Hwy 81 Safety, Signal and Turn Lanes
I-29 to 20th Street

2193+00 to 2196+15.78

NDDOT ABBREVIATIONS

D-101-1

?	This is a special text character used in the labeling of existing features. It indicates a feature that has an unknown characteristic, potentially based on: lack of description, location accuracy or purpose.
Abn	abandoned
Abut	abutment
Ac	acres
Adj	adjusted
Aggr	aggregate
Ahd	ahead
ARV	air release valve
Align	alignment
Al	alley
Alt	alternate
Alum	aluminum
ADA	Americans with Disabilities Act
A	ampere
&	and
Appr	approach
Approx	approximate
ACP	asbestos cement pipe
Asph	asphalt
AC	asphalt cement
Assmd	assumed
@	at
Atten	attenuation
ATR	automatic traffic recorder
Ave	Avenue
Avg	average
ADT	average daily traffic
Az	azimuth
Bk	back
BF	back face
Bs	backsight
Balc	balcony
B Wire	barbed wire
Barr	barricade
Btry	battery
Brg	bearing
BI	beehive inlet
Beg	begin
BG	below grade
BM	bench mark
Bkwy	bikeway
Bit	bituminous
Blk	block
Bd Ft	board feet
BH	bore hole
BS	both sides
Bot	bottom
Blvd	Boulevard
Bndry	boundary
BC	brass cap
Brkwy	breakaway
Br	bridge
Bldg	building
BV	butterfly valve
Byp	bypass
C Gdrl	cable guardrail
Calc	calculate
Cd	candela
CIP	cast iron pipe
CB	catch basin
CRS	cationic rapid setting
C Gd	cattle guard
C To C	center to center
CI or ℄	centerline
Cm	centimeter
Ch	chain
Chnlk	chain-link
Ch Blk	channel block
Ch Ch	channel change
Chk	check
Chsld	chiseled
Cir	circle
Cl	class
Cl	clay
Cl F	clay fill
Cl Hvy	clay heavy
Cl Lm	clay loam
Clnt	clean-out
Clr	clear
Cl&gr	clearing & grubbing
Co S	coal slack
C Gr	coarse gravel
CS	coarse sand
Comb.	combination
Coml	commercial
Compr	compression
CADD	computer aided drafting & design
Conc	concrete
CECB	concrete erosion control blanket
Cond	conductor
Const	construction
Cont	continuous
CSB	continuous split barrel sample
Contr	contraction
Contr	contractor
CP	control point
Coord	coordinate
Cor	corner
Corr	corrected
CAES	corrugated aluminum end section
CAP	corrugated aluminum pipe
CMES	corrugated metal end section
CMP	corrugated metal pipe
CPVCP	corrugated poly-vinyl chloride pipe
CSES	corrugated steel end section
CSFES	corrugated steel flared end section
CSP	corrugated steel pipe
CSTES	corrugated steel traversable end section
C	coulomb
Co	County
Crse	course
Ct	Court
Xarm	cross arm
Xbuck	cross buck
Xsec	cross sections
Xing	crossing
Xrd	Crossroad
Crn	crown
CF	cubic feet
M3	cubic meter
M3/s	cubic meters per second
CY	cubic yard
Cy/mi	cubic yards per mile
Culv	culvert
C&G	curb & gutter
CI	curb inlet
CR	curb ramp
CS	curve to spiral
C	cut
Dd Ld	dead load
Defl	deflection
Defm	deformed
Deg or D	degree
Dlnt	delineate
Dlntr	delineator
Depr	depression
Desc	description
Det	detail
DWP	detectable warning panel
Dtr	detour
Dia or ø	diameter
Dir	direction
Dist	distance
DM	disturbed material
DB	ditch block
DG	ditch grade
Dbl	double
Dn	down
Dwg	drawing
Dr	drive
Drwy	driveway
DI	drop inlet
D	dry density
DSDS	dynamic speed display sign
Ea	each
Esmt	easement
E	East
EB	Eastbound
Elast	elastomeric
EL	electric locker
E Mtr	electric meter
Elec	electric/al
EDM	electronic distance meter
Elev or El	elevation
Ellipt	elliptical
Emb	embankment
Emuls	emulsion/emulsified
ES	end section
Engr	engineer
ESS	environmental sensor station
Eq	equal
Eq	equation
Evgr	evergreen
Exc	excavation
Exst	existing
Exp	expansion
Expy	Expressway
E	external of curve
Extru	extruded
FOS	factor of safety
F	Fahrenheit
FS	far side
F	farad
Fed	Federal
FP	feed point
Ft	feet/foot
Fn	fence
Fn P	fence post
FO	fiber optic
FB	field book
FD	field drive
F	fill
FAA	fine aggregate angularity
FS	fine sand
FH	fire hydrant
Fl	flange
Flrd	flared
FES	flared end section
F Bcn	flashing beacon
FA	flight auger sample
FL	flow line
Ftg	footing
FM	force main
Fs	foresight

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
07-01-14	
REVISIONS	
DATE	CHANGE
04-23-18	General Revisions
09-20-18	General Revisions

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NDDOT ABBREVIATIONS

D-101-2

Fnd	found
Fdn	foundation
Frac	fractional
Frwy	freeway
Frt	front
FF	front face
F Disp	fuel dispenser
FFP	fuel filler pipes
FLS	fuel leak sensor
Furn	furnish/ed
Gal	gallon
Galv	galvanized
Gar	garage
Gs L	gas line
G Reg	gas line regulator
GMV	gas main valve
G Mtr	gas meter
GSV	gas service valve
GVP	gas vent pipe
GV	gate valve
Ga	gauge
Geod	geodetic
GIS	Geographical Information System
G	giga
GPS	Global Positioning System
Gov	government
Grd	graded/grade
Gr	gravel
Grnd	ground
GWM	ground water monitor
Gdrl	guardrail
Gtr	gutter
H Plg	H piling
Hdwl	headwall
Ha	hectare
Ht	height
HI	height of instrument
Hel	helical
H	henry
Hz	hertz
HDPE	high density polyethylene
HM	high mast
HP	high pressure
HPS	high pressure sodium
Hwy	highway
Hor	horizontal
HBP	hot bituminous pavement
HMA	hot mix asphalt
Hr	hour(s)
Hyd	hydrant
Ph	hydrogen ion content
Id	identification
In or "	inch
Incl	inclinometer tube
IMH	inlet manhole
ID	inside diameter
Inst	instrument
Intchg	interchange
Intmdt	intermediate
Intscn	intersection
Inv	invert
IM	iron monument
I Pn	Iron Pin
IP	iron Pipe
Jt	joint
J	joule
Jct	junction
K	kelvin
Kn	kilo newton
Kpa	kilo pascal
Kg	kilogram
Kg/m3	kilogram per cubic meter
Km	kilometer
K	Kip(s)
LS	Land Surveyor (licensed)
LSIT	Land Surveyor In Training
Ln	lane
Lg	large
Lat	latitude
Lt	left
L	length of curve
Lens	lenses
Lvl	level
LB	level book
Lvlng	leveling
Lht	light
LP	light pole
Ltg	lighting
Lig Co	lignite coal
Lig Sl	lignite slack
LF	linear foot
Liq	liquid
LL	liquid limit
L	litre
Lm	loam
Loc	location
LC	long chord
Long.	longitude
Lp	loop
LD	loop detector
Lm	lumen
Lum	luminaire
L Sum	lump sum
Lx	lux
Mb	mailbox
ML	main line
M Hr	man hour
MH	manhole
Mkd	marked
Mkr	marker
Mkg	marking
MA	mast arm
Matl	material
Max	maximum
MC	meander corner
Meas	measure
Mdn	median
MD	median drain
MC	medium curing
M	mega
Mer	meridian
M	meter
M/s	meters per second
M	mid ordinate of curve
MGS	Midwest Guardrail System
Mi	mile
MM	mile marker
MP	mile post
Ml	milliliter
Mm	millimeter
Mm/hr	millimeters per hour
Min	minimum
Misc	miscellaneous
Mon	monument
Mnd	mound
Mtbl	mountable
Mtd	mounted
Mtg	mounting
Mk	muck
Mun	municipal
N	nano
NGS	National Geodetic Survey
NS	near side
Neop	neoprene
Ntwk	network
N	newton
N	North
NE	North East
NW	North West
NB	Northbound
No. or #	number
Obsc	obscure(d)
Obsn	observation
Ocpd	occupied
Ocpy	occupy
Off Loc	office location
O/s	offset
OC	on center
C	one dimensional consolidation
OC	organic content
Orig	original
O To O	out to out
OD	outside diameter
OH	overhead
PMT	pad mounted transformer
Pg	pages
Pntd	painted
Pr	pair
Pnl	panel
Pk	park
PK	Parker-Kalon nail
Pa	pascal
PSD	passing sight distance
Pvmt	pavement
Ped	pedestal
Ped	pedestrian
PPP	pedestrian pushbutton post
Pen.	penetration
Perf	perforated
Per.	perimeter
PL	pipeline
Pl	place
P&P	plan & profile
PL	plastic limit
P Cap	plastic cap
Pl or ℙ	plate
Pt	point
PCC	point of compound curve
PC	point of curve
PI	point of intersection
PRC	point of reverse curvature
PT	point of tangent
POC	point on curve
POT	point on tangent
PE	polyethylene
PVC	polyvinyl chloride
PCC	Portland Cement concrete
Lb or #	pounds
PP	power pole
Preempt	preemption
Prefab	prefabricated
Prfmd or Pref	preformed
Prep	preperation
Press.	pressure

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
07-01-14	
REVISIONS	
DATE	CHANGE
08-03-15	General Revisions
04-23-18	General Revisions

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NDDOT ABBREVIATIONS

D-101-3

PRV	pressure relief valve
Prestr	prestressed
Pvt	private
PD	private drive
Prod.	production/produce
Prog	programmed
Prop.	property
Prop Ln	property line
Ppsd	proposed
PB	pull box
Qty	quantity
Qtr	quarter
Rad or R	radius
RR	railroad
Rlwy	railway
Rsd	raised
RTP	random traverse point
Rge or R	range
RC	rapid curing
Rec	record
Rcy	recycle
RAP	recycled asphalt pavement
RPCC	recycled portland cement concrete
Ref	reference
R Mkr	reference marker
RM	reference monument
RP	reference point
Refl	reflectorized
RCB	reinforced concrete box
RCES	reinforced concrete end section
RCFES	reinforced concrete flared end section
RCTES	reinforced concrete traversable end section
RCP	reinforced concrete pipe
RCPS	reinforced concrete pipe sewer
Reinf	reinforcement
Res	reservation
Rs	residence
Ret	retaining
Rev	reverse
Rt	right
R/W	right of way
Riv	river
Rd	road
Rdbd	road bed
Rdwy	roadway
RWIS	roadway weather information system
Rk	rock
Rt	route
Salv	salvage(d)
Sd	sand
Sdy Cl	sandy clay
Sdy Cl Lm	sandy clay loam
Sdy Fl	sandy fill
Sdy Lm	sandy loam
San	sanitary sewer line
Sc	scoria
Sec	seconds
Sec	section
SL	section line
Sep	separation
Seq	sequence
Serv	service
Sh	shale
Sht	sheet
Shtng	sheeting
Shldr	shoulder
Sw or Sdwk	sidewalk
S	siemens
SD	sight distance
SN	sign number
Sig	signal
Si Cl	silt clay
Si Cl Lm	silty clay loam
Si Lm	silty loam
Sgl	single
SRCP	slotted reinforced concrete pipe
SC	slow curing
SS	slow setting
Sm	small
S	South
SE	South East
SW	South West
SB	Southbound
Sp	spaces
Spcl	special
SA	special assembly
SP	special provisions
G	specific gravity
Spk	spike
SC	spiral to curve
ST	spiral to tangent
SB	split barrel sample
SH	sprinkler head
SV	sprinkler valve
Sq	square
SF	square feet
Km2	square kilometer
M2	square meter
SY	square yard
Stk	stake
Std	standard
N	standard penetration test
Std Specs	standard specifications
Sta	station
Sta Yd	station yards
Stm L	steam line
SEC	steel encased concrete
SMA	stone matrix asphalt
SSD	stopping sight distance
SD	storm drain
St	street
SPP	structural plate pipe
SPPA	structural plate pipe arch
Str	structure
Subd	subdivision
Sub	subgrade
Sub Prep	subgrade preperation
Ss	subsoil
SE	superelevation
SS	supplement specification
Supp	supplemental
Surf	surfacing
Surv	survey
Sym	symmetrical
SI	systems international
Tan	tangent
T	tangent (semi)
TS	tangent to spiral
Tel	telephone
Tel B	Telephone Booth
Tel P	telephone pole
Tv	television
Temp	temperature
Temp	temporary
TBM	temporary bench mark
T	tesla
T	thinwall tube sample
T/mi	tons per mile
Ts	topsoil
Twp or T	township
Traf	traffic
TSCB	traffic signal control box
Tr	trail
Transf	transformer
TB	transit book
Trans	transition
TT	transmission tower
TES	traversable end section
Trans	transverse
Trav	traverse
TP	traverse point
Trtd	treated
Trmt	treatment
Qc	triaxial compression
TERO	tribal employment rights ordinance
Tpl	triple
TP	turning point
Typ	typical
Qu	unconfined compressive strength
Ugrnd	underground
USC&G	US Coast & Geodetic Survey
USGS	US Geologic Survey
Util	utility
VG	valley gutter
Vap	vapor
Vert	vertical
VC	vertical curve
VCP	vitrified clay pipe
V	volt
Vol	volume
Wkwy	walkway
W	water content
WGV	water gate valve
WL	water line
WM	water main
WMV	water main valve
W Mtr	water meter
WSV	water service valve
WW	water well
W	watt
Wrng	wearing
Wb	weber
WIM	weigh in motion
W	west
WB	westbound
Wrng	wiring
W/	with
W/o	without
WC	witness corner
WGS	world geodetic system
Z	zenith

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
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NDDOT UTILITY COMPANY AND ORGANIZATION ABBREVIATIONS

D-101-10

702COM	702 Communications
ACCENT	Accent Communications
AGASSIZ WU	Agassiz Water Users Incorporated
AGC	Assiociated General Contractors of America
All PI	Alliance Pipeline
ALL SEAS WU	All Seasons Water Users Association
AMOCO PI	Amoco Pipeline Company
AMRDA HESS	Amerada Hess Corporation
AT&T	AT&T Corporation
B PAW	Bear Paw Energy Incorporated
BAKER ELEC	Baker Electric
BASIN ELEC	Basin Electric Cooperative Incorporated
BEK TEL	Bek Communications Cooperative
BELLE PL	Belle Fourche Pipeline Company
BLM	Bureau of Land Management
BNSF	Burlington Northern Santa Fe Railway
BOEING	Boeing
BRNS RWD	Barnes Rural Water District
BURK-DIV ELEC	Burke-Divide Electric Cooperative
BURL WU	Burleigh Water Users
Cable One	Cable One
CABLE SERV	Cable Services
CAP ELEC	Capital Electric Cooperative Incorporat
CASS CO ELEC	Cass County Electric Cooperative
CASS RWU	Cass Rural Water Users Incorporated
CAV ELEC	Cavalier Rural Electric Cooperative
CBLCOM	Cablecom Of Fargo
CENEX PL	Cenex Pipeline
CENT PL WATER DIST	Central Pipe Line Water District
CENT PWR ELEC	Central Power Electric Cooperative
COE	Corps of Engineers
CONS TEL	Consolidated Telephone
CONT RES	Continental Resource Inc
CPR	Canadian Pacific Railway
D O E	Department Of Energy
DAK CARR	Dakota Carrier Network
DAK CENT TEL	Dakota Central Telephone
DAK RWD	Dakota Rural Water District
DGC	Dakota Gasification Company
DICKEY R NET	Dickey Rural Networks
DICKEY RWU	Dickey Rural Water Users Association
DICKEY TEL	Dickey Telephone
DNRR	Dakota Northern Railroad
DOME PL	Dome Pipeline Company
DVELEC	Dakota Valley Electric Cooperative
DVMW	Dakota, Missouri Valley & Western
ENBRDG	Enbridge Pipelines Incorporated
ENVENTIS	Enventis Telephone
FALK MNG	Falkirk Mining Company
FHWA	Federal Highway Administration
G FKS-TRL WD	Grand Forks-traill Water District
GETTY TRD & TRAN	Getty Trading & Transportation
GLDN W ELEC	Golden West Electric Cooperative
GRGS CO TEL	Griggs County Telephone
GTR RAMSEY WD	Greater Ramsey Water District
GT PLNS NAT GAS	Great Plains Natural Gas Company
HALS TEL	Halstad Telephone Company
IDEA1	Idea1
INT-COMM TEL	Inter-Community Telephone Company
KANEB PL	Kaneb Pipeline Company
KEM ELEC	Kem Electric Cooperative Incorporated
KOCH GATH SYS	Koch Gathering Systems Incorporated
LKHD PL	Lakehead Pipeline Company
LNGDN RWU	Langdon Rural Water Users Incorporated
LWR YELL R ELEC	Lower Yellowstone Rural Electric
MCKNZ CON	McKenzie Consolidated Telcom
MCKNZ ELEC	McKenzie Electric Cooperative
MCKNZ WRD	McKenzie County Water Resource District
MCLEOD	McLeod USA
MCLN ELEC	McLean Electric Cooperative
MCLN-SHRDN R WAT	McLean-Sheridan Rural Water
MDU	Montana-dakota Utilities
MID-CONT CABLE	Mid-Continent Cable
MIDSTATE TEL	Midstate Telephone Company
MINOT CABLE	Minot Cable Television
MINOT TEL	Minot Telephone Company
MISS VALL COMM	Missouri Valley Communications
MISS W W S	Missouri West Water System
MNKOTA PWR	Minnkota Power
MOR-GRAN-SOU ELEC	Mor-gran-sou Electric Cooperative
MOUNT-WILLI ELEC	Mountrail-williams Electric Cooperative
MRE LBTY TEL	Moore & Liberty Telephone
MUNICIPAL	City Water And Sewer
MUNICIPAL	City Of '.....'
N CENT ELEC	North Central Electric Cooperative
N VALL W DIST	North Valley Water District
ND PKS & REC	North Dakota Parks And Recreation
ND TEL	North Dakota Telephone Company
NDDOT	North Dakota Department of Transportation
NDSU SOIL SCI DEPT	NDSU Soil Science Department
NEMONT TEL	Nemont Telephone
NODAK R ELEC	Nodak Rural Electric Cooperative
NOON FRMS TEL	Noonan Farmers Telephone Company
NPR	Northern Plains Railroad
NSP	Northern States Power
NTH PRAIR RW	Northern Prairie Rural Water Association
NTHN BRDR PL	Northern Border Pipeline
NTHN PLNS ELEC	Northern Plains Electric Cooperative Incorporated
NTHWSTRN REF	Northwestern Refinery Company
NW COMM	Northwest Communication Cooperation
NWRWD	Northwest Rural Water District
ONEOK	Oneok gas
OSHA	Occupational Safety and Health Administration
OTTR TL PWR	Otter Tail Power Company
P L E M	Prairielands Energy Marketing
POLAR COM	Polar Communications
PVT ELEC	Private Electric
QWEST	Qwest Communications
R&T W SUPPLY	R & T Water Supply Association
RED RIV TEL	Red River Rural Telephone
RESVTN TEL	Reservation Telephone
ROBRTS TEL	Roberts Company Telephone
R-RIDER ELEC	Roughrider Electric Cooperative
RRVW	Red River Valley & Western Railroad
S CENT REG WD	South Central Regional Water District
S E W U	South East Water Users Incorporated
SCOTT CABLE	Scott Cable Television Dickinson
SHERDN ELEC	Sheridan Electric Cooperative
SHEYN VLY ELEC	Sheyenne Valley Electric Cooperative
SKYTECH	Skyland Technologies Incorporated
SLOPE ELEC	Slope Electric Cooperative Incorporated
SOURIS RIV TELCOM	Souris River Telecommunications
ST WAT COMM	State Water Commission
STATE LN WATER	State Line Water Cooperative
STER ENG	Sterling Energy
STUT RWU	Stutsman Rural Water Users
SW PL PRJ	Southwest Pipeline Project
T M C	Turtle Mountain Communications
TCI	TCI of North Dakota
TESORO HGH PLNS PL	Tesoro High Plains Pipeline
TRI-CNTY WU	Tri-County Water Users Incorporated
TRL CO RWU	Traill County Rural Water Users
UNTD TEL	United Telephone
UPPR SOUR WUA	Upper Souris Water Users Association
US SPRINT	U.S. Sprint
USAF MSL CABLE	U.S.A.F. Missile Cable
USFWS	US Fish and Wildlife Service
USW COMM	U.S. West Communications
VRNDRY ELEC	Verendrye Electric Cooperative
W RIV TEL	West River Telephone Incorporated
WEB	W. E. B. Water Development Association
WILLI RWA	Williams Rural Water Association
WILSTN BAS PL	Williston Basin Interstate Pipeline Company
WLSH RWD	Walsh Water Rural Water District
WOLVRTN TEL	Wolverton Telephone
XLENER	Xcel Energy
YSVR	Yellowstone Valley Railroad

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
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04-23-18	General Revisions
09-20-18	General Revisions

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Line Styles

D-101-20

Existing Topography

- Existing Ground Void
- Existing Cemetary Boundary
- Existing Box Culvert Bridge
- Existing Concrete Surface
- Existing Drainage Structure
- Existing Gravel Surface
- Existing Riprap
- Existing Dirt Surface
- Existing Asphalt Surface
- Existing Tie Point Line
- Existing Railroad Centerline
- Existing Guardrail Cable
- Existing Guardrail Metal
- Existing Edge of Water
- Existing Fence
- Existing Railroad
- Existing Field Line
- Exst Flow
- Existing Curb
- Existing Valley Gutter
- Existing Driveway Gutter
- Existing Curb and Gutter
- Existing Mountable Curb and Gutter

- Existing 3-Cable w Posts
- Site Boundary
- Existing Berm, Dike, Pit, or Earth Dam
- Existing Ditch Block
- Existing Tree Boundary
- Existing Brush or Shrub Boundary
- Existing Retaining Wall
- Existing Planter or Wall
- Existing W-Beam Guardrail with Posts
- Existing Railroad Switch
- Gravel Pit - Borrow Area
- Existing Wet Area-Vegetation Break

Proposed Topography

- 3-Cable w Posts
- Flow
- Fence
- Remove Line
- Wall
- Retaining Wall (Plan View)
- W-Beam w Posts

Existing Utilities

- Existing Electrical
- Existing Fiber Optic Line
- Existing TV Fiber Optic
- Existing Gas Pipe
- Existing Overhead Utility Line
- Existing Power
- Existing Fuel Pipeline
- Existing Undefined Above Ground Pipe Line
- Existing Sanitary Sewer
- Existing Sanitary Force Main
- Existing Storm Drain
- Existing Storm Drain Force Main
- Existing Culvert
- Existing Telephone Line
- Existing TV Line
- Existing Water or Steam Line
- Existing Under Drain
- Existing Slotted Drain
- Existing Conduit
- Existing Conductor
- Existing Down Guy Wire Down Guy
- Existing Underground Vault or Lift Station

Proposed Utilities

- 24 Inch Pipe
- Reinforced Concrete Pipe
- Under Drain
- Edge Drain

Traffic Utilities

- Conductor
- Fiber Optic
- Existing Loop Detector
- Existing Double Micro Loop Detector
- Micro Loop Detector Double
- Existing Micro Loop Detector
- Micro Loop Detector
- Signal Head with Mast Arm
- Existing Signal Head with Mast Arm

Sign Structures

- Existing Overhead Sign Structure
- Existing Overhead Sign Structure Cantilever
- Overhead Sign Structure Cantilever

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
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09-23-16	Added and Revised Items, Organized by Functional Groups

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Line Styles

D-101-21

Right Of Way

- Easement
- Existing Easement
- Right of Way
- Existing Right of Way
- Existing Right of Way Railroad
- Existing Right of Way Not State Owned
- Existing Government Lot Line
- Existing Adjacent Block Lines
- Existing Adjacent Lot Lines
- Existing Adjacent Property Line
- Existing Adjacent Subdivision Lines
- Sight Distance Triangle Line
- Dimension Leader

Boundary Control

- Existing City Corporate Limits or Reservation Boundary
- Existing State or International Line
- Existing Township
- Existing County
- Existing Section Line
- Existing Quarter Section Line
- Existing Sixteenth Section Line
- Existing Centerline
- Tangent Line

Cross Sections and Typicals

- Existing Ground
- Existing Topsoil (Cross Section View)
- Existing Ground Void (Not Surveyed) (void — void — void — v)
- Existing Concrete
- Existing Aggregate (Cross Section View)
- Existing Curb and Gutter (Cross Section View)
- Existing Asphalt (Cross Section View)
- Existing Reinforcement Rebar

Geotechnical

- Geotextile Fabric Type D (D — D)
- Geogrid (Geo — Geo)
- Geotextile Fabric Type R (R — R)
- Geotextile Fabric Type R1 (R — R)
- Geotextile Fabric Type RR (RR — RR)
- Geotextile Fabric Type S (S — S)
- Subgrade Reinforcement
- Failure Line

Countours

- Depression Contours
- Supplemental Contour

Profile

- Subgrade, Subcut or Ditch Grade
- Topsoil Profile

Striping

- Centerline Pavement Marking
- Barrier with Centerline Pavement Marking
- Barrier Pavement Marking
- Stripe 4 IN Dotted Extension White
- Stripe 8 IN Dotted Extension White
- Stripe 8 IN Lane Drop

Pavement Joints

- Doweled Joint
- Tie Bar 30 Inch 4 Foot Center to Center
- Tie Bar 18 Inch 3 Foot Center to Center
- Tie Bar at Random Spacing

Bridge Details

- Hidden Object
- Small Hidden Object
- Large Hidden Object
- Phantom Object
- Centerline Main
- Centerline
- Existing Ground (Details)
- Existing Conditions
- Sheet Piling

Erosion Control

- Limits of Const Transition Line
- Bale Check
- Rock Check
- Floating Silt Curtain (S — S)
- Silt Fence (SF — SF)
- Excavation Limits
- Fiber Rolls

Environmental

- Wetland Mitigation
- Existing Wetland Easement USFWS
- Existing Wetland Jurisdictional
- Existing Wetland
- Tree Row

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Symbols

D-101-30

North Arrow (Half Scale)

Truck Mounted Attenuator

Type I Barricade

Type II Barricade

Type III Barricade

Catch Basin

Cairn or Stone Circle

Video Detection Camera

Storm Drain Cap or Stub

Corrugated Metal End Section 18 Inch

Corrugated Metal End Section 24 Inch

Corrugated Metal End Section 30 Inch

Corrugated Metal End Section 36 Inch

Corrugated Metal End Section 42 Inch

Corrugated Metal End Section 48 Inch

Concrete Foundation

Ground Connection Conductor

Neutral Connection Conductor

Phase 1 Connection Conductor

Phase 2 Connection Conductor

Traffic Cone

Signal Controller

Pad Mounted Signal Controller

Alignment Data Point

Emergency Vehicle Detector

Attenuation Device

Diamond Grade Delineator Type A

Diamond Grade Delineator Type B

Diamond Grade Delineator Type C

Diamond Grade Delineator Type D

Diamond Grade Delineator Type E

Flexible Delineator

Flexible Delineator Type A

Flexible Delineator Type B

Flexible Delineator Type C

Flexible Delineator Type D

Flexible Delineator Type E

Delineator Type A

Delineator Type A Reset

Delineator Type B

Delineator Type B Reset

Delineator Type C

Delineator Type D

Delineator Type E

Delineator Drums

Spot Elevation

Existing Access Control Arrow

Existing Artifact

Existing Flashing Beacon

Existing Benchmark

Existing Railroad Battery Box

Existing Bush or Shrub

Existing Gas Cap or Stub

Existing Sanitary Cap or Stub

Existing Storm Drain Cap or Stub

Existing Water Cap or Stub

Existing Sanitary Cleanout

Existing Concrete Foundation

Existing Traffic Signal Controller

Existing Pad Mounted Signal Controller

Existing Sixteenth Section Corner

Existing Quarter Section Corner

Existing Section Corner

Existing Railroad Crossbuck

Existing Satellite Dish

Existing Fuel Dispensers

Existing Flexible Delineator Type A

Existing Flexible Delineator Type B

Existing Flexible Delineator Type C

Existing Flexible Delineator Type D

Existing Flexible Delineator Type E

Existing Delineator Type A

Existing Delineator Type B

Existing Delineator Type C

Existing Delineator Type D

Existing Delineator Type E

Existing EFB Misc

Existing Flashing Beacon

Existing Pipe Mounted Flasher

Existing Pad Mounted Feed Point

Existing Pipe Mounted Feed Point with Pad

Existing Pole Mounted Feed Point

Existing Railroad Frog

Existing Snow Gate 18

Existing Snow Gate 28

Existing Snow Gate 40

Existing Headwall

Existing Pedestrian Head with Number

Existing Signal Head

Existing Sprinkler Head

Existing Fire Hydrant

Existing Catch Basin Drop Inlet

Existing Curb Inlet

Existing Manhole Inlet

Existing Junction Box

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Symbols

D-101-31

- Existing Light Standard
- Existing High Mast Light Standard 10 Luminaire
- Existing High Mast Light Standard 3 Luminaire
- Existing High Mast Light Standard 4 Luminaire
- Existing High Mast Light Standard 5 Luminaire
- Existing High Mast Light Standard 6 Luminaire
- Existing High Mast Light Standard 7 Luminaire
- Existing High Mast Light Standard 8 Luminaire
- Existing High Mast Light Standard 9 Luminaire
- Existing Overhead Sign Structure Load Center
- Existing Luminaire
- Existing Light Standard Luminaire
- Existing Federal Mailbox
- Existing Private Mailbox
- Existing Meander Section Corner
- Existing Meter
- Existing Electrical Manhole
- Existing Gas Manhole
- Existing Sanitary Manhole
- Existing Sanitary Force Main Manhole
- Existing Sanitary Manhole with Valve
- Existing Storm Drain Manhole
- Existing Force Main Storm Drain Manhole
- Existing Force Main Storm Drain Manhole with Valve
- Existing Telephone Manhole
- Existing Manhole with Valve Water
- Existing Water Manhole
- Existing Mile Post Type A
- Existing Mile Post Type B
- Existing Mile Post Type C
- Existing Reference Marker
- Existing RW Marker
- Existing Utility Marker
- Iron Monument Found
- Iron Pin R/W Monument
- Existing Object Marker Type I
- Existing Object Marker Type II
- Existing Object Marker Type III
- Existing Electrical Pedestal
- Existing Telephone Pedestal
- Existing Fiber Optic Telephone Pedestal
- Existing TV Pedestal
- Existing Fiber Optic TV Pedestal
- Existing Fuel Filler Pipes
- Existing Traverse PI Aerial Panel
- Existing Pole
- Existing Power Pole
- Existing Power Pole with Transformer
- Existing Telephone Pole
- Existing Wood Pole
- Existing Post
- Existing Pedestrian Push Button Post
- Existing Control Point CP
- Existing Control Point GPS-RTK
- Existing Control Point TRI
- Existing Reference Marker Point NGS
- Existing Pull Box
- Existing Intelligent Transportation Pull Box
- Existing Water Pump
- Existing Slotted Reinforced Concrete Pipe
- Existing RR Profile Spot
- Existing Fuel Leak Sensors
- Existing Highway Sign
- Existing Miscellaneous Spot
- Existing Lighting Standard Pole
- Existing Traffic Signal Standard
- Existing Transformer
- Existing Large Evergreen Tree
- Existing Small Evergreen Tree
- Existing Large Tree
- Existing Small Tree
- Existing Tree Trunk
- Existing Pad Mounted Traffic Signal Control Box
- Existing Undefined Manhole
- Existing Undefined Pull Box
- Existing Undefined Pedestal
- Existing Undefined Valve
- Existing Undefined Pipe Vent
- Existing Gas Valve
- Existing Water Valve
- Existing Fuel Pipe Vent
- Existing Gas Pipe Vent
- Existing Sanitary Pipe Vent
- Existing Storm Drain Pipe Vent
- Existing Water Pipe Vent
- Existing Weather Station
- Existing Ground Water Well Bore Hole
- Existing Windmill or Tower
- Existing Witness Corner
- Flashing Beacon
- Flagger
- Pipe Mounted Flasher
- Sanitary Force Main with Valve

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Symbols

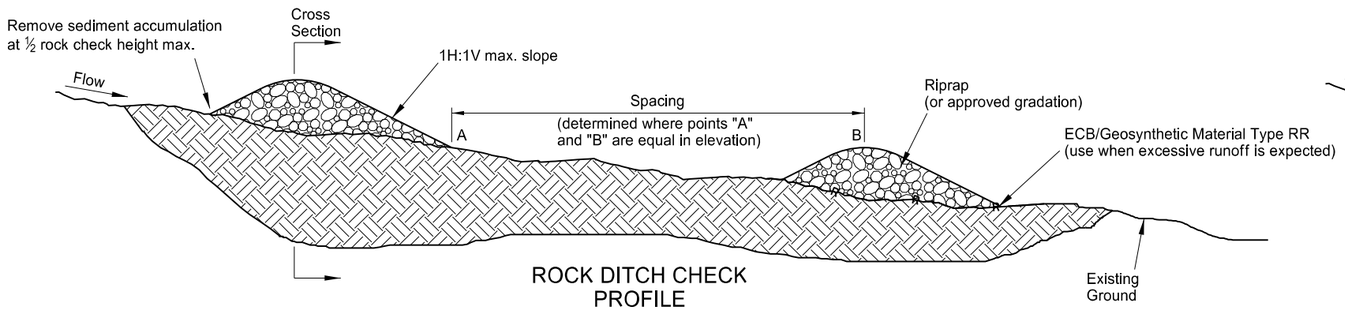
D-101-32

- Pad Mounted Feed Point
- Pipe Mounted Feed Point with Pad
- Pole Mounted Feed Point
- Headwall
- Double Headwall with Vegitation Barrier
- Single Headwall with Vegitation Barrier
- Pole Mounted Head
- Sprinkler Head
- Fire Hydrant
- Inlet Type 1
- Inlet Type 2
- Double Inlet Type 2
- Inlet Grate Type 2
- Junction Box
- High Mast Light Standard 10 Luminaire
- High Mast Light Standard 3 Luminaire
- High Mast Light Standard 4 Luminaire
- High Mast Light Standard 5 Luminaire
- High Mast Light Standard 6 Luminaire
- High Mast Light Standard 7 Luminaire
- High Mast Light Standard 8 Luminaire
- High Mast Light Standard 9 Luminaire
- Relocate Light Standard
- Overhead Sign Structure Load Center
- Light Standard 100 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 1000 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 150 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 175 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 200 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 250 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 310 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 35 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 400 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 50 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 70 Watt High Pressure Sodium Vapor Luminaire
- Light Standard 700 Watt High Pressure Sodium Vapor Luminaire
- Manhole
- Manhole 48 Inch
- Sanitary Force Main Manhole
- Sanitary Sewer Manhole
- Storm Drain Manhole
- Storm Drain Manhole with Inlet
- Reset Mile Post
- Mile Post Type A
- Mile Post Type B
- Mile Post Type C
- Right of Way Marker
- Tubular Marker
- Alignment Monument
- Iron Pin Reference Monument
- Object Marker Type I
- Object Marker Type II
- Object Marker Type III
- Caution Mode Arrow Panel
- Back to Back Vertical Panel Sign
- Double Direction Arrow Panel
- Left Directional Arrow Panel
- Right Directional Arrow Panel
- Sequencing Arrow Panel
- Truck Mounted Arrow Panel
- Power Pole
- Wood Pole
- Pedestrian Push Button Post
- Property Corner
- Pull Box
- Intelligent Transportation Pull Box
- Sanitary Pump
- Storm Drain Pump
- Reinforced Pavement
- Reinforced Concrete End Section 15 Inch
- Reinforced Concrete End Section 18 Inch
- Reinforced Concrete End Section 24 Inch
- Reinforced Concrete End Section 30 Inch
- Reinforced Concrete End Section 36 Inch
- Reinforced Concrete End Section 42 Inch
- Reinforced Concrete End Section 48 Inch
- Reinforced Concrete End Section 54 Inch
- Reset Right of Way Marker
- Reset USGS Marker
- Right of Way Markers
- Riser 30 Inch
- Continuous Split Barrel Sample (CSB)
- Flight Auger Sample (FA)
- Split Barrel Sample (SB)
- Thinwall Tube Sample
- Highway Sign
- SNOW GATE 18 FT
- SNOW GATE 28 FT
- SNOW GATE 40 FT
- Standard Penetration Test (N)
- Transformer
- Inclinometer Tube (Incl)
- Underdrain Cleanout
- Excavation Unit
- Water Valve

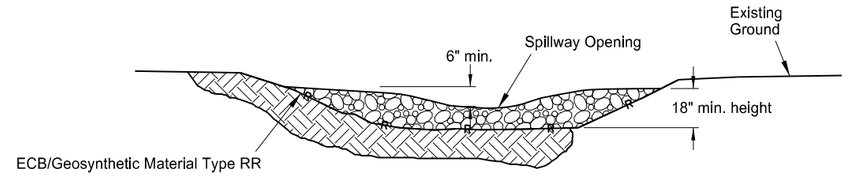
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
07-01-14	
REVISIONS	
DATE	CHANGE

This document was originally issued and sealed by Roger Weigel, Registration Number PE- 2930 , on 07/01/14 and the original document is stored at the North Dakota Department of Transportation

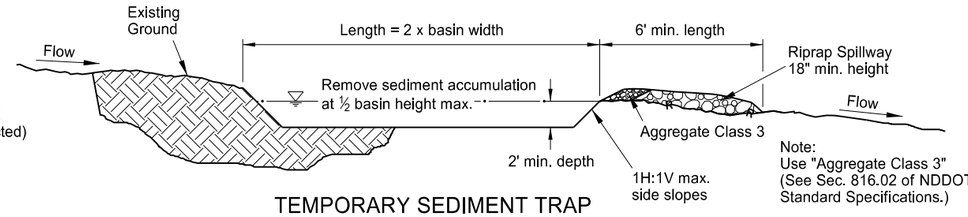
EROSION AND SILTATION CONTROLS



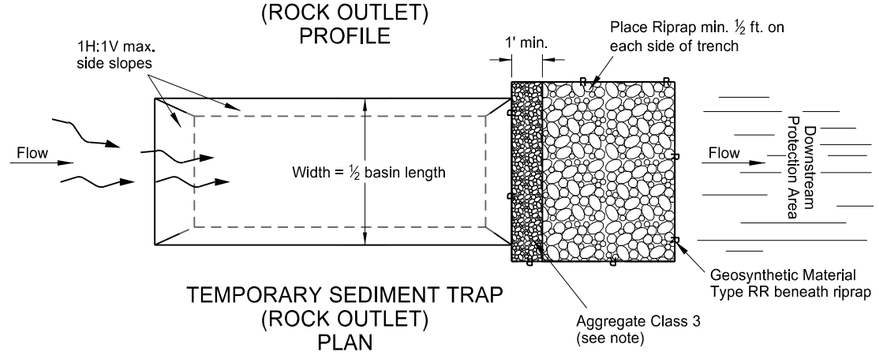
ROCK DITCH CHECK
PROFILE



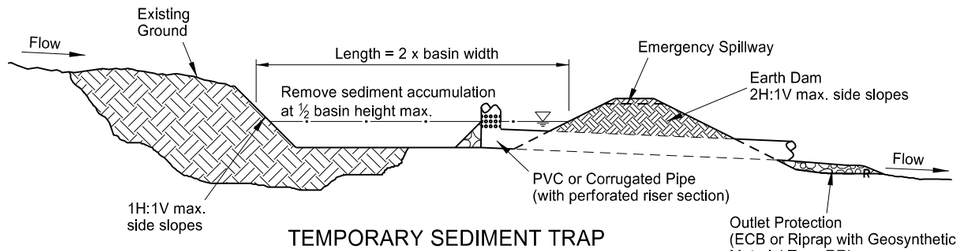
ROCK DITCH CHECK
CROSS SECTION



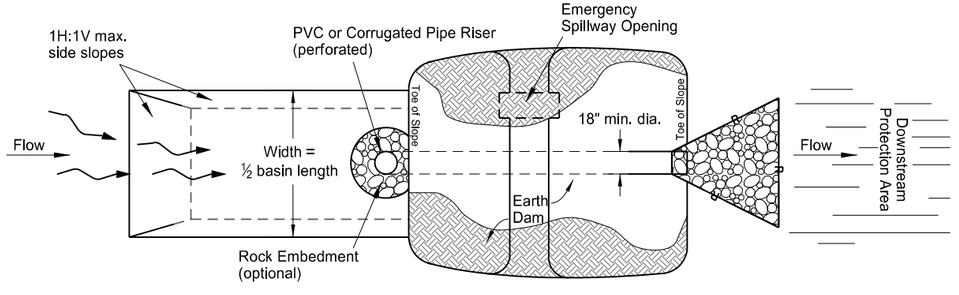
TEMPORARY SEDIMENT TRAP
(ROCK OUTLET)
PROFILE



TEMPORARY SEDIMENT TRAP
(ROCK OUTLET)
PLAN



TEMPORARY SEDIMENT TRAP
(RISER PIPE OUTLET)
PROFILE

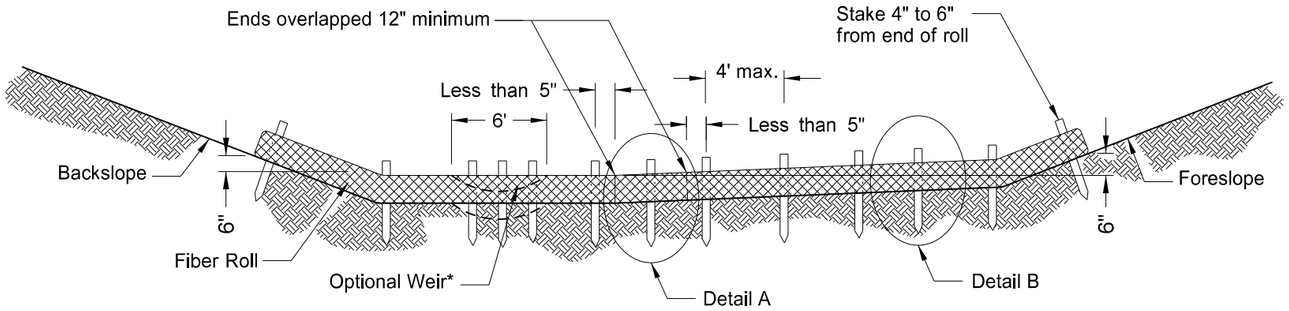


TEMPORARY SEDIMENT TRAP
(RISER PIPE OUTLET)
PLAN

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-03-13	
REVISIONS	
DATE	CHANGE
06-26-14	Changed standard drawing number from D-708-2 to D-256-1. Deleted silt fence details.
10-17-17	Updated to active voice.
08-27-19	New Design Engineer PE Stamp

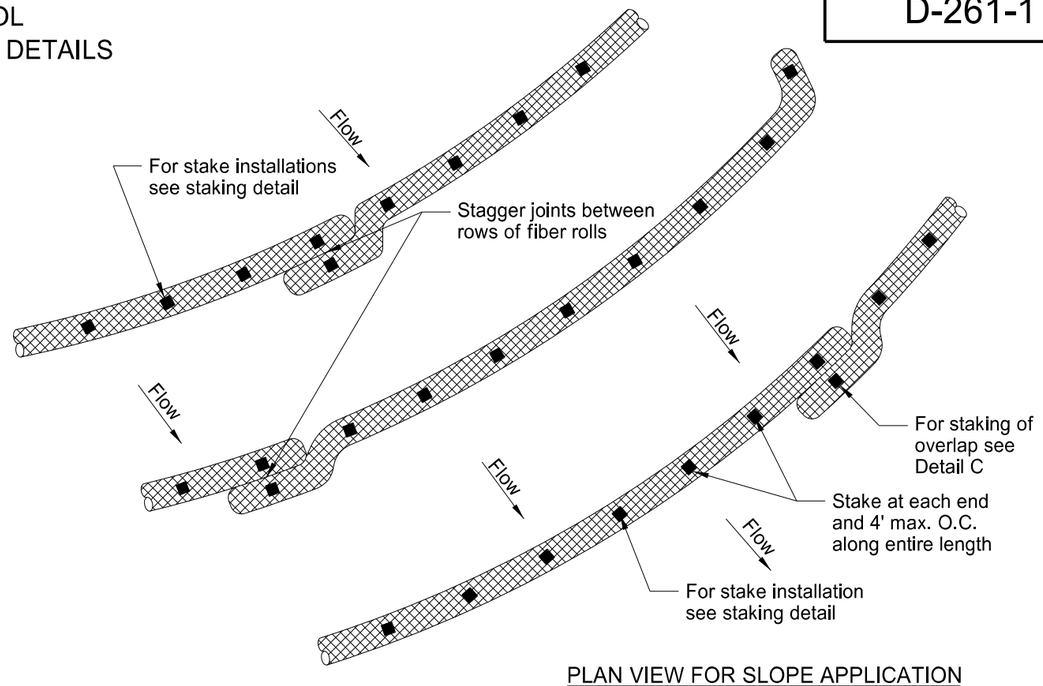
This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8-27-2019 and the original document is stored at the North Dakota Department of Transportation

EROSION CONTROL
FIBER ROLL PLACEMENT DETAILS

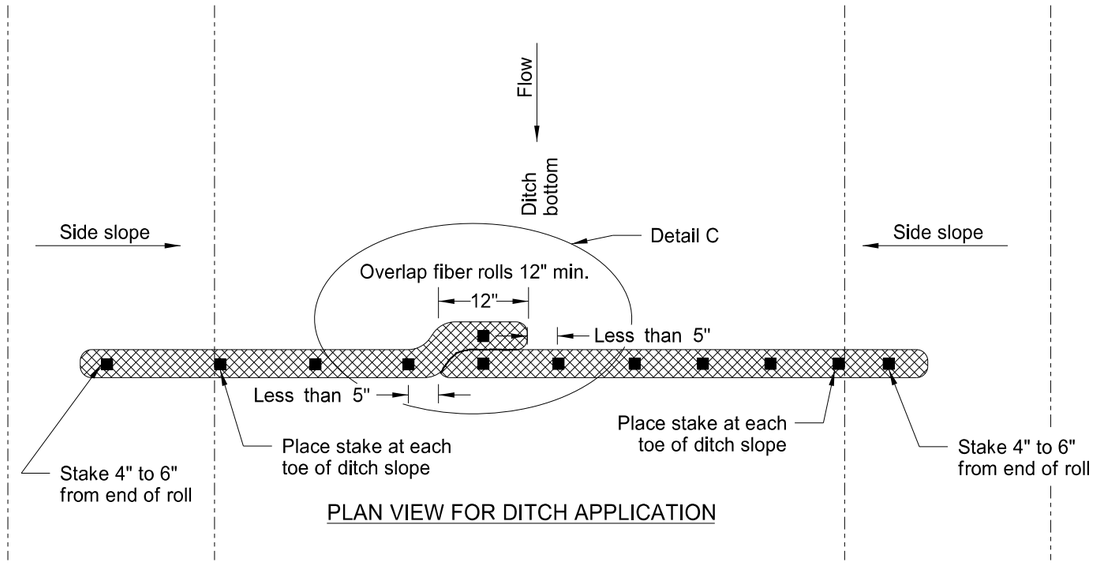


*Optional Weir. Use in flat areas, such as the Red River Valley, where there is potential for water to back up on adjacent property. Lower fiber roll enough to prevent water from backing up on adjacent property. Do not use 20-inch fiber rolls in flat areas where there is potential for water to back up on adjacent property.

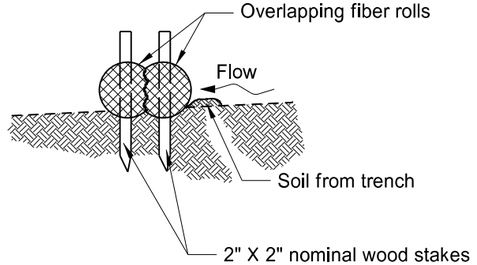
12 OR 20 INCH FIBER ROLL - DITCH BOTTOM



PLAN VIEW FOR SLOPE APPLICATION

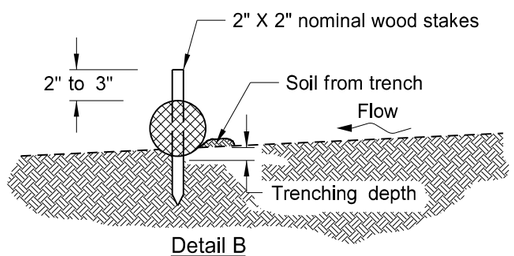


PLAN VIEW FOR DITCH APPLICATION



Detail A

Fiber Roll Overlapping Staking Detail



Detail B

Fiber Roll Staking Detail

FIBER ROLL DIAMETER	NOMINAL STAKE SIZE	MINIMUM STAKE LENGTH	MINIMUM TRENCH DEPTH	MAXIMUM TRENCH DEPTH
6"	2" x 2"	18"	2"	2"
12"	2" x 2"	24"	2"	3"
20"	2" x 2"	36"	3"	5"

NOTE: Runoff must not be allowed to run under or around roll.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

11-18-10

REVISIONS

DATE	CHANGE
06-10-13	Added plan view for ditch and slope application. Added table with values for stake and trench dimensions.
10-04-13	Revised fiber roll overlap detail.
06-26-14	Changed standard drawing number from D-708-7 to D-261-1.
08-27-19	New Design Engineer PE Stamp

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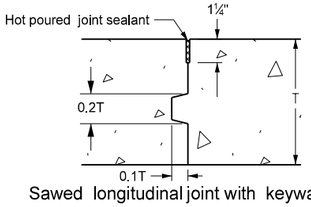
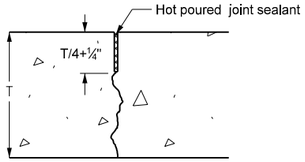
LONGITUDINAL JOINT DETAILS

D-550-2

UNTIED JOINTS

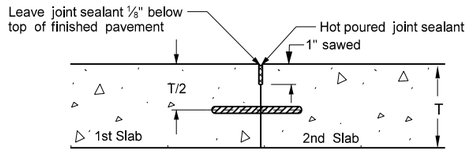


Sawed longitudinal joint with keyway



Sawed longitudinal joint without keyway

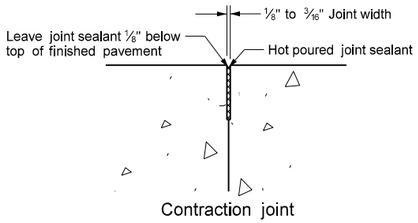
TIED JOINTS



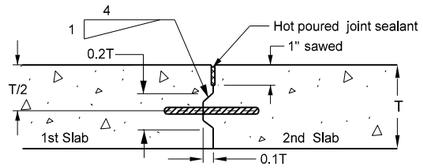
Longitudinal construction joint (tied butt joint)

Notes:

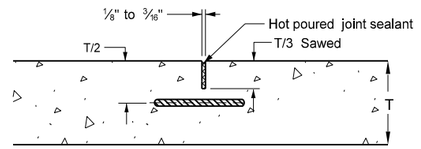
1. Provide hot poured joint sealant meeting the requirements of Section 826.02A.2 of the Standard Specifications.
2. Include all costs of the longitudinal joint and seal in the price bid for the PCC pavement.
3. Do not place tie bars within 18 inches of a transverse skewed joint.
4. Use Grade 40 steel for tie bars installed bent and later straightened.
5. Increase the tie bar spacing up to 10%, when necessary to facilitate construction.
6. Place tie Bars at a 48 inch maximum spacing.
7. A "Warp" joint is a sawed joint or a construction joint with a keyway.
8. A "Butt joint" is a construction joint with no keyway.



Contraction joint



Longitudinal construction joint (tied keyed joint)



Sawed longitudinal joint

TIEBAR SPACINGS (In)

BAR SIZE / GRADE STEEL / BAR LENGTH / DIST TO FREE EDGE (FT) / JOINT TYPE / PVMT THICKNESS		# 3 BAR										# 4 BAR												# 5 BAR												# 6 BAR											
		GRADE 40				GRADE 60						GRADE 40					GRADE 60							GRADE 40						GRADE 60						GRADE 40						GRADE 60					
		24"				30"						24"					36"							30"						42"						36"						48"					
		4	6	8	10	4	6	8	10	12	14	8	10	12	14	16	8	10	12	14	16	22	24	10	12	14	16	22	24	10	12	14	16	22	24	10	12	14	16	19	22	24	10	12	14	16	19	22	24
6"	WARP		48	39			48	48				48					48																															
	BUTT		37	27			48	42				48					48																															
8"	WARP	48	39	29	24	48	48	44	35	29	25	48	42	35	30	26	48	48	48	45	39	28	26	48	48	47	41	30	27	48	48	48	48	45	41	48	48	48	48	48	43	39	48	48	48	48	48	48	48
	BUTT	42	27			48	42	31	25			37	29	24			48	44	37	32	27			46	39	33	29			48	48	48	43	32	29	48	48	48	48	35	30	27	48	48	48	48	48	45	41
8½"	WARP	48	37	28		48	48	42	33	28	24	48	39	33	28	24	48	48	48	42	37	27	24	48	48	44	38	28	25	48	48	48	48	42	38	48	48	48	48	47	40	37	48	48	48	48	48	48	48
	BUTT	39	26			44	39	29				35	27				48	42	35	29	26			44	36	31	27			48	48	47	41	30	27	48	48	45	39	33	28	26	48	48	48	48	48	42	39
9"	WARP	48	35	26		48	48	39	31	26		47	37	31	26		48	48	47	40	35	25		48	48	42	36	26	24	48	48	48	48	40	36	48	48	48	48	44	38	35	48	48	48	48	48	48	48
	BUTT	37	24			48	37	27				33	26				48	40	33	28	25			41	34	29	25			48	48	44	39	28	25	48	48	42	37	31	26	24	48	48	48	48	47	40	37
9½"	WARP	48	33	25		48	48	37	30	25		44	35	29	25		48	48	44	38	33	24		48	46	39	34	25		48	48	48	48	38	34	48	48	48	48	42	36	33	48	48	48	48	48	48	48
	BUTT	35				48	35	26				31	25				47	37	31	27				39	32	27	25			48	48	42	37	27	24	48	47	40	35	29	25		48	48	48	48	44	38	35
10"	WARP	47	31			48	47	35	28			42	34	28	24		48	48	42	36	31			48	44	37	33	24		48	48	48	48	36	33	48	48	48	48	40	34	31	48	48	48	48	48	48	47
	BUTT	33				48	33	25				29	24				45	36	29	25				37	31	26	24			48	46	40	35	25		48	45	38	33	28	24		48	48	48	48	42	36	33
10½"	WARP	45	30			48	45	34	27			40	32	26			48	48	40	34	30			48	42	36	31			48	48	48	47	34	31	48	48	48	48	45	38	33	30	48	48	48	48	48	48	45
	BUTT	32				48	32	24				28					42	34	28	24				35	29	25				48	44	38	33	24		48	42	36	32	27			48	48	48	48	40	34	31
11"	WARP	43	28			48	43	32	26			38	31	25			48	46	38	33	28			48	40	34	30			48	48	48	45	32	30	48	48	48	43	36	31	28	48	48	48	48	48	47	43
	BUTT	30				46	30					27					40	32	27					34	28	24				48	42	36	32			48	40	35	30	25			48	48	48	46	38	33	30
11½"	WARP	41	27			48	41	31	24			36	29	24			48	44	36	31	27			46	38	32	28			48	48	48	43	31	28	48	48	47	41	34	30	27	48	48	48	48	48	45	41
	BUTT	29				44	29					25					39	31	25					32	27					48	40	35	30			46	39	33	29	24			48	48	48	44	37	31	29
12"	WARP	39	26			48	39	29				35	28				48	42	35	30	26			44	36	31	28			48	48	47	41	30	27	48	48	45	40	33	28	26	48	48	48	48	48	43	39
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12½"	WARP	38	25			48	38	28				33	27				48	40	33	29	25			42	35	30	26			48	48	45	39	28	26	48	48	43	38	32	27	25	48	48	48	48	48	41	38
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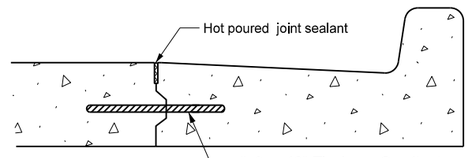
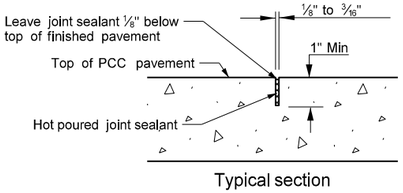
14"	WARP	34				48	34	25				30	24				45	36	30	25				37	31	27				48	47	40	35	25		48	45	38	34	28	24		48	48	48	48	43	37	34
	BUTT	24				35	24					23					32	25						26						39	33	28	25			38	32	27	24				48	47	40	35	30	26	
14½"	WARP	32				48	32	24				29					43	35	29	25				36	30	26				48	45	39	34	24		48	43	37	32	27			48	48	48	48	41	35	32
	BUTT					34						22					30	25						25						38	32	27	24			36	30	26					48	46	39	34	29	25	
15"	WARP	31				47	31					28					42	33	28	24				35	29	25				48	44	37	33	24		48	42	36	31	26			48	48	48	47	40	34	31
	BUTT					33						21					29							25						37	31	26				35	29	25					48	44	38	33	28	24	



Curb and gutter sections

JOINT SEALER DETAILS



Typical section

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

9-15-2010

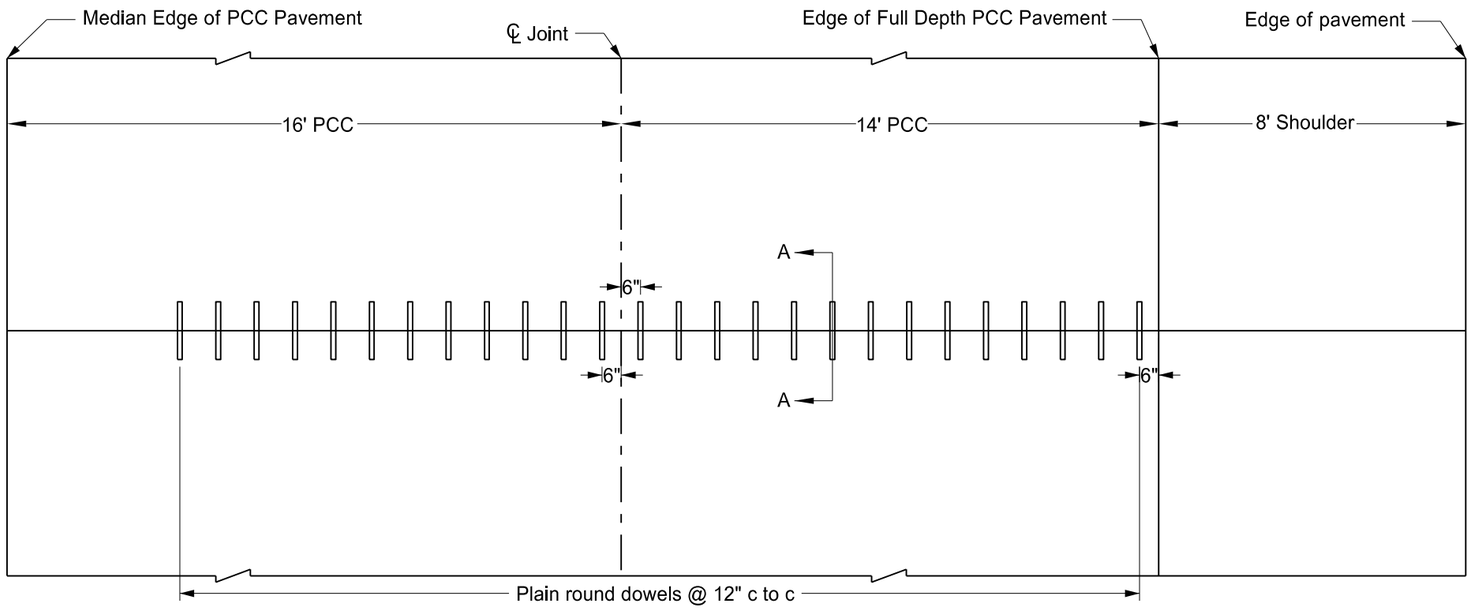
REVISIONS

DATE	CHANGE
10/23/2012	Expanded Tie Bar Table
03/16/2016	Updated Jt Details & notes
10/25/2019	Corrected "Typo" in Note 3

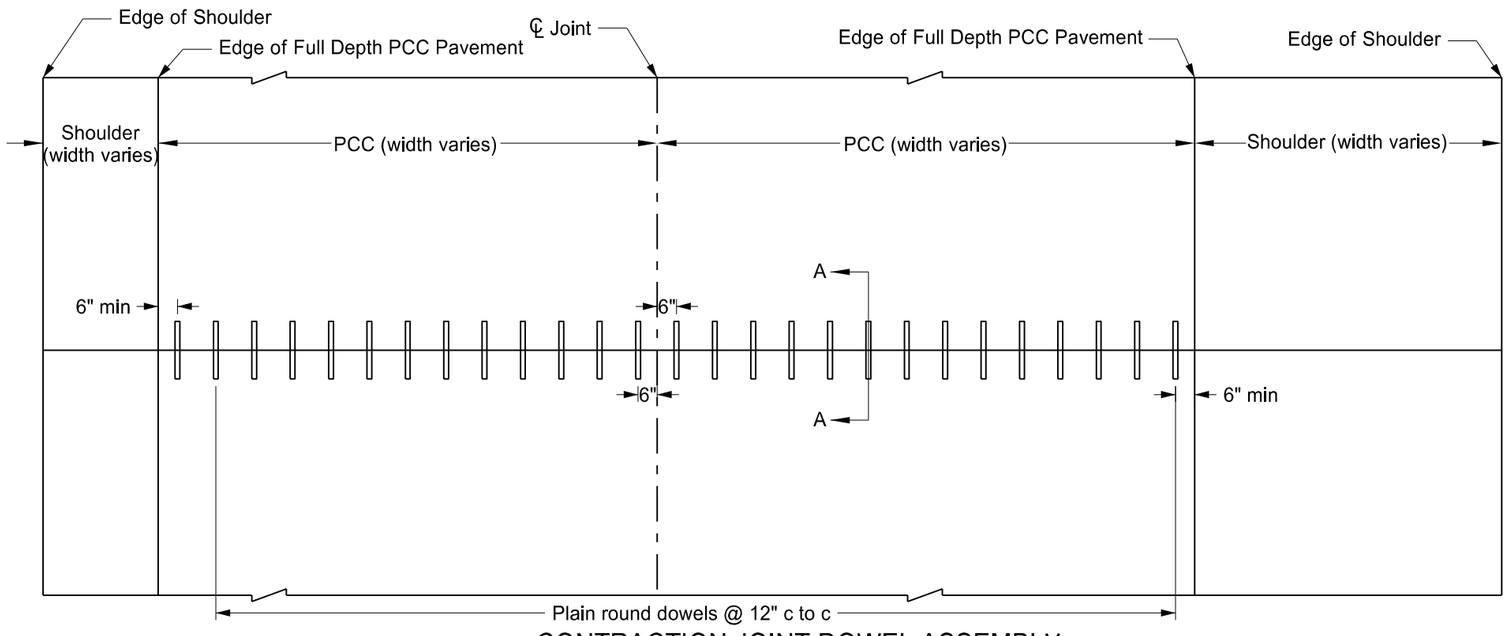
This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 10/25/19 and the original document is stored at the North Dakota Department of Transportation

TRANSVERSE CONTRACTION JOINT DETAILS

D-550-3



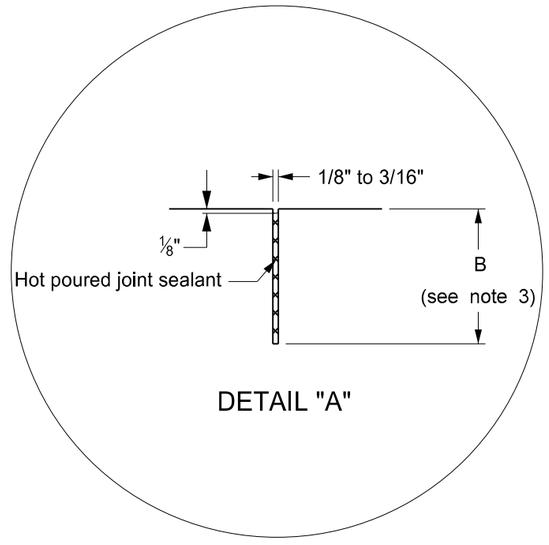
CONTRACTION JOINT DOWEL ASSEMBLY
INTERSTATE



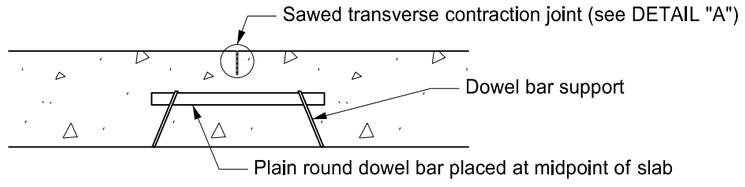
CONTRACTION JOINT DOWEL ASSEMBLY
NON-INTERSTATE

Notes

1. The joint seal details apply to both doweled and non-doweled (plain) transverse joints.
2. T = Thickness of pavement.
3. B = T/4 + ¼" for AE or YE for non-dowelled concrete pavement or
   B = T/3 for AAE or dowelled concrete pavement



DETAIL "A"



SECTION A-A

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
9-15-10	
REVISIONS	
DATE	CHANGE
6/23/2014	Removed dowel size reference
3/16/2016	Revised Joint Details and notes
10/25/2019	Expanded Details for clarity

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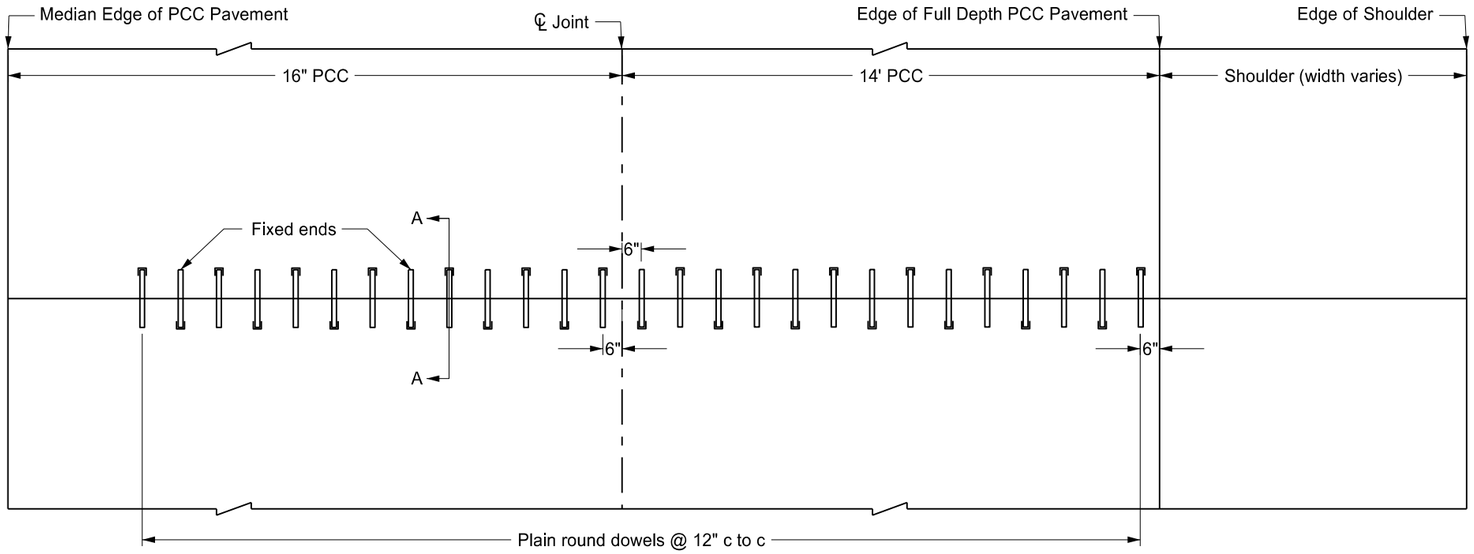
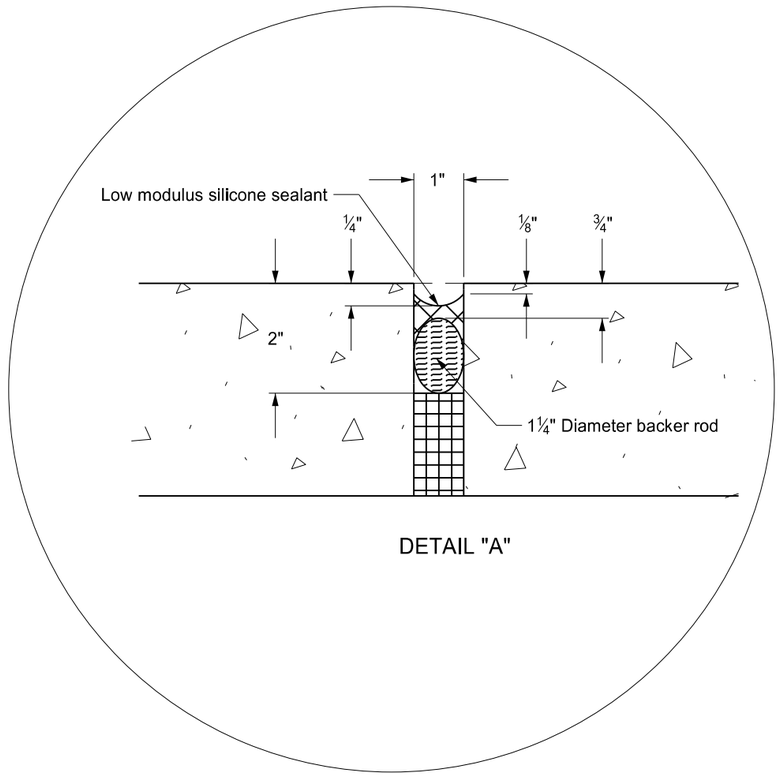
TRANSVERSE EXPANSION JOINT DETAIL

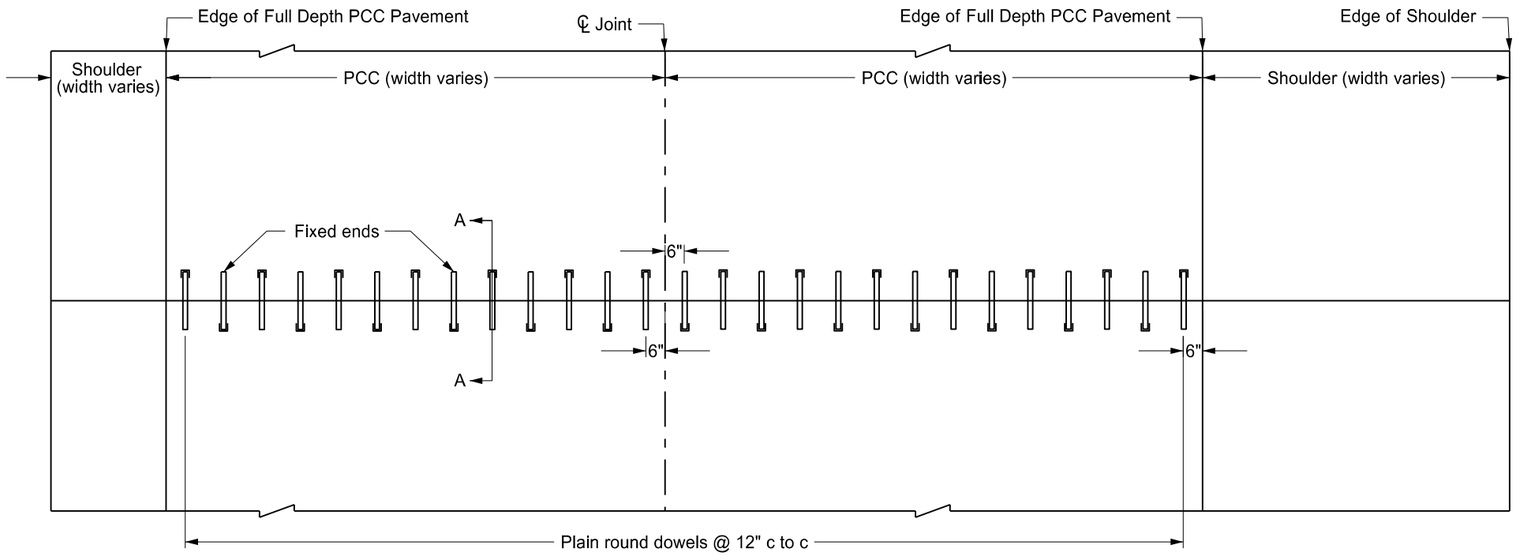
D-550-4



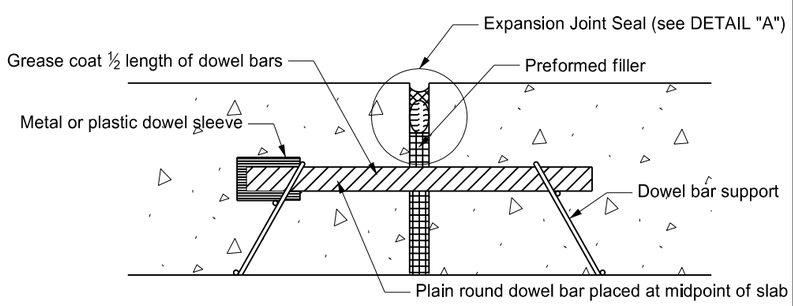
DOWELED EXPANSION JOINT ASSEMBLY
INTERSTATE



DETAIL "A"



DOWELED EXPANSION JOINT ASSEMBLY
NON-INTERSTATE



SECTION A-A

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
9-15-2010	
REVISIONS	
DATE	CHANGE
6/23/2014 10/25/2019	Removed dowel bar sizes Expanded details for clarity

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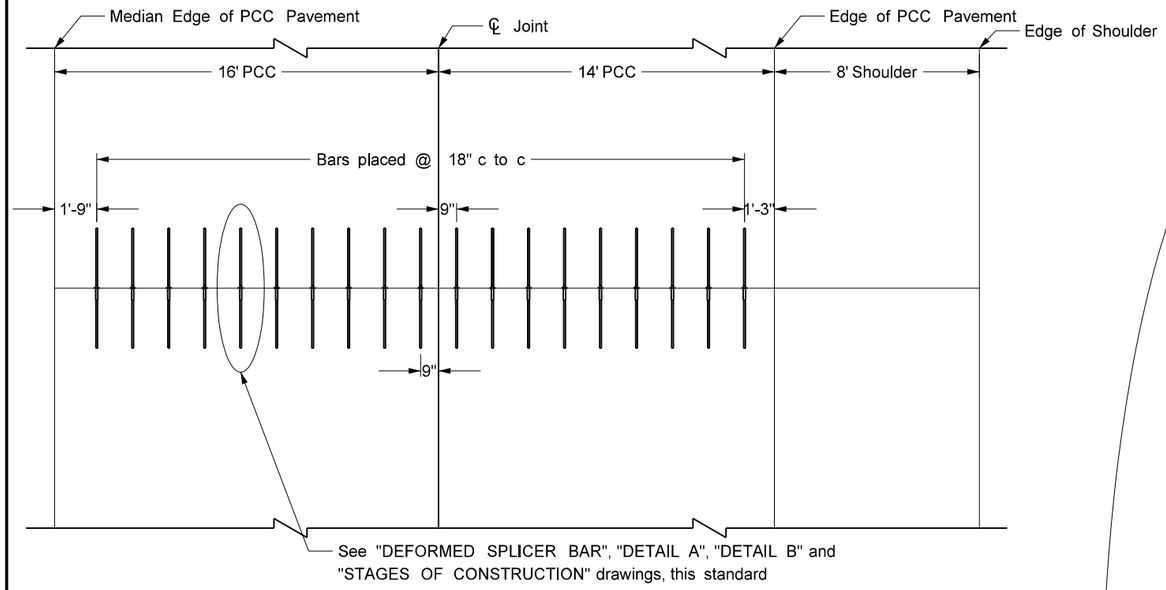
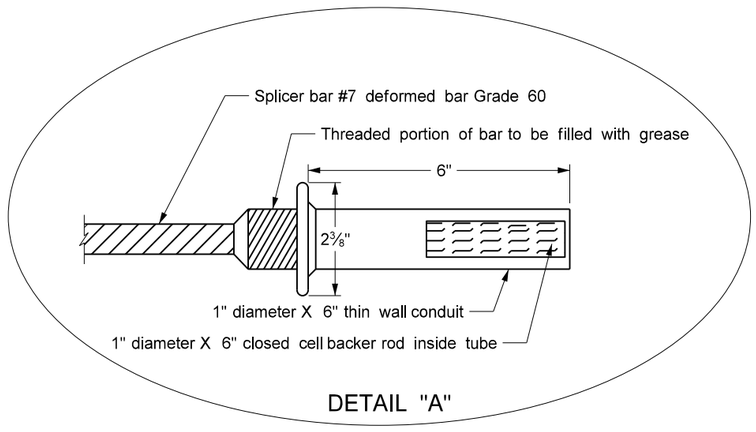
TRANSVERSE CONSTRUCTION JOINT

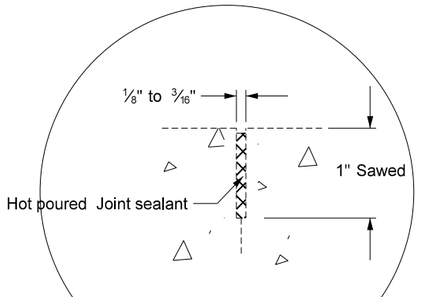
D-550-5



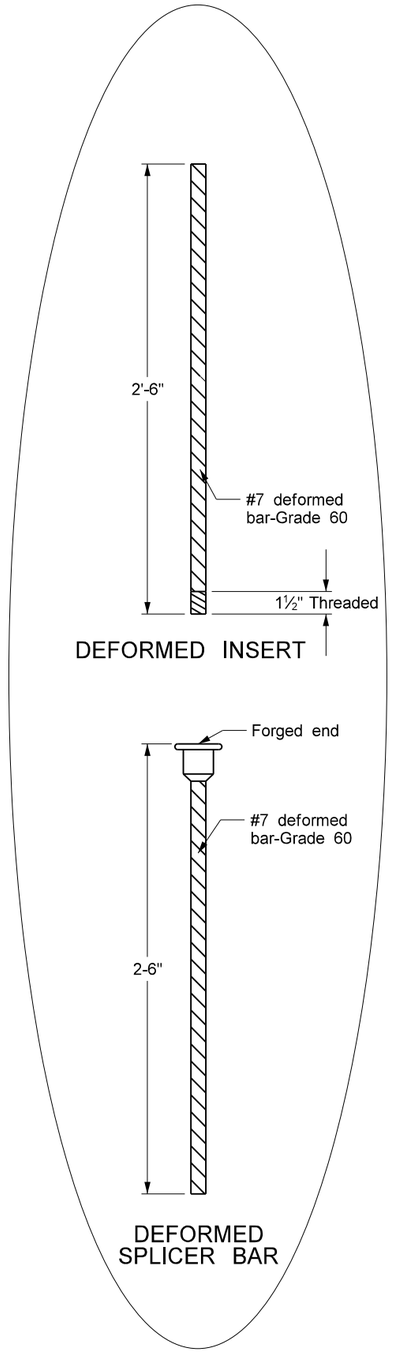
PLAN VIEW



DETAIL "A"



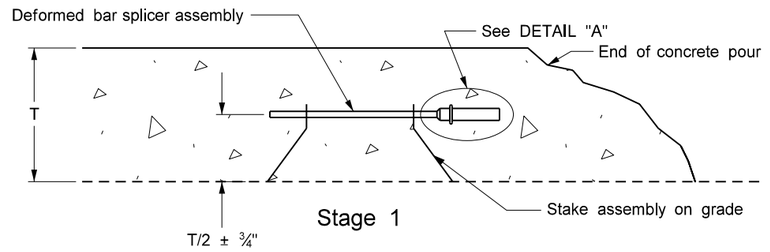
DETAIL "B"



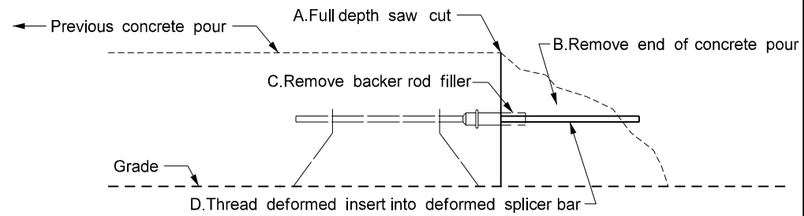
DEFORMED INSERT

DEFORMED SPLICER BAR

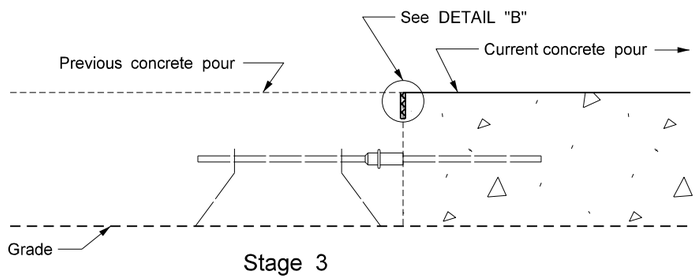
STAGES OF CONSTRUCTION



Stage 1



Stage 2



Stage 3

Notes

1. Saw and seal all construction joints.
2. Include all costs for transverse construction joints in the price bid for PCC pavement.
3. Do not saturate the subgrade during the sawing operation.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
9-15-2010	
REVISIONS	
DATE	CHANGE
3-16-16 8-27-19	Revised Joint Details & notes. New Design Engr PE Stamp.

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CONSTRUCTION SIGN DETAIL

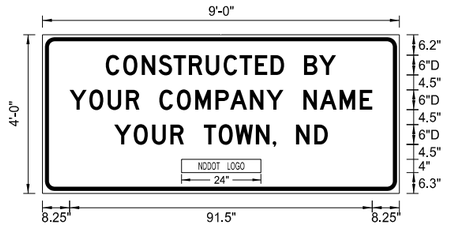
D-704-5

SIGN NUMBER	G20-10-108
WIDTH x HEIGHT	9'-0" x 4'-0"
BORDER WIDTH	1.25" (inset 0.75")
CORNER RADIUS	3"
MOUNTING	Ground
BACKGROUND	TYPE: IV Reflective
	COLOR: Fluorescent Orange
LEGEND/BORDER	TYPE: Non-Refl
	COLOR: Black

SYMBOL	X	Y	WID	HT	ANGLE
	42.1	6.2	24	4	0

STATION(S):

AREA: 36.0 Sq.Ft.



Dimensions are in inches.tenths

Letter locations are panel edge to lower left corner

LETTER POSITION (X)																		LENGTH	SIZE	SERIES
C	O	N	S	T	R	U	C	T	E	D		B	Y					69.7	6	D 2000
19.2	24.5	30	35.1	39.7	44.3	49.4	54.8	59.7	64.3	69	73.1	79.1	83.7							
Y	O	U	R		C	O	M	P	A	N	Y		N	A	M	E		91.5	6	D 2000
8.3	14.2	19.8	25.3	29.4	35.4	40.7	46.2	52.4	56.8	62.8	67.8	72.9	78.9	83.9	89.9	96				
Y	O	U	R		T	O	W	N	,		N	D						64.6	6	D 2000
21.7	27.6	33.2	38.7	42.8	48.8	53.3	58.4	64.6	69.6	70.7	76.7	82.2								

Notes:

1. Post mount sign a distance of ½A following the End Road Work (G20-2-48) sign (maximum 2 signs per project.)

2. Use sign on rural projects with a 30 day or longer duration (not required on seal coats or other short duration projects.)

3. Do not place sign in urban areas or within city limits.

Advance Warning Sign Spacing (A)			
Road Type	Distance between signs min. (ft)		
	A	B	C
Urban - Low Speed (30 mph or less)	150	150	150
Urban - Low Speed (over 30 to 40 mph)	280	280	280
Urban - High Speed (over 40 mph to 50 mph)	360	360	360
Rural - High Speed (over 50 mph to 65 mph)	720	720	720
Urban Expressway and Freeway (55 mph to 60 mph)	850	1350	2200
Rural Expressway and Freeway (70 mph to 75 mph)	1000	1500	2640
Interstate/4-Lane Divided (Maintenance and Surveying)	750	1000	1500

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
8-22-12	
REVISIONS	
DATE	CHANGE
7-18-14	Revise sheeting to type IV.
9-27-17	Updated to active voice.
8-30-18	Updated sign number in note 1.
10-03-19	New Design Engineer PE Stamp.

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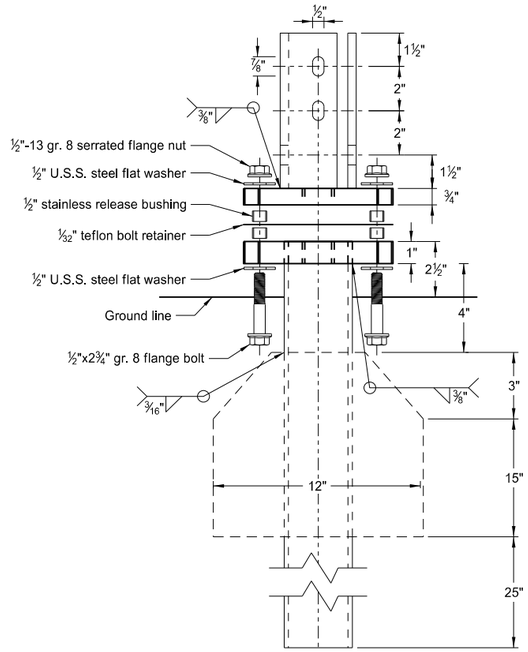
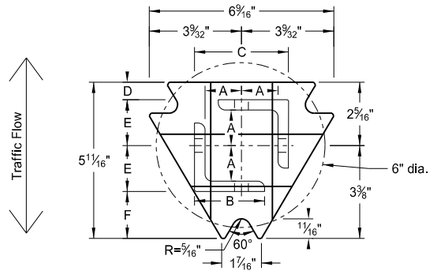
BREAKAWAY SYSTEMS FOR CONSTRUCTION ZONE SIGNS

D-704-7

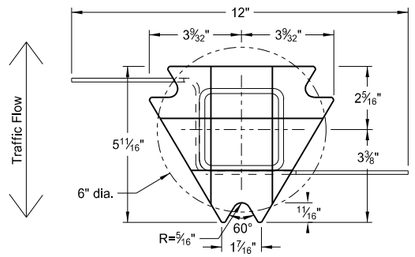


Multi-Directional
Slip Base Assembly

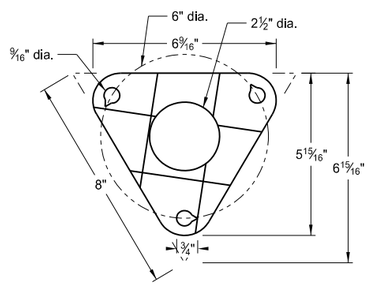
Perforated Tube



Top Post Receiver
Plate - ASTM A572 grade 50
Angle Receiver - 2½"x2½"x⅜" ASTM A36 structural angle



Bottom Soil Stub
Tube - 3"x3"x7 gauge ASTM A500 grade B tube
Stabilizing Wing - 7 gauge H.R.P.O. ASTM A1011
Plate - ASTM A572 grade 50



Bolt Retainer for Base Connection
Bolt Retainer- 1/32" Reprocessed Teflon

Notes:

1. Torque slip base bolts as specified by manufacturer.
2. Use anchor with 43.9 KSI yield strength and 59.3 KSI tensile strength.
3. Provide 4" vertical clearance for anchor or breakaway base. Measure the 4"x60" measurement above and below post location and back and ahead of post.
4. In concrete sidewalk, use same anchor without wings.
5. Provide more than 7' between the first and fourth posts of a four post sign.

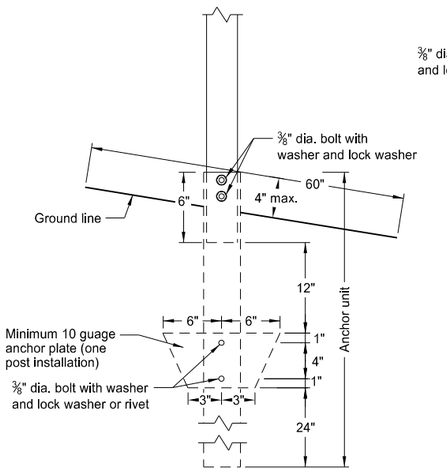
Telescoping Perforated Tube						
Number of Posts	Post Size in.	Wall Thick-ness Gauge	Sleeve Size in.	Wall Thick-ness Gauge	Slip Base	Anchor Size without Slip Base in.
1	2	12			No	2¼
1	2¼	12			No	2½
1	2½	12			(A)	3
1	2½	10			Yes	
1	2¼	12	2	12	Yes	
1	2½	12	2¼	12	Yes	
2	2	12			No	2¼
2	2¼	12			No	2½
2	2½	12			Yes	
2	2½	12			Yes	
2	2¼	10	2	12	Yes	
2	2½	12	2¼	12	Yes	
3 & 4	2½	12			Yes	
3 & 4	2½	10			Yes	
3 & 4	2½	12	2¼	12	Yes	
3 & 4	2¼	12	2	12	Yes	
3 & 4	2½	10	2³/16	10	Yes	

Properties of Telescoping Perforated Tube						
Tube Size in.	Wall Thickness in.	U.S. Standard Gauge	Weight per Foot lbs.	Moment of Inertia in.⁴	Cross Sec. Area in.²	Section Modulus in.³
1½ x 1½	0.105	12	1.702	0.129	0.380	0.172
2 x 2	0.105	12	2.416	0.372	0.590	0.372
2¼ x 2¼	0.105	12	2.773	0.561	0.695	0.499
2³/16 x 2³/16	0.135	10	3.432	0.605	0.841	0.590
2½ x 2½	0.105	12	3.141	0.804	0.803	0.643
2½ x 2½	0.135	10	4.006	0.979	1.010	0.785

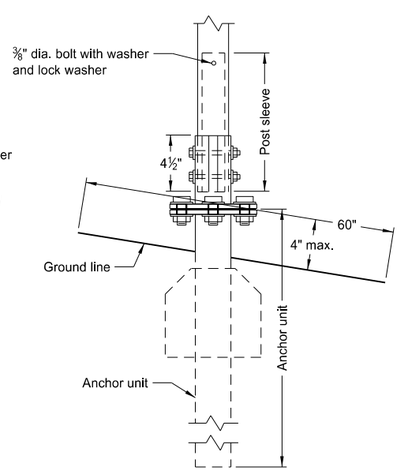
Top Post Receiver Data Table						
Square Post Sizes (B)	A	B	C	D	E	F
2³/16"x10 ga.	1⁹/64"	2½"	3¹/32"	2⁵/32"	1³³/64"	1⅞"
2½"x10 ga.	1⁹/32"	2½"	3⁵/16"	⅝"	1²¹/32"	1¾"

(A) Use breakaway base when support is placed in weak soils. Engineer determines if soils are weak.

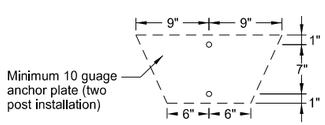
(B) For additional wind load, insert the 2³/16"x10 ga. into 2½"x10 ga.



Anchor Unit and Post Assembly



Multi-Directional
Slip Base Anchor Unit
and Post Sleeve Assembly



NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
2-28-14	
REVISIONS	
DATE	CHANGE
9-27-17	Updated to active voice
10-03-19	New Design Engr PE Stamp

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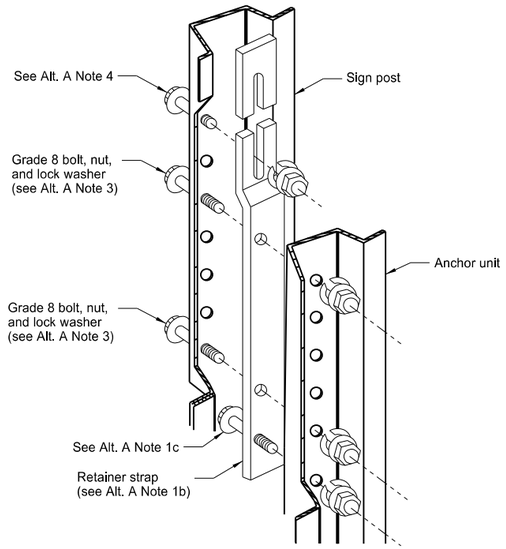
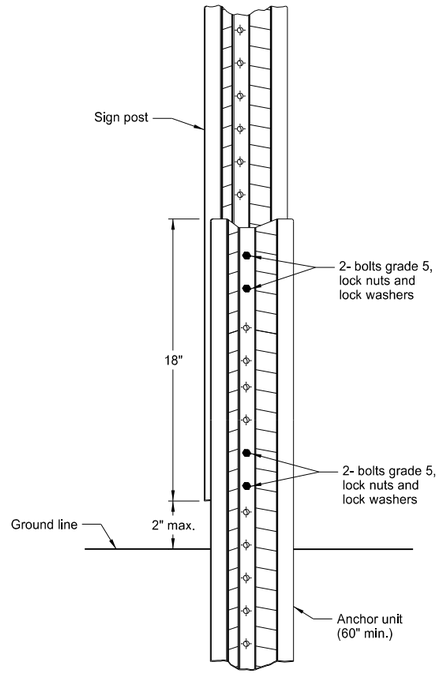
BREAKAWAY SYSTEMS FOR CONSTRUCTION ZONE SIGNS

D-704-8

U-Channel Post

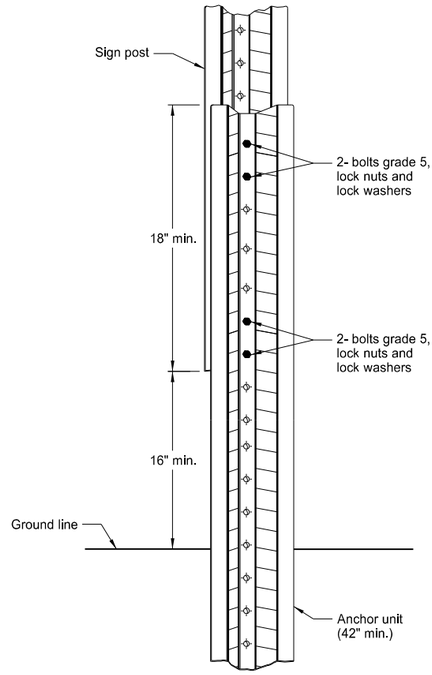


Detail A



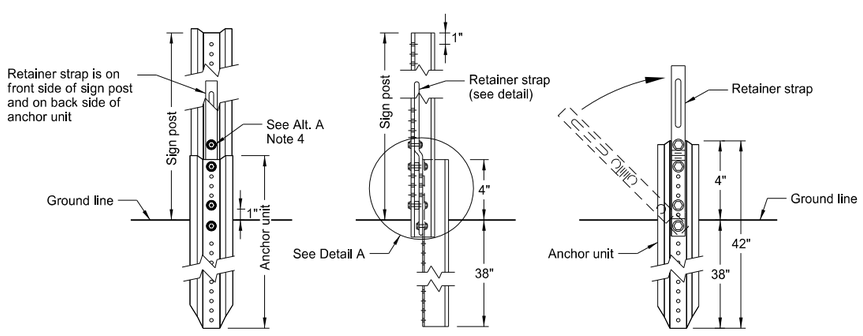
Breakaway U-Channel Splice Detail
Alternate B
(2.5 and 3 lb/ft)

Install a maximum of 3 posts within 7'.



Breakaway U-Channel Splice Detail
Alternate C
(2.5 and 3 lb/ft)

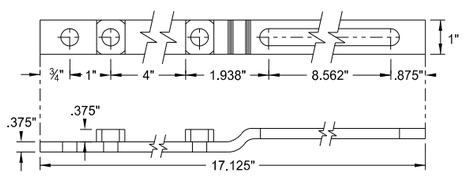
Install a maximum of 3 posts within 7'.



Front View Side View Back View

Breakaway U-Channel Detail
Alternate A

Install a maximum of 2 posts within 7'.



Retainer Strap Detail

Alternate A Steps of Installation:

1. a) Drive anchor unit to within 12" of ground level.
   b) Establish proper assembly by lining up bottom hole of retainer strap with 6th hole from the top of the anchor unit.
   c) Assemble strap to back of anchor unit using 5/16"x2" bolt, lock washer and nut.
   d) Rotate strap 90° to left.
2. a) Drive anchor unit to 4" above ground.
   b) Rotate strap to vertical position.
3. a) Place 5/16"x2" bolt, lock washer and nut in bottom of sign post to facilitate alignment of sign post with proper hole in anchor unit.
   b) Alternately tighten two connector bolts.
4. Complete assembly by tightening 5/16"x2" bolt (this fastens sign post to retainer strap).
5. Properly nest base post, strap, and sign post. Proper nesting occurs when all flat surfaces of the base post, strap, and sign post at the bolts have full contact across the entire width.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
2-28-14	
REVISIONS	
DATE	CHANGE
9-27-17	Updated to active voice
10-03-19	New Design Engr PE Stamp

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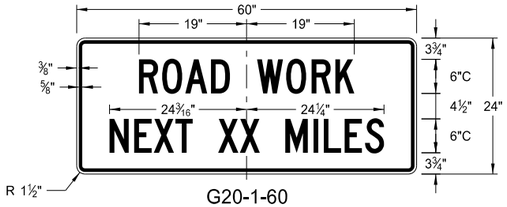
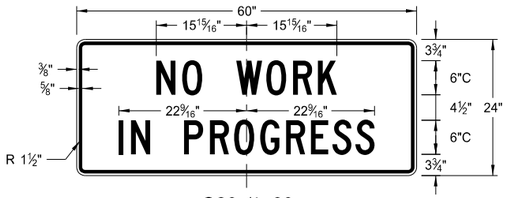
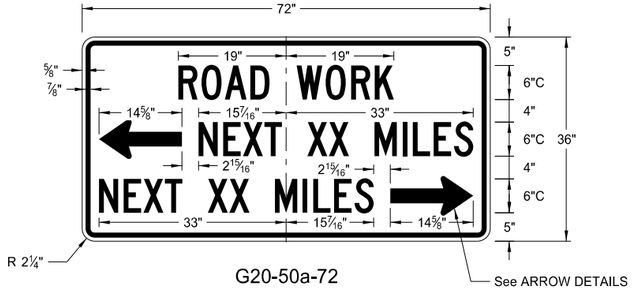
CONSTRUCTION SIGN DETAILS
TERMINAL AND GUIDE SIGNS



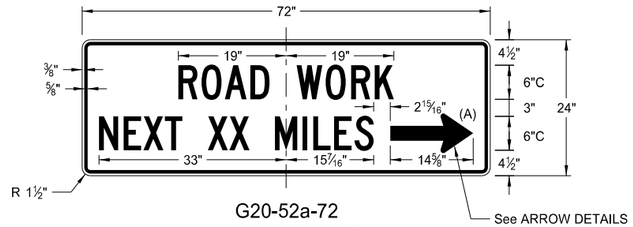
G20-1-60
Legend: black (non-refl)
Background: orange



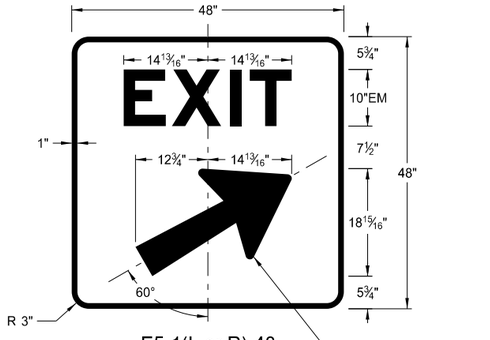
G20-1b-60
Legend: black (non-refl)
Background: orange



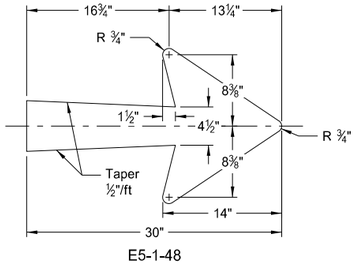
G20-50a-72
Legend: black (non-refl)
Background: orange



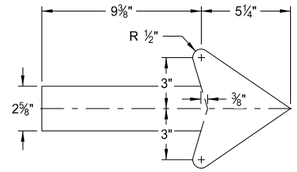
G20-52a-72
Legend: black (non-refl)
Background: orange



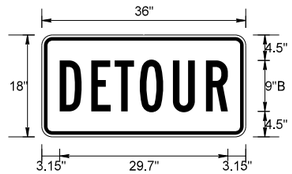
E5-1(L or R)-48
Legend: white
Background: green (orange optional)



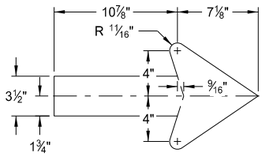
E5-1-48



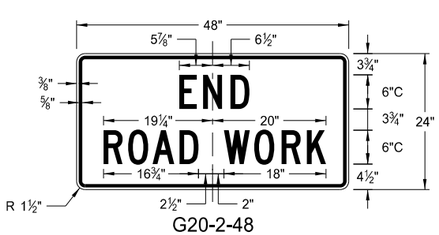
G20-50a-72
G20-52a-72



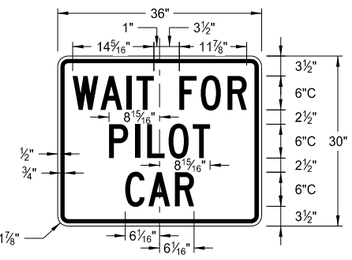
M4-8-36
Legend: black (non-refl)
Background: orange



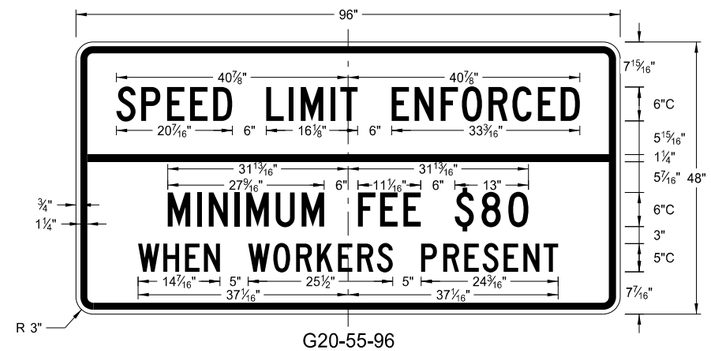
M4-9(L or R)-30
Right or Left



G20-2-48
Legend: black (non-refl)
Background: orange



G20-4b-36
Legend: black (non-refl)
Background: orange



G20-55-96
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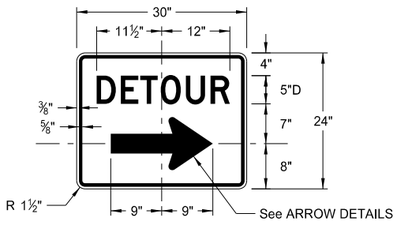
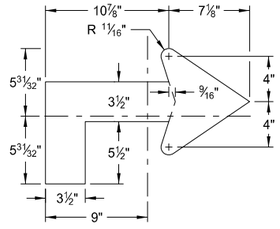
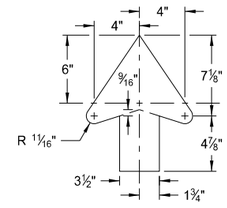
Background: orange



M4-9(L or R)-30 &
M4-9-30
Legend: black (non-refl)
Background: orange



M4-9(L or R)-30
Advanced Right or Left



M4-9-30
Straight

ARROW DETAILS

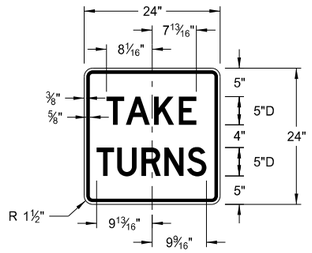
NOTES:

(A) Arrow may be right or left of the legend to indicate construction to the right or left.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
8-13-13	
REVISIONS	
DATE	CHANGE
8-17-17	Added sign & background color
10-03-19	New Design Engineer PE Stamp

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 10/03/19 and the original document is stored at the North Dakota Department of Transportation

CONSTRUCTION SIGN DETAILS
REGULATORY SIGNS



R1-50P-24
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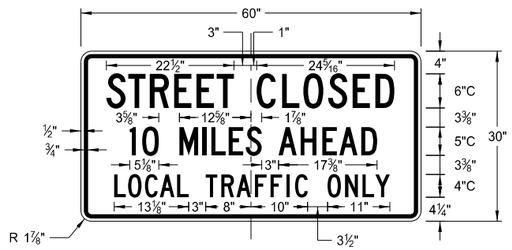
Background: white



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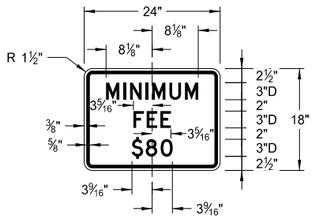

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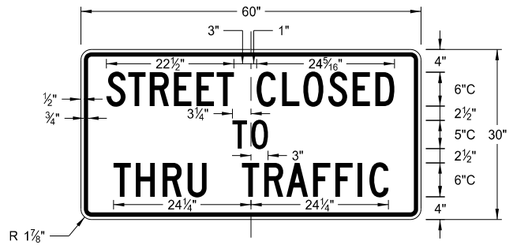


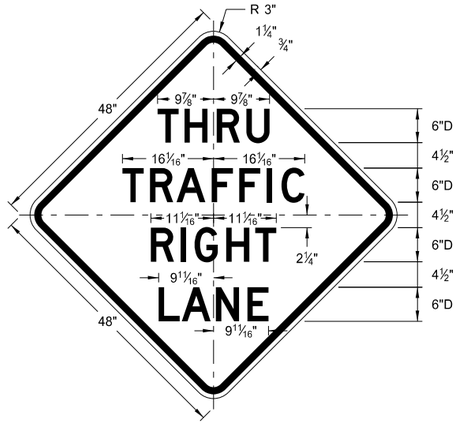
R11-4a-60
Legend: black (non-refl)
Background: white

R11-2a-48
Legend: black (non-refl)
Background: white

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
8-13-13	
REVISIONS	
DATE	CHANGE
8-17-17	Revised sign number
10-03-19	New Design Engineer PE Stamp

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 10/03/19 and the original document is stored at the North Dakota Department of Transportation

CONSTRUCTION SIGN DETAILS
WARNING SIGNS



W5-8-48
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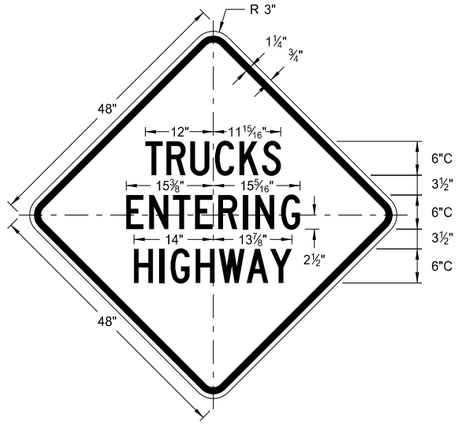
Background: orange



W8-53-48
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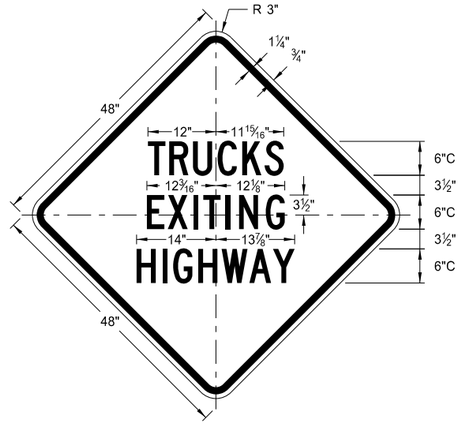
Background: orange



W8-56-48
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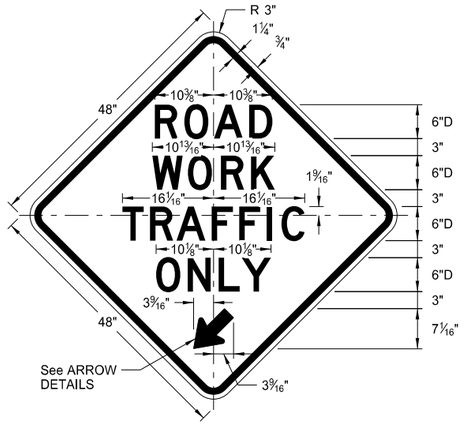

W5-9-48
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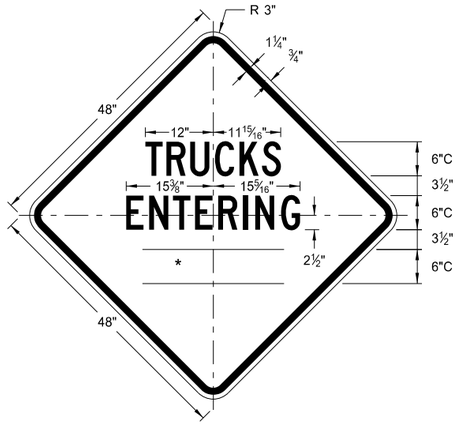
Background: orange



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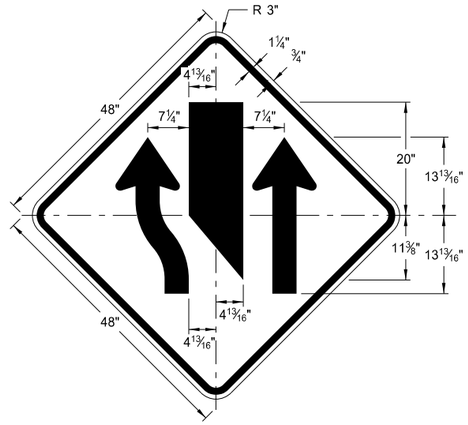
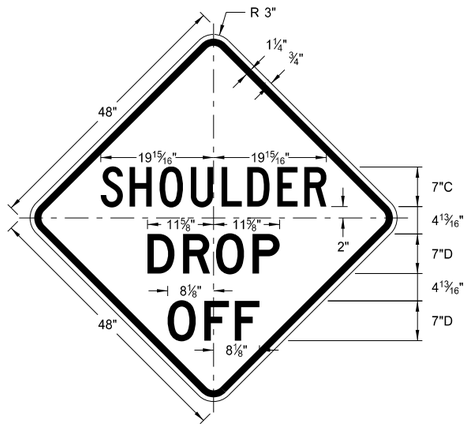
Background: orange



W9-3a-48
Legend: black (non-refl)
Background: orange



W8-9a-48
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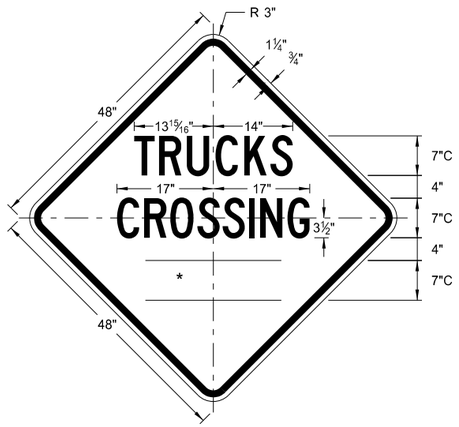
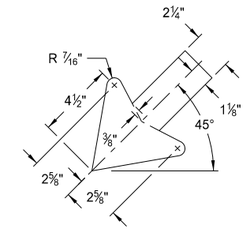
Background: orange



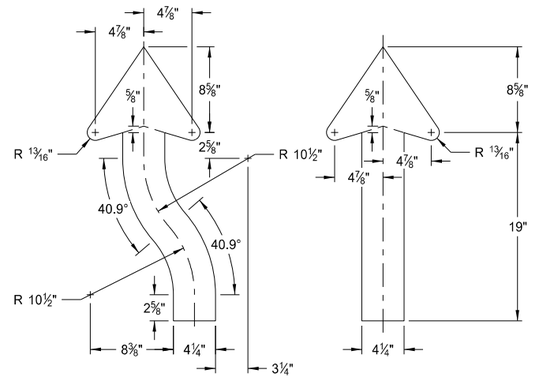
W8-55-48
Legend: black (non-refl)
Background: orange

WORD	LETTER SPACING
AHEAD	Standard
200 FT	Standard
350 FT	Standard
500 FT	Standard
1000 FT	Reduce 40%
1500 FT	Reduce 40%
½ MILE	Reduce 50%
1 MILE	Standard

* DISTANCE MESSAGES



W5-9-48



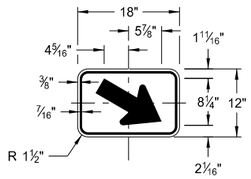
W9-3a-48

ARROW DETAILS

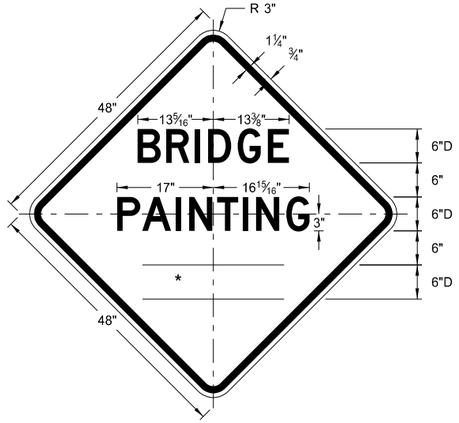
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
8-13-13	
REVISIONS	
DATE	CHANGE
8-17-17	Updated sign number
5-31-18	Revised sign and arrow details
10-03-19	New Design Engineer PE Stamp

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 10/03/19 and the original document is stored at the North Dakota Department of Transportation

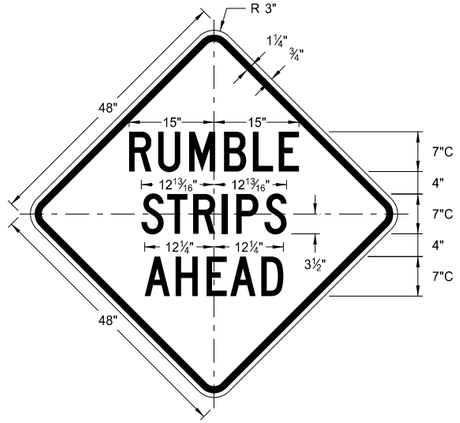
CONSTRUCTION SIGN DETAILS
WARNING SIGNS



W16-7aP-18
Legend: black (non-refl)
Background: orange



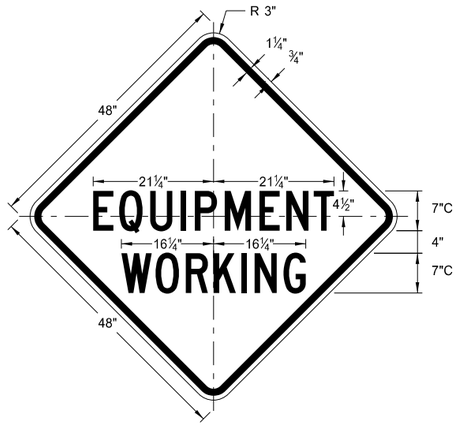
W21-50-48
Legend: black (non-refl)
Background: orange



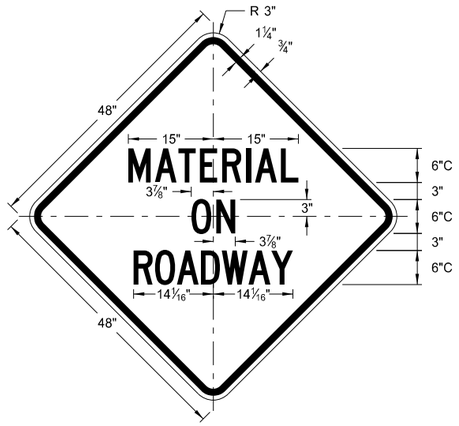
W21-53-48
Legend: black (non-refl)
Background: orange

WORD	LETTER SPACING
AHEAD	Standard
200 FT	Standard
350 FT	Standard
500 FT	Standard
1000 FT	Reduce 40%
1500 FT	Reduce 40%
½ MILE	Reduce 50%
1 MILE	Standard

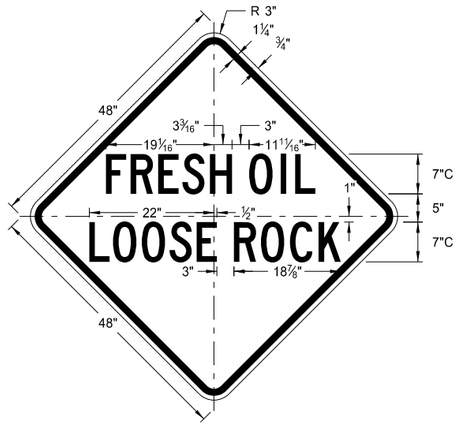
* DISTANCE MESSAGES



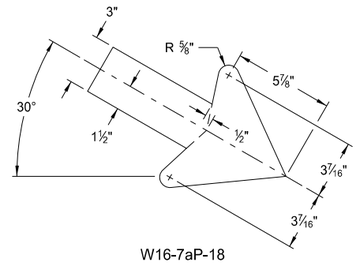
W20-51-48
Legend: black (non-refl)
Background: orange



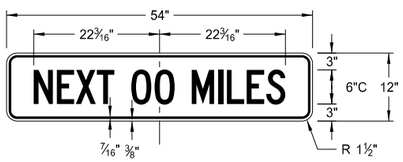
W21-51-48
Legend: black (non-refl)
Background: orange



W22-8-48
Legend: black (non-refl)
Background: orange



W16-7aP-18



W20-52P-54
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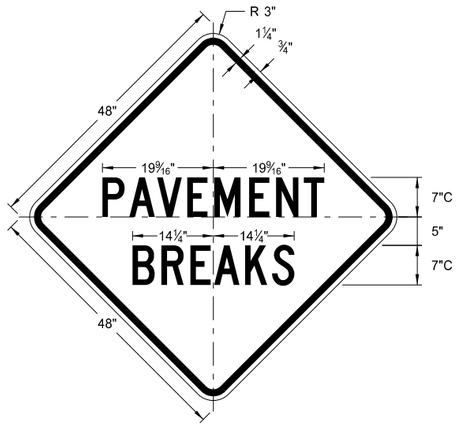
Background: orange



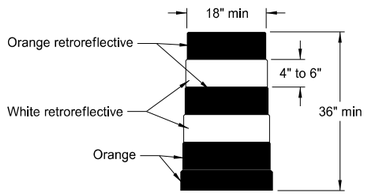
W21-52-48
Legend: black (non-refl)
Background: orange

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
5-31-18	
REVISIONS	
DATE	CHANGE
11-01-19	Added details for sign W16-7aP-18.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 11/1/19 and the original document is stored at the North Dakota Department of Transportation

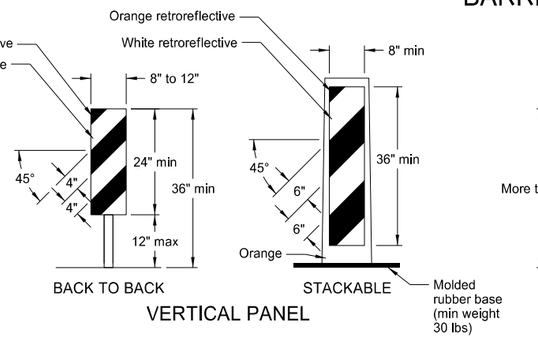
BARRICADE AND CHANNELIZING DEVICE DETAILS

D-704-13



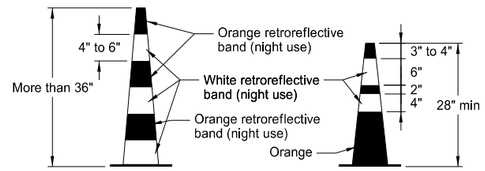
DELINEATOR DRUM

Provide horizontal, circumferential, alternating orange and white retroreflective stripes 4" to 6" wide for drum markings. Use a minimum of two orange and two white stripes with the top stripe being orange for each drum. Do not exceed 3" nonretroreflectorized spaces between the horizontal orange and white stripes. Avoid placement of stripes on drum ribs or indentations. Use closed top drums that will not allow collection of debris. Do not place ballast on the top of drum.



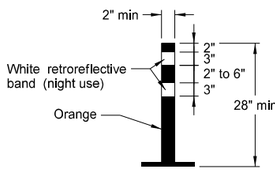
VERTICAL PANEL

Provide alternating orange and white retroreflective stripes, sloping downward in direction vehicular traffic is to pass. Place retroreflective sheeting on both sides of panel with a minimum of 270 square inches of retroreflective area facing vehicular traffic. Where the height of the retroreflective material on the vertical panel is 36 inches or more, use a stripe width of 6 inches.



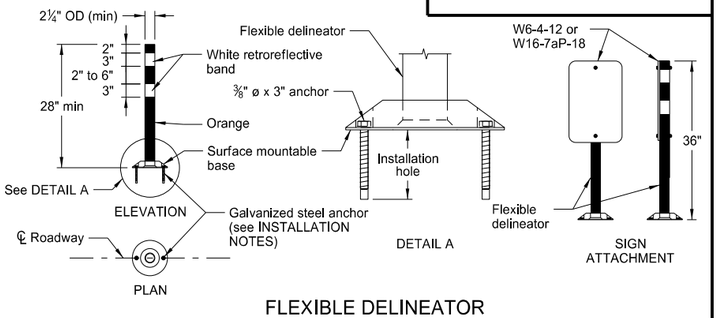
TRAFFIC CONE

Provide retroreflectorization of cones more than 36" in height by alternating orange and white retroreflective stripes. Use a minimum of two orange and two white stripes for each cone with the top stripe being orange. Use maximum 3" nonretroreflectorized space between the orange and white stripes.



TUBULAR MARKER

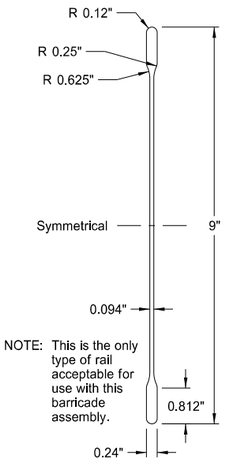
Provide retroreflectorization of tubular markers more than 42" in height by alternating four 4" to 6" wide orange and white stripes with the top stripe being orange.



FLEXIBLE DELINEATOR

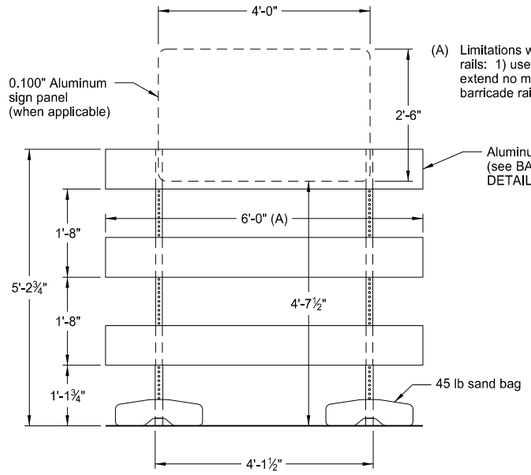
INSTALLATION NOTES:

1. Drill installation holes to diameter and depth required by manufacturer's specifications.
2. For removal, remove anchors and fill installation hole with an epoxy designed to bond to pavement surface.
3. In lieu of bolted down base, use an 8" x 8" butyl pad or hot melt butyl. Remove butyl as close as possible to pavement surface.



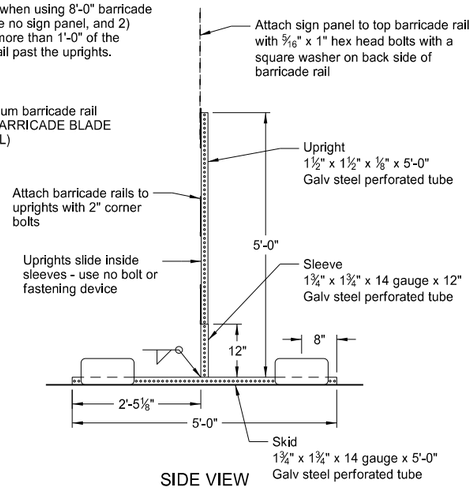
NOTE: This is the only type of rail acceptable for use with this barricade assembly.

BARRICADE BLADE DETAIL



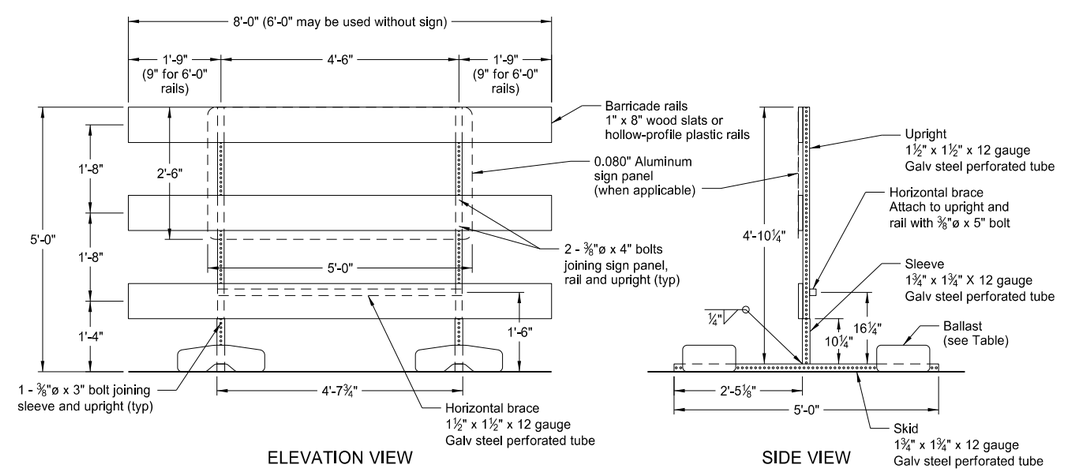
(A) Limitations when using 8'-0" barricade rails: 1) use no sign panel, and 2) extend no more than 1'-0" of the barricade rail past the uprights.

ELEVATION VIEW



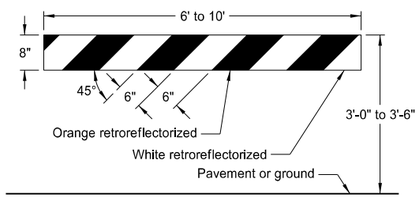
SIDE VIEW

BARRICADE ASSEMBLY DETAIL (Aluminum Barricade Rails)

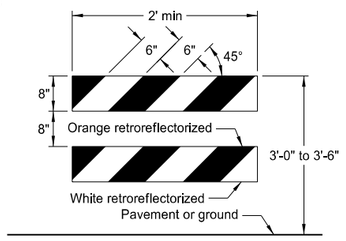


BARRICADE ASSEMBLY DETAIL (Wood or Plastic Rails)

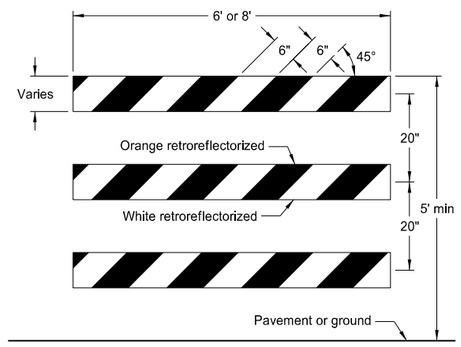
NOTE: For barricade markings use alternating orange and white retroreflective stripes, sloping downward in the direction traffic is to pass. Place retroreflective sheeting on both sides of the rails with a minimum of 270 square inches of visible retroreflective area facing vehicular traffic. When the barricade length is less than 36", use a rail stripe width of 4".



TYPE I BARRICADE

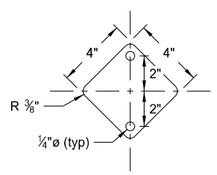


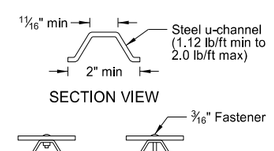
TYPE II BARRICADE

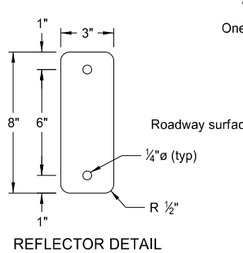


TYPE III BARRICADE

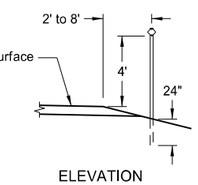
BARRICADE RAIL DETAILS







REFLECTOR DETAIL



ELEVATION

DELINEATORS

MINIMUM BALLAST
(For each side of barricade support)

Without Sign	4 - 25 lb sandbags
With Sign	6 - 25 lb sandbags

Note: Number of sandbags based on a wind speed of 55 MPH. Sandbags assumed to be placed at or near the ends of the skids.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-3-13	
REVISIONS	
DATE	CHANGE
9-27-17 11-01-19	Updated to active voice Revised details for Flexible Delineator

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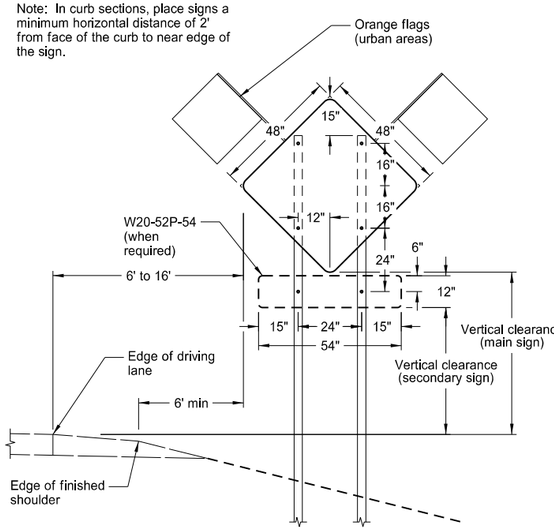
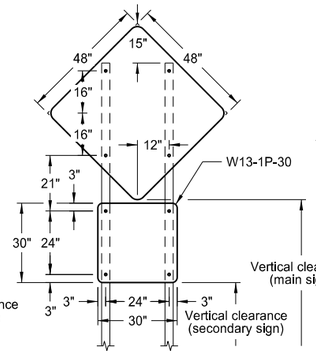
CONSTRUCTION SIGN PUNCHING AND MOUNTING DETAILS

D-704-14

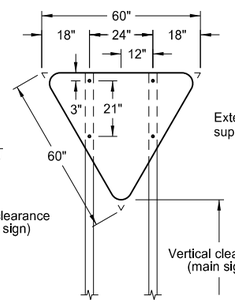
Note: In curb sections, place signs a minimum horizontal distance of 2' from face of the curb to near edge of the sign.



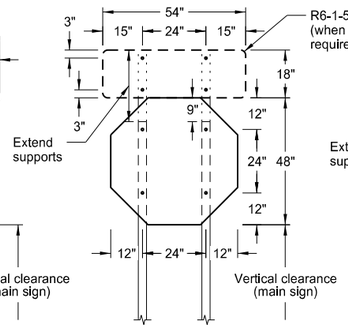
TYPICAL SECTION
(48" x 48" diamond warning sign shown)



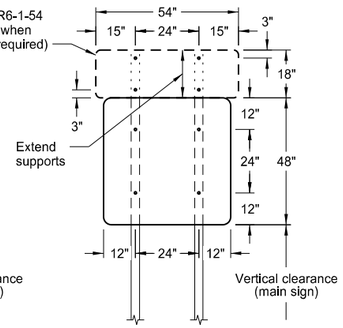
48" x 48" DIAMOND SIGN
(with 30" x 30" secondary sign)



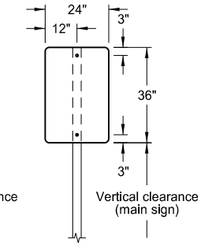
R1-2-60 - YIELD SIGN



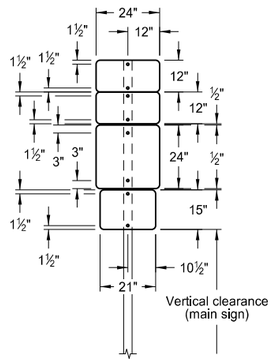
R1-1-48 - STOP SIGN
(with R6-1-54 sign as required)



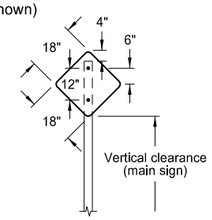
48" x 48" SIGN
(with R6-1-54 sign as required)



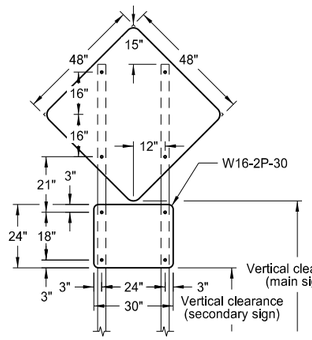
24" x 36" SIGN



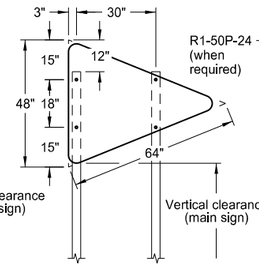
24" x 24"
ROUTE MARKER
ASSEMBLY



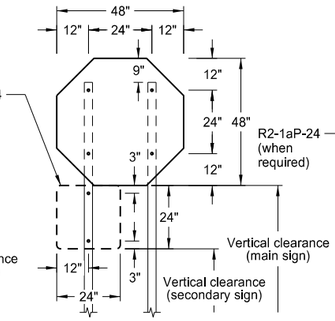
18" x 18"
DIAMOND SIGN



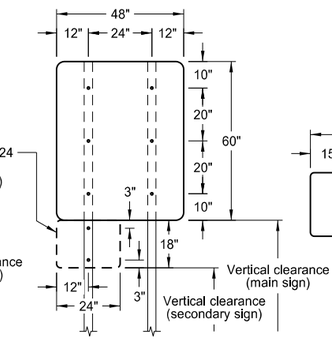
48" x 48" DIAMOND SIGN
(with 30" x 24" secondary sign)



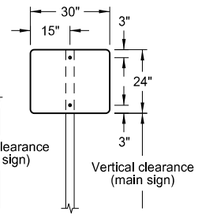
W14-3-64 - PENNANT SIGN



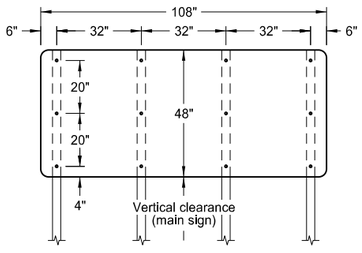
R1-1-48 - STOP SIGN
(with R1-50P-24 sign as required)



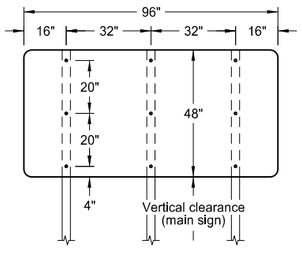
48" x 48" SIGN
(with R2-1aP-24 sign as required)



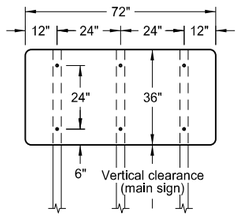
30" x 24" SIGN



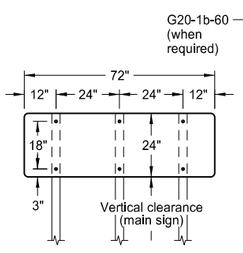
108" x 48" SIGN



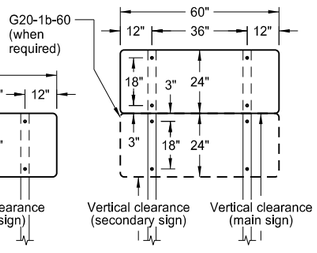
96" x 48" SIGN



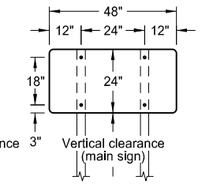
72" x 36" SIGN



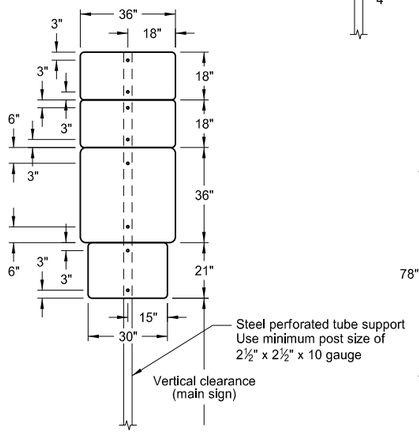
72" x 24" SIGN



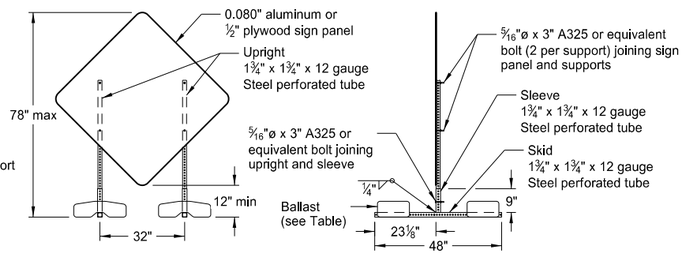
60" x 24" SIGN



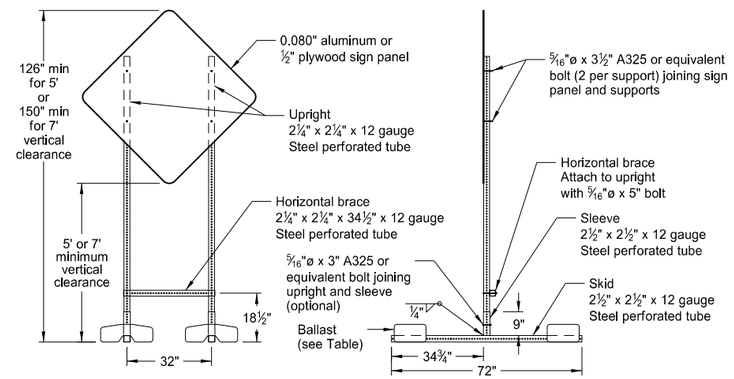
48" x 24" SIGN



36" x 36"
ROUTE MARKER
ASSEMBLY



PORTABLE SIGN SUPPORT
LOW-MOUNTING HEIGHT



PORTABLE SIGN SUPPORT
HIGH-MOUNTING HEIGHT

NOTES:

1. Sign Supports: Galvanize or paint supports. Minimum post sizes are 2.5 lb/ft u-channel or 2" x 2" x 12 gauge steel perforated tube, except where noted. When installing signs on u-channel, minimum post size for assemblies containing a secondary sign is 3.0 lb/ft. Post sizes based on a wind speed of 55 MPH.

   Place signs over 50 square feet on 2½" x 2½" perforated tube supports as a minimum.

   Do not attach guy wires to sign supports. Attach wind beams behind sign panels when used with u-posts.

2. Sign Panels: Provide sign panels made of 0.100" aluminum, ½" plywood, or other approved material, except where noted. Punch all holes round for ⅜" bolts.

3. Alternate Messages: Install and remove alternate message signs on reflectorized plate (without borders) as required. (i.e. "Left" and "Right" message on lane closure sign)

4. Route Marker Auxiliary Signs: Provide route marker auxiliary signs, such as the cardinal direction and directional arrows, with a background and legend that match the route marker they are used with:

   Interstate - white legend on blue background
   Interstate Business Loop - white legend on green background
   US and State - black legend on white background
   County - yellow legend on blue background

5. Vertical Clearance: Install signs with a vertical clearance of 5'-0" (see TYPICAL SECTION.) In areas where parking or pedestrian movements are likely or the view of the sign may be obstructed, install signs with a vertical clearance of 7'-0" from the top of the curb or from the near edge of the driving lane in absence of a curb.

   The vertical clearance to secondary signs is 1'-0" less than the vertical clearance stated above.

   Provide a minimum clearance of 7'-0" from the ground at the post for signs with an area exceeding 50 square feet.

6. Portable Signs: Provide portable signs that meet the vertical clearance stated above when it is necessary to place signs within the pavement surface.

   Use of low-mounting height (minimum 12" vertical clearance) portable signs for 5 days or less, is allowed as long as the view of the sign is not obstructed. Time delays caused by unforseen circumstances, such as equipment breakdown, rain, subgrade failures, etc., will not accrue towards the 5 day period. Use of R9-8 through R9-11a series, W1-6 through W1-8 series, M4-10, and E5-1 is allowed for longer than 5 days.

   Restrict signs mounted on portable sign supports shown in the LOW-MOUNTING HEIGHT and HIGH-MOUNTING HEIGHT details to a maximum surface area of 16 square feet.

MINIMUM BALLAST
(For each side of sign support base)

Sign Panel Mounting Height (ft)	Number of 25 lb sandbags for 4' x 4' sign panel
1'	6
5'	8
7'	10

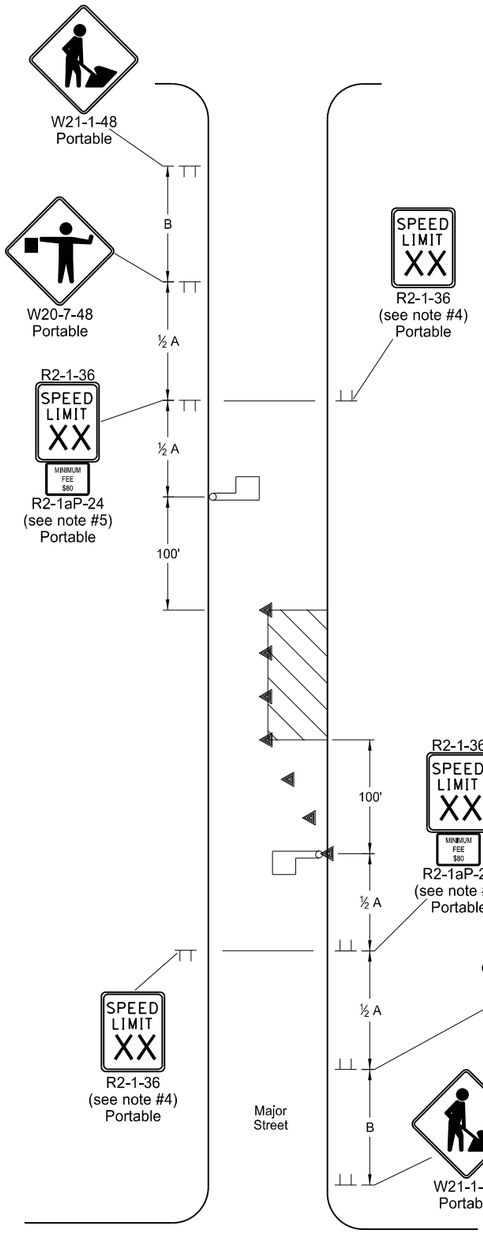
Note: The number of sandbags are based on a wind speed of 55 MPH. Place sandbags at or near the ends of skids.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-4-13	
REVISIONS	
DATE	CHANGE
11-14-13	Revised Note 6
9-27-17	Updated to active voice
11-01-19	Revised 60"x24" sign detail

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 11/1/19 and the original document is stored at the North Dakota Department of Transportation

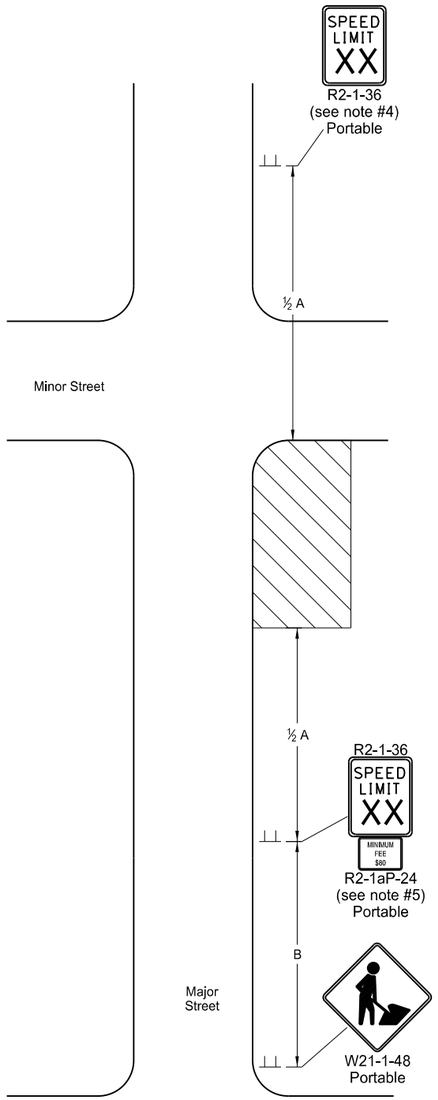
LANE CLOSURES ON URBAN STREETS LAYOUTS

D-704-25



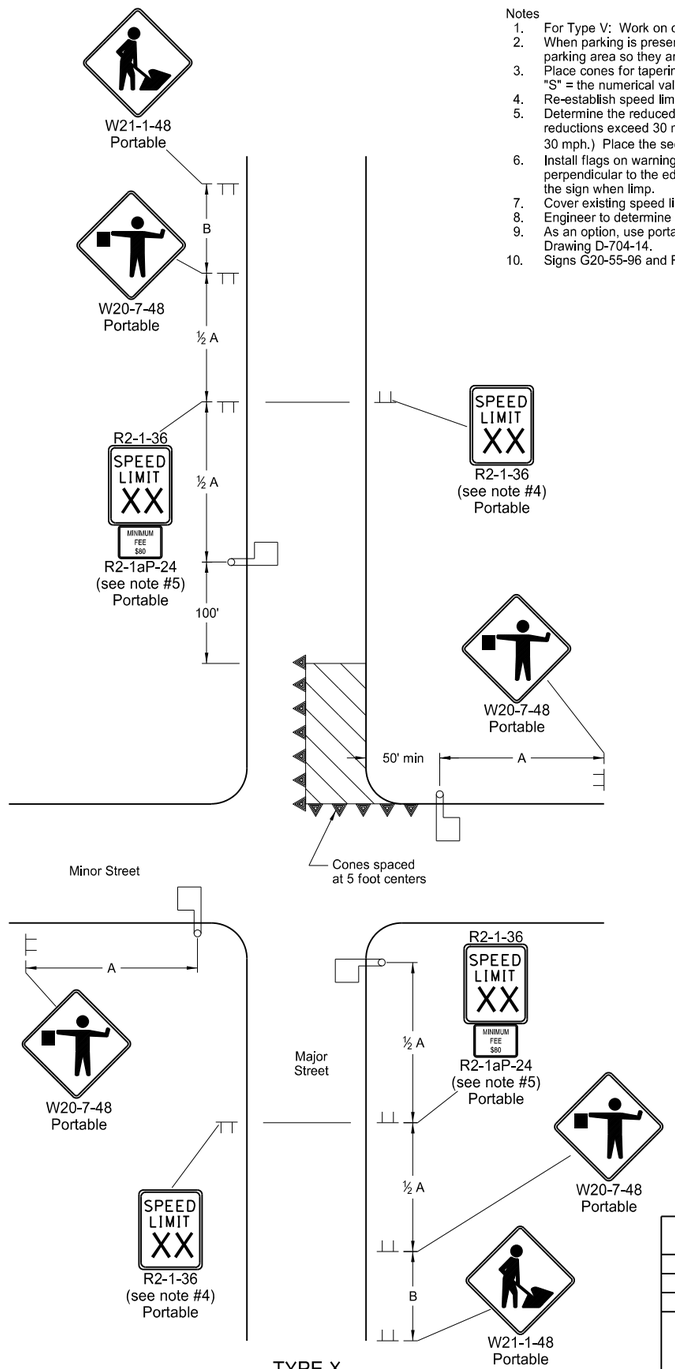
TYPE V
LANE CLOSURE ON URBAN STREET

Portion of roadway closed to traffic only
during daylight hours (mid block location).



TYPE W
WORK BEYOND CURB ON URBAN STREET

Work area outside driving lane and no closure necessary.



TYPE X
LANE CLOSURE NEAR INTERSECTION ON URBAN STREET

Portion of roadway closed to traffic only
during daylight hours (end block location).

Notes

1. For Type V: Work on one side of roadway at a time so as not to block off more than one lane of traffic.
2. When parking is present, place signs so they are entirely visible above parked vehicles or at the edge of the parking area so they are visible to oncoming traffic. Place signs on portable mounts when located on roadway.
3. Place cones for tapering traffic at 3 equal spaces and cones for tangents at dimension "S".
   "S" = the numerical value of speed limit.
4. Re-establish speed limit. Determine exact speed limit in the field, dependent on location and conditions.
5. Determine the reduced speed limit based on the in-place speed limit before construction. Where speed reductions exceed 30 mph, install a second speed limit sign with the desired speed reduction (not to exceed 30 mph.) Place the second speed limit sign at ½ B.
6. Install flags on warning signs in urban areas when signs are not portable. Mount 24 inches square flags perpendicular to the edges of the sign, and at such a distance above the edge that the flag does not touch the sign when limp.
7. Cover existing speed limit signs within reduced speed zones.
8. Engineer to determine safe speed, when necessary.
9. As an option, use portable sign supports in lieu of post mounted signs in accordance with NDDOT Standard Drawing D-704-14.
10. Signs G20-55-96 and R2-1aP-24 are not required for urban projects.

ADVANCE WARNING SIGN SPACING			
Road Type	Distance Between Signs Min. (ft)		
	A	B	C
Urban - Low Speed (30 mph or less)	150	150	150
Urban - Low Speed (over 30 to 40 mph)	280	280	280
Urban - High Speed (over 40 mph to 50 mph)	360	360	360
Rural - High Speed (over 50 mph to 65 mph)	720	720	720
Urban Expressway and Freeway (55 mph to 60 mph)	850	1350	2200
Rural Expressway and Freeway (70 mph to 75 mph)	1000	1500	2640
Interstate/4-Lane Divided (Maintenance and Surveying)	750	1000	1500

KEY

Sign | Work area | Cones | Flagger

NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

9-27-13

REVISIONS

DATE	CHANGE
8-17-17	Updated notes & removed signs
11-01-19	Revised note & added Min Fee sign

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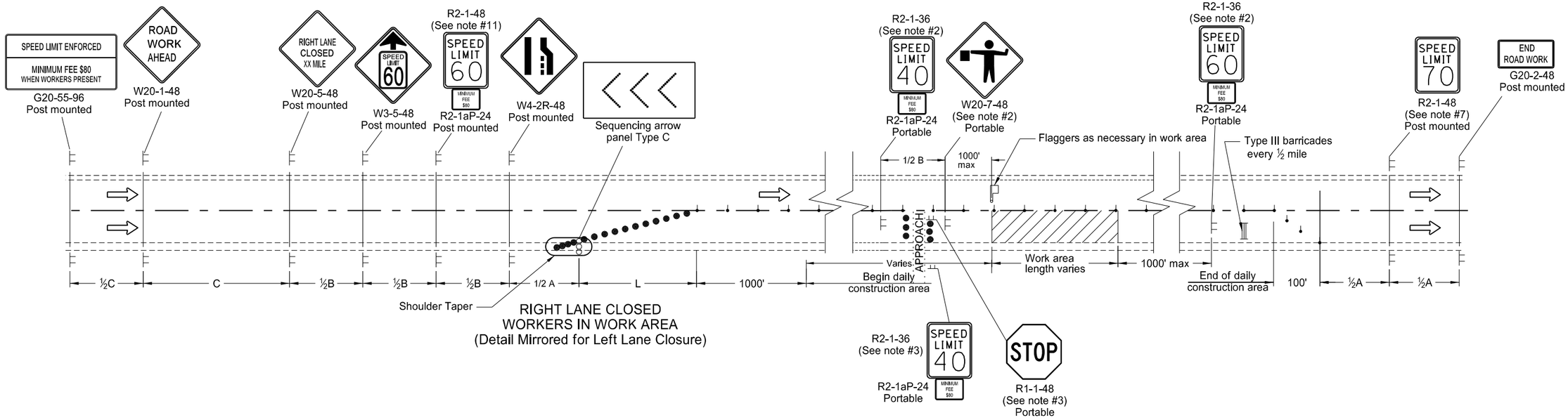
SIGN LAYOUT FOR ONE LANE CLOSURE

D-704-34



RIGHT LANE CLOSED
WORKERS IN WORK AREA
(Detail Mirrored for Left Lane Closure)

Notes:

1. Install advance signs for flagging when flaggers are flagging.

2. Move the advanced flagger sign and speed limit signs as the work area moves through the construction zone. When the work area is not visible from the flagger, move the flagger station so the work area is visible. Place the 40 mph speed limit sign at ½A in advance of the flagger sign and move the 60 mph speed limit sign. Cover or remove the 40 mph speed limit and the Minimum Fee $80 signs upon completion of the work day or when workers are not present. Determine the exact speed limit in the field, dependent on location and conditions.

3. Approaches: When the work area encompasses an approach, install a 40 mph speed limit sign to control the approach. Cover the existing stop sign and install a new portable stop sign when the approach is on the side of the lane closure. Remove the approach speed limit sign once the main line 40 mph speed zone is moved past the approach.

4. Variables:
   S=Numerical value of speed limit or 85th percentile
   W=The width of taper.
   L=Minimum length of taper, or SxW for freeways, expressways, and all other roads with speeds of 45 mph or greater, or
   (WxSxS)/60 for urban, residential, and other streets with speeds of 40 mph or less.

5. Space delineator drums for tapering traffic at the dimension "S". Space tubular markers used for tangents at 2 times dimension "S".

6. Place sequencing arrow panels at the beginning of the taper when possible. Where shoulder width does not provide sufficient room, move the panel closer to the work area and place on the roadway surface.
   Use Type A on roadways with slow moving traffic speeds and low volume (25 mph or less and 750 ADT or less).
   Use Type B on roadways with moderate traffic speeds and volumes (40 mph or less and 5000 ADT or less).
   Use Type C on roadways with high traffic speeds and volumes (over 40 mph or over 5000 ADT).

7. Re-establish the speed limit. Determine the exact speed limit in the field, dependent on location and conditions.

8. Cover existing speed limit signs within a reduced speed zone.

9. Install flags on warning signs in urban areas when signs are not portable. Mount 24 inch square flags perpendicular to the edges of the diamond sign, and at such a distance above the edge that the flag does not touch the sign when limp.

10. Determine the reduced speed limit dependent on the in place speed limit before construction. Where speed limits are to be reduced more than 30 mph, install a second speed limit sign with the desired speed reduction (not to exceed 30 mph.) Place the second speed limit sign at ½B.

11. As an option use portable sign supports in lieu of post mounted signs in accordance with NDDOT Standard Drawing D-704-14.

12. Sign G20-55-96 is not required if this standard is part of other traffic control layouts or the work is less than 15 days.

KEY

Type I barricade	Work area
Type II barricade	Flagger
Type III barricade	Sequencing arrow panel
Sign	Tubular markers
Delineator drum	

ADVANCE WARNING SIGN SPACING			
Road Type	Distance Between Signs Min (ft)		
	A	B	C
Urban - Low Speed (30 mph or less)	150	150	150
Urban - Low Speed (over 30 to 40 mph)	280	280	280
Urban - High Speed (over 40 mph to 50 mph)	360	360	360
Rural - High Speed (over 50 mph to 65 mph)	720	720	720
Urban Expressway and Freeway (55 mph to 60 mph)	850	1350	2200
Rural Expressway and Freeway (70 mph to 75 mph)	1000	1500	2640
Interstate/4-Lane Divided (Maintenance and Surveying)	750	1000	1500

Longitudinal Buffer Space	
Speed (mph)*	Length Min (feet)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820

*Posted speed, off-peak 85th percentile speed prior to work starting, or the anticipated operating speed in mph.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

9-26-2012

REVISIONS

DATE	CHANGE
3-15-16	Removed Do Not Pass signs and updated notes.
8-17-17	Updated notes & sign nos. & moved Speed Limit signs.
11-01-19	Removed shldr taper details & revised tubular mkr symbol

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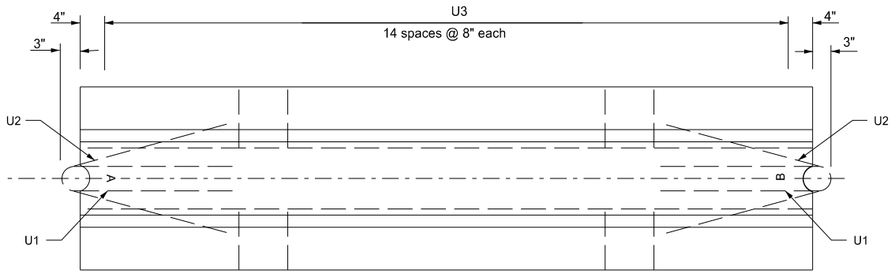
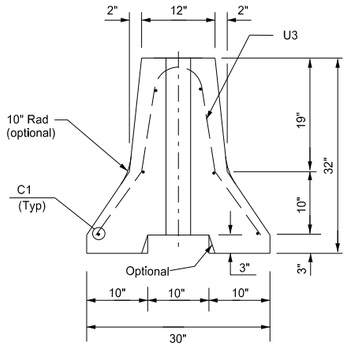
PORTABLE PRECAST CONCRETE MEDIAN BARRIER
(TEMPORARY USAGE)

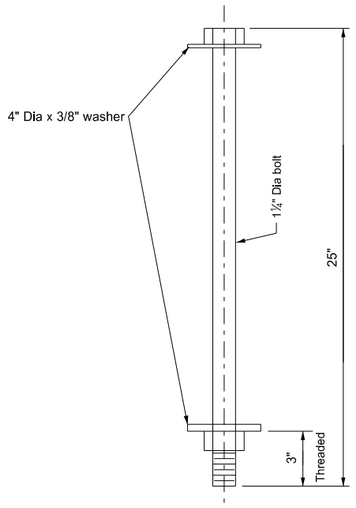
D-704-51



Plan View



End View

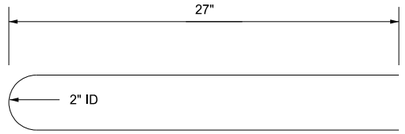


Connecting Bolt Detail

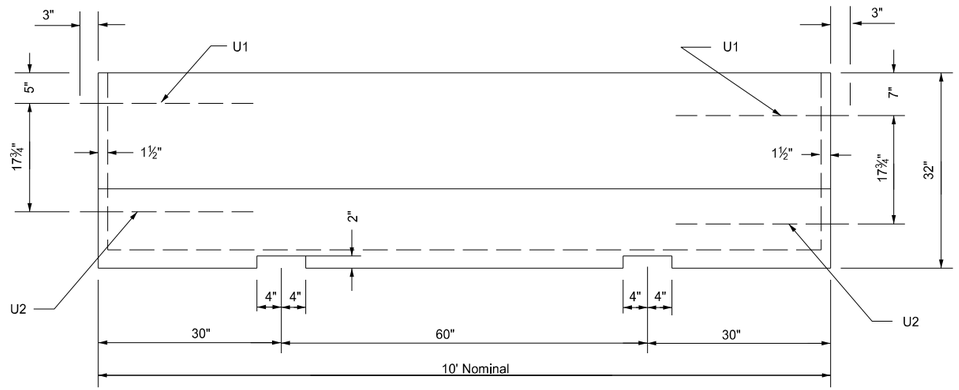
(One per 10 Ft section)

Notes:

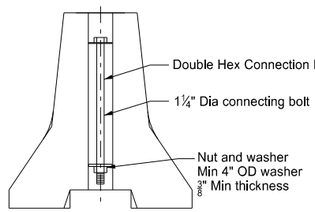
1. Galvanize all exposed hardware as per ASTM A153, except for the loop inserts.
2. Use AAE-3 Concrete.
3. Provide steel in accordance with Section 612 of NDDOT Standard Specifications.
4. Imprint barrier ends A and B as shown with 4 inch letters. Field match A end with B end.
5. Place barrier markers at the center of the barrier at 20' centers.
6. Connect barrier sections with 1 ¼" Dia A-307 double hex connecting bolt. Maintain bottom nut and washer connection for duration of barrier installation.
7. Place barrier to minimize openings between individual sections.



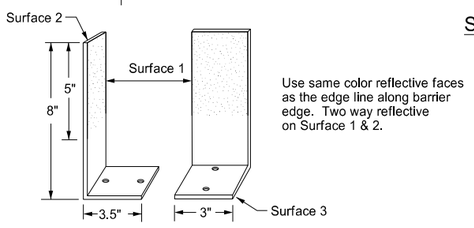
U1 Bar Detail



Side View

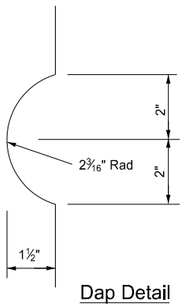


Bolt Connection Detail

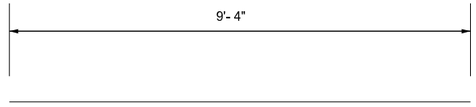


Use same color reflective faces as the edge line along barrier edge. Two way reflective on Surface 1 & 2.

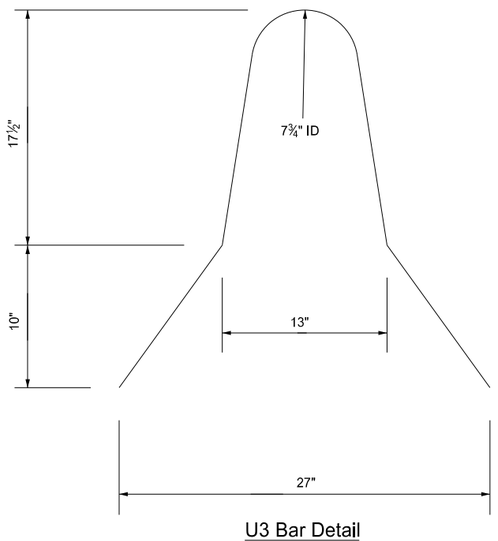
Barrier Marker Detail



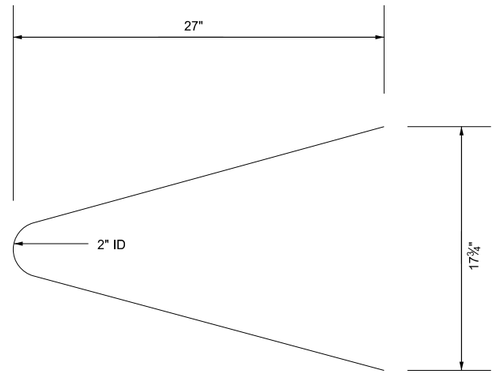
Dap Detail



C1 Bar Detail



U3 Bar Detail



U2 Bar Detail

Marker Body
Use high impact,weatherable engineering thermo-plastic material conforming to the following:

Property	Result	ASTM Test Method
Thickness (min)	.090"	——
Tensile strength (min psi) @ yield	5,500	D638
Impact strength @ -20°F (ft-lbs/in of notch)	3.2	D256 Method A
Impact strength @ 73°F (ft-lbs/in of notch)	14.0	D256 Method A
Flexural strength, PSI ¼" @ 73°F	8,000	D790
Flexural modulus, PSI ¼" @ 73°F	300,000	D790
Elongation @ yield	30%	D638

Reflective Tape
Use retroreflective, acrylic microprism material with acrylic backing, 3" wide, providing the following minimum optical performance with an observation angle of 0.1° measured in candlepower for the reflector:

Entrance Angle	Specific Intensity
Yellow - 4"	136
White - 4"	200

Adhesive
Use factory applied solid butyl rubber ⅛" thick, 2" wide on 2¼" wide release paper on surface 3 to temporarily mount markers to portable concrete barrier.

Bar List

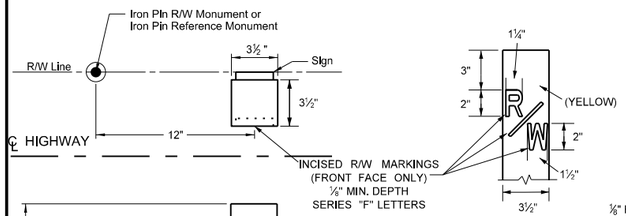
Mark	Size	No.	Length	Shape
C1	4	6	9'- 4"	Straight
U1	4	2	4'- 8"	Bent
U2	4	2	4'- 10¼"	Bent
U3	4	15	5'- 4"	Bent

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
07-20-12	
REVISIONS	
DATE	CHANGE
9-27-17	Updated to active voice
11-01-19	New Design Engr PE Stamp

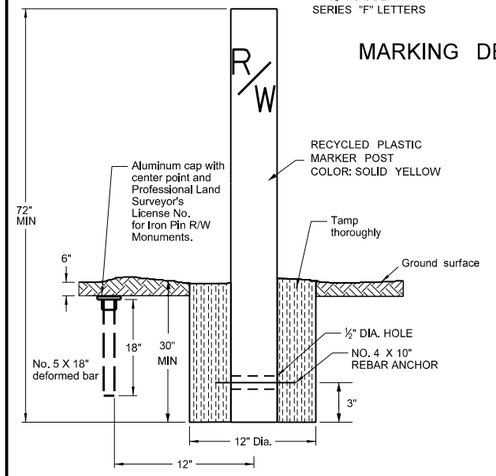
This document was originally issued and sealed by Kirk J Hoff, Registration Number PE- 4683, on 11/1/19 and the original document is stored at the North Dakota Department of Transportation

STANDARD MONUMENTS AND RIGHT OF WAY MARKERS

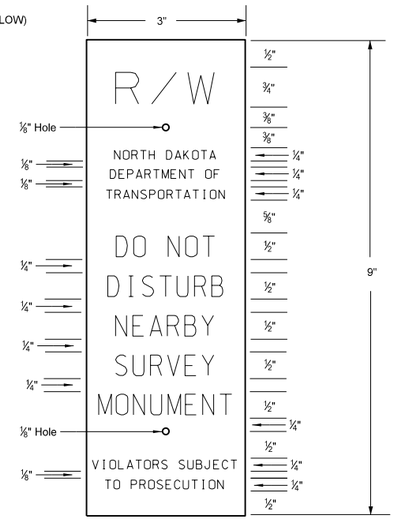
D-720-1



MARKING DETAIL



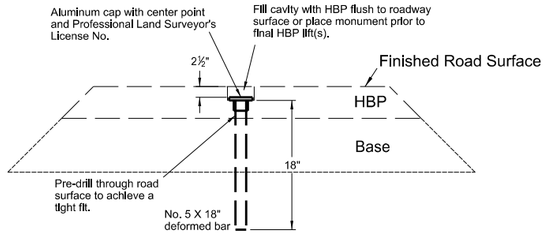
RECYCLED PLASTIC
RIGHT OF WAY MARKER
(WITNESS POST) DETAILS
&
IRON PIN REFERENCE AND R/W
MONUMENT DETAILS



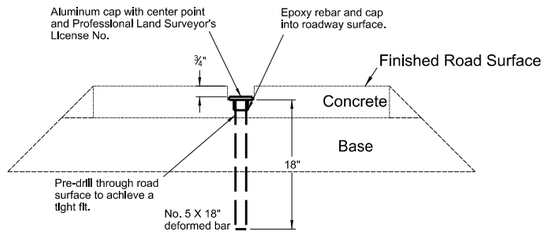
SIGN DETAIL

Black letters on orange high intensity background sheeting meeting ASTM D-4956 Type III or higher on 80 gauge 5052-H38 aluminum. Silk screen graphics. One color print. Attach sign by drilling two holes in the face of the post (side facing the private owner, away from the Department of Transportation right of way). Put inserts into the holes and mount the sign with #4 vandal proof screws. Install sign 2" from top of post.

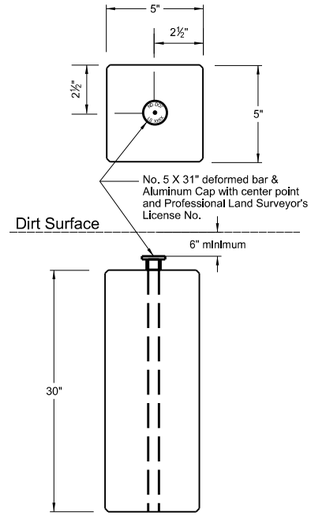
ALIGNMENT MONUMENT DETAILS



IRON PIN
(Within Finished Roadway Surface)



IRON PIN
(Within Finished Roadway Surface)



PRECAST CONCRETE
(Outside Finished Roadway Surface)
(Inside R/W Limits)

NOTES:

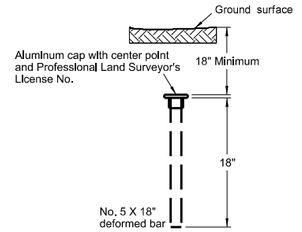
Construct and install Alignment Monuments, Iron Pin Reference Monuments, Iron Pin R/W Monuments, and Right of Way Markers (witness posts) according to Section 720 of the Standard Specifications.

ALIGNMENT MONUMENTS: Place Iron Pin or Precast Concrete Alignment Monuments with aluminum caps on the centerline alignment PI's, section corners, quarter corners, section line crossings, quarter line crossings, and at curve points (PC's, PT's, TS's, and ST's) on the centerline.

IRON PIN R/W MONUMENT: Place Iron Pns with aluminum caps (No. 5 X 18") at breaks on the Right of Way line, and at curve points (PC's, PT's, TS's and ST's) on the Right of Way line.

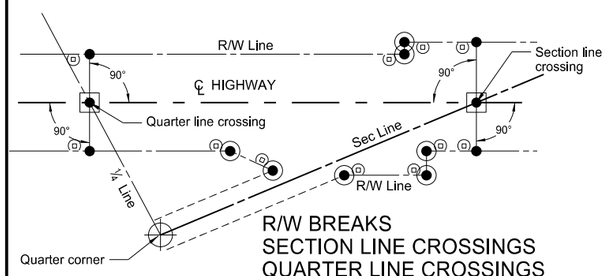
IRON PIN REFERENCE MONUMENT: Place Iron Pins without aluminum caps (No. 5 X 18") as reference monuments on the Right of Way line at section corners, quarter corners, section line crossings, and quarter line crossings.

R/W MARKERS (WITNESS POST) WITHIN DRIVEWAYS: If a single iron Pin R/W or Reference Monument is within a driveway, place right of way marker (witness post) 50 feet back, in stationing, from the Iron Pin Monument along the R/W line. If R/W break is within a driveway, place right of way markers (witness posts) 50 feet back, or ahead from respective Iron Pin R/W Monuments along the R/W lines. Maintain Iron Pin R/W or Reference Monument original position within driveway.

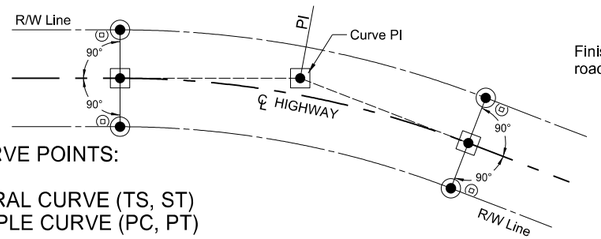


IRON PIN
(Outside Finished Roadway Surface)
(Outside R/W Limits)

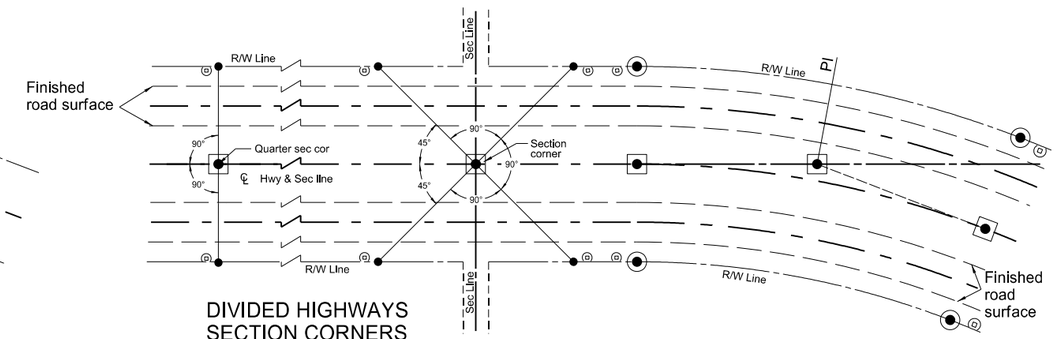
VARIOUS MONUMENT AND MARKER PLACEMENTS



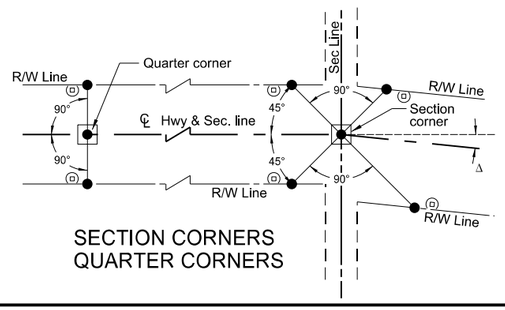
R/W BREAKS
SECTION LINE CROSSINGS
QUARTER LINE CROSSINGS



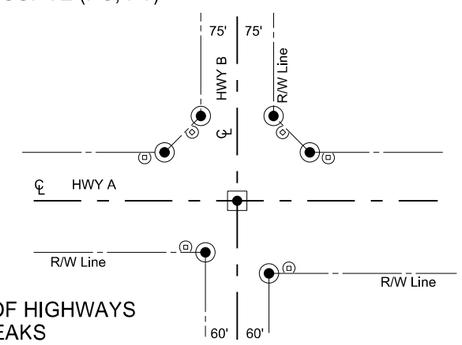
CURVE POINTS:
PI
SPIRAL CURVE (TS, ST)
SIMPLE CURVE (PC, PT)



DIVIDED HIGHWAYS
SECTION CORNERS
QUARTER CORNERS



SECTION CORNERS
QUARTER CORNERS



INTERSECTION OF HIGHWAYS
FLARED R/W BREAKS

LEGEND

- Iron Pin Reference Monument
- R/W Marker (witness post)
- Alignment Monument
- Iron Pin R/W Monument

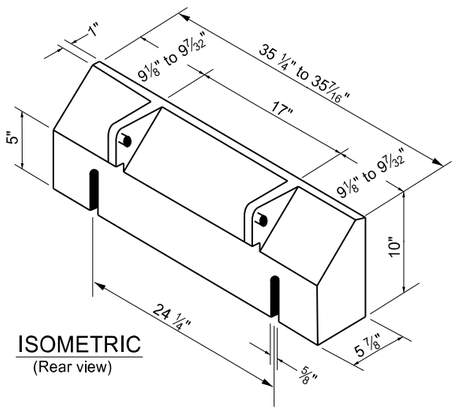
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-3-2013	
REVISIONS	
DATE	CHANGE
11/12/13	Note for SIGN DETAIL modified to meet ASTM D-4956 Type III or higher on 80 gauge 5052-H38
10/17/17	Updated to active voice.
08/27/19	New Design Engr PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/27/19 and the original document is stored at the North Dakota Department of Transportation

INLET - TYPE 2

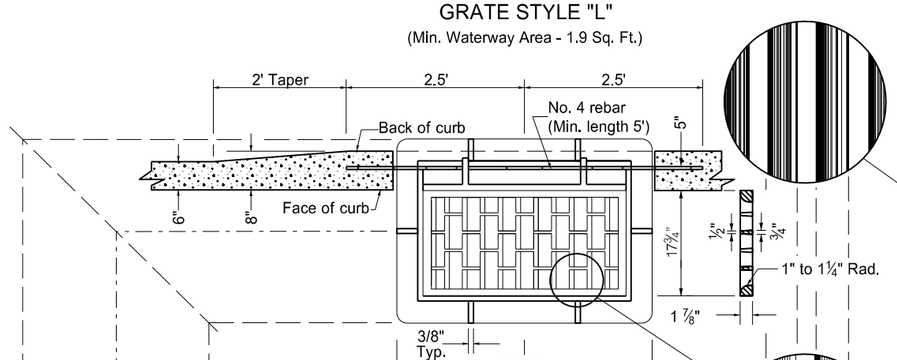
D-722-2

Pay Items
Inlet - Type 2 .....Ea.
Inlet - Type 2, Double.....Ea.

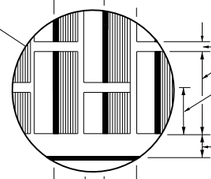


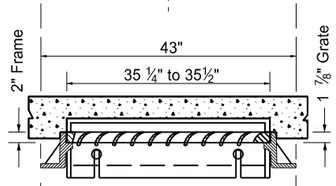
ISOMETRIC
(Rear view)

GRATE STYLE "L"
(Min. Waterway Area - 1.9 Sq. Ft.)



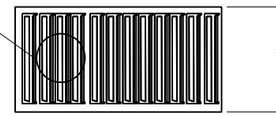
TOP



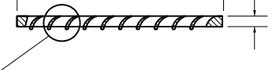


FRONT

GRATE STYLE "V"
(Min. Waterway Area - 2.4 Sq. Ft.)

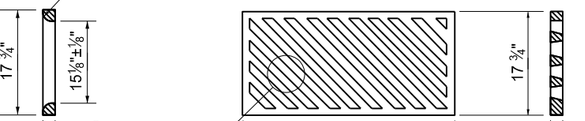


TOP



FRONT

GRATE STYLE "D"
(Min. Waterway area - 1.6 Sq. Ft.)



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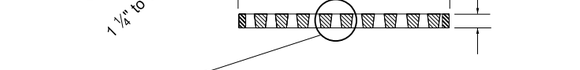
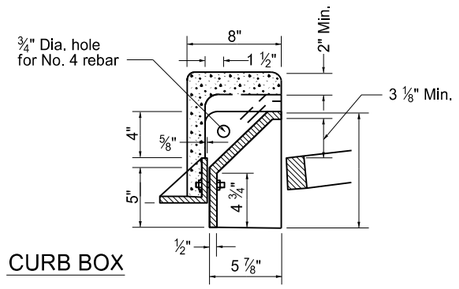
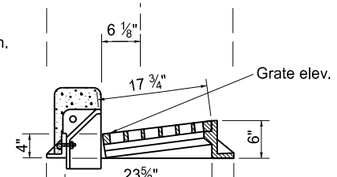


FRONT

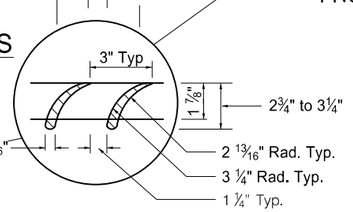


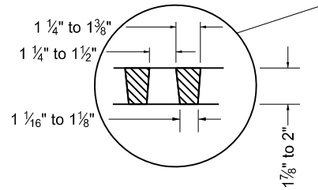
CURB BOX



SIDE

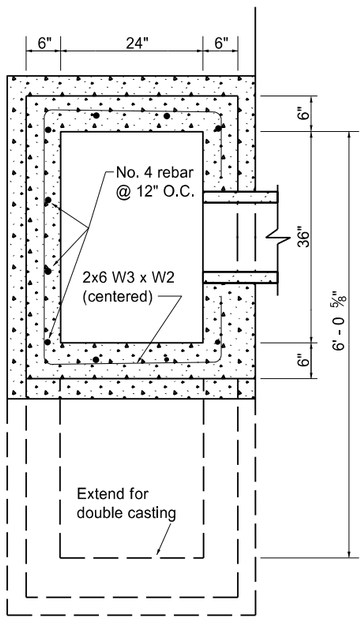
CASTING DETAILS





Notes:

1. Drainage structure castings shall be manufactured in accordance with AASHTO M306. Metal used in the manufacture of castings shall conform to AASHTO M105 Class 35B.
2. Other castings, similar in dimension, may be used if the casting conforms to the riser section and has the grate style as specified in the plans. If modifications to the inlet riser are required to accomodate similar castings, the contractor must receive written approval from the engineer.
3. Precast risers shall be constructed in accordance with ASTM C858.
4. The contractor shall have the option of using precast or poured in place bases. Cast in place concrete shall be Class AE-3. Construction shall be in accordance with section 722 of the Standard Specifications.
5. On projects with P.C.C. pavement, all inlet risers or barrels shall be constructed 4 to 5 inches below final elevation and adjusted to final grade after paving. Adjustment may be done with adjusting rings or cast-in-place concrete. All costs for this adjustment shall be included in the price bid for the inlet.
6. Welded wire reinforcing fabric shall conform to AASHTO M55 Grade 65.
7. The deformed reinforcing steel shall conform to AASHTO M31.



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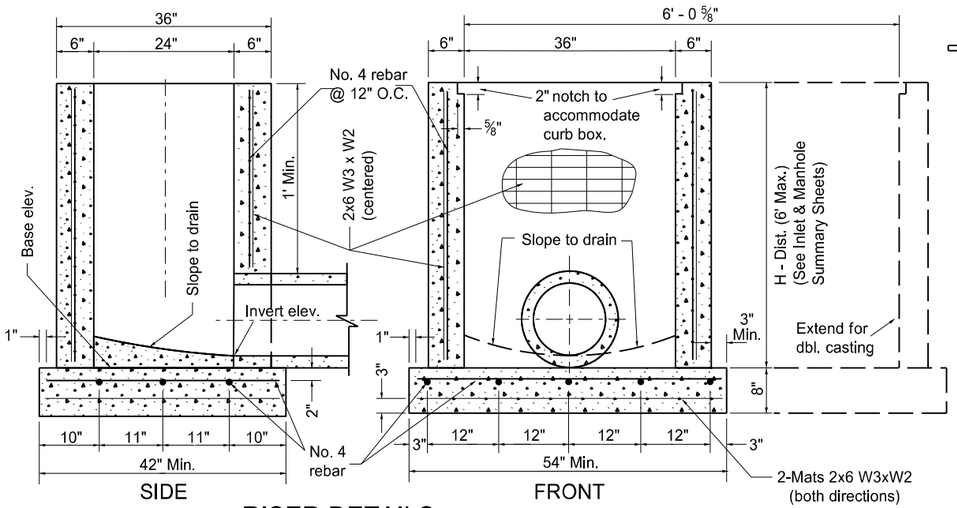
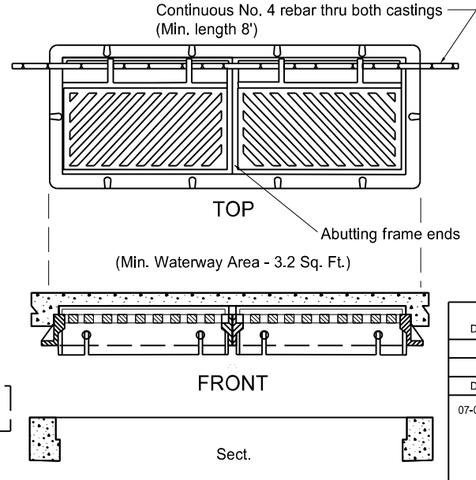


SIDE

FRONT

RISER DETAILS



TOP

FRONT

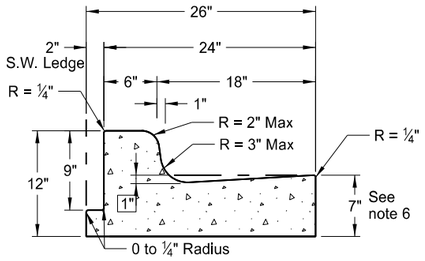
INLET - TYPE 2 - DOUBLE

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
05-12-14	
REVISIONS	
DATE	CHANGE
07-07-14	Revised Note 4

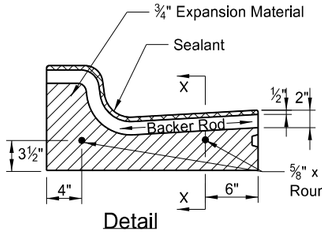
This document was originally issued and sealed by TERRENCE R. UDLAND Registration Number PE- 2674, on 07/07/14 and the original document is stored at the North Dakota Department of Transportation

Curb & Gutter and Valley Gutter

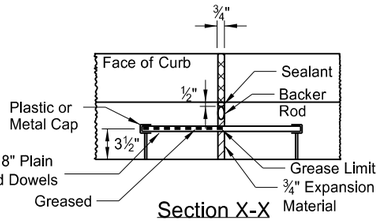
D-748-1



Curb & Gutter Type 1 (Sec. A & B)
Adjacent to Concrete Sidewalk, Median, or Parking Lot.
(Sec. A shown. See Sec B for additional details.)

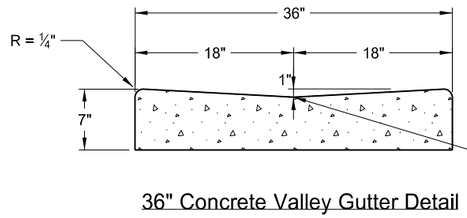


Detail

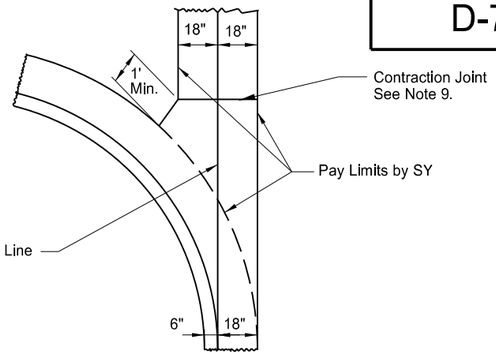


Section X-X

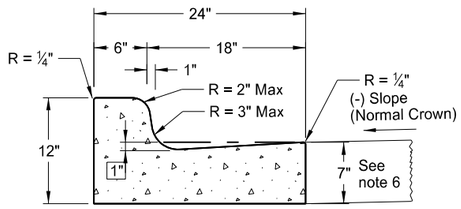
Isolation Joint



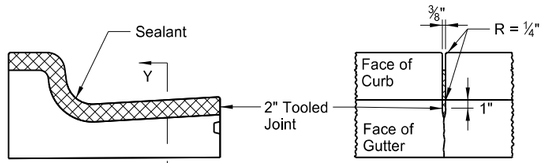
36" Concrete Valley Gutter Detail



36" Concrete Valley Gutter Plan



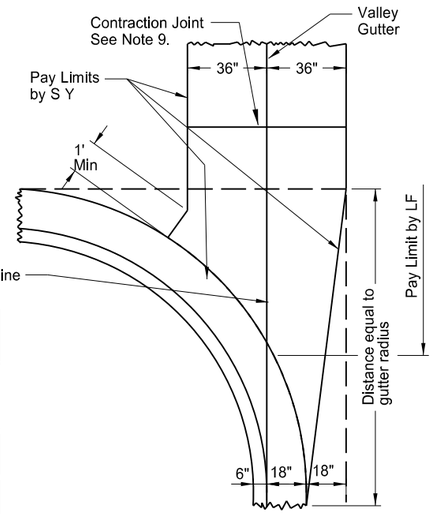
Curb & Gutter Type 1 (Sec. A)



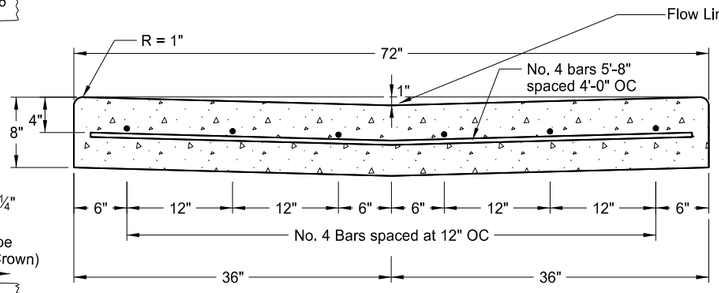
Detail
(10' Max Spacing)

Section Y-Y

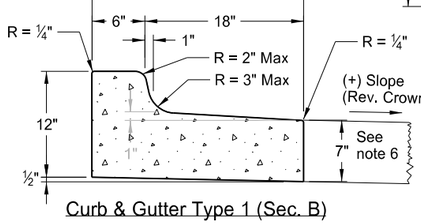
Contraction Joint



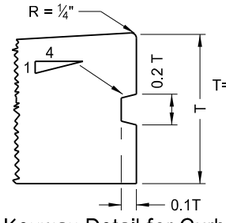
72" Concrete Valley Gutter Plan



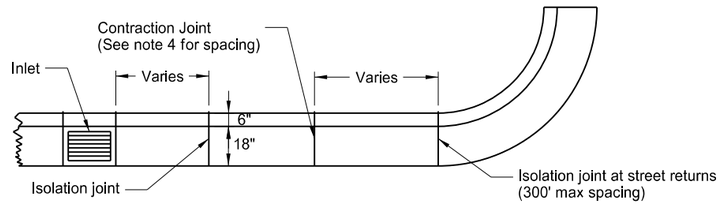
72" Concrete Valley Gutter Detail



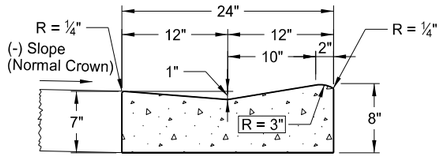
Curb & Gutter Type 1 (Sec. B)



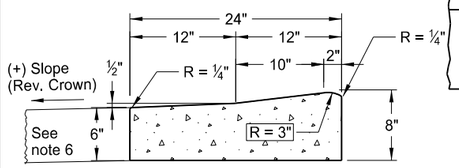
Keyway Detail for Curb & Gutter
(To be used with PCC Pavement and Drives)



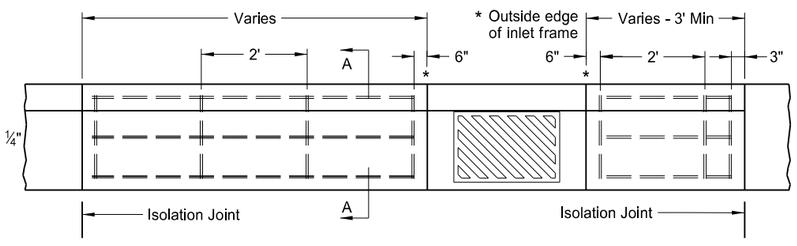
Joint Location Detail



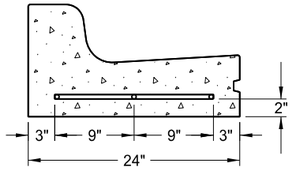
Mountable Curb & Gutter Type 1 (Sec. A)



Mountable Curb & Gutter Type 1 (Sec. B)



Curb & Gutter Reinforcing at Inlets



Section A-A

NOTE: Use #4 deformed reinforcing bars without splices. Include all costs for reinforcing bars at inlet locations (even inlets located on radii) in the price bid for "Curb and Gutter - Type 1." Extend reinforcement to the second joint (rebar placed through the first joint) in cases where the 3' min. panel length cannot be obtained.

NOTES:

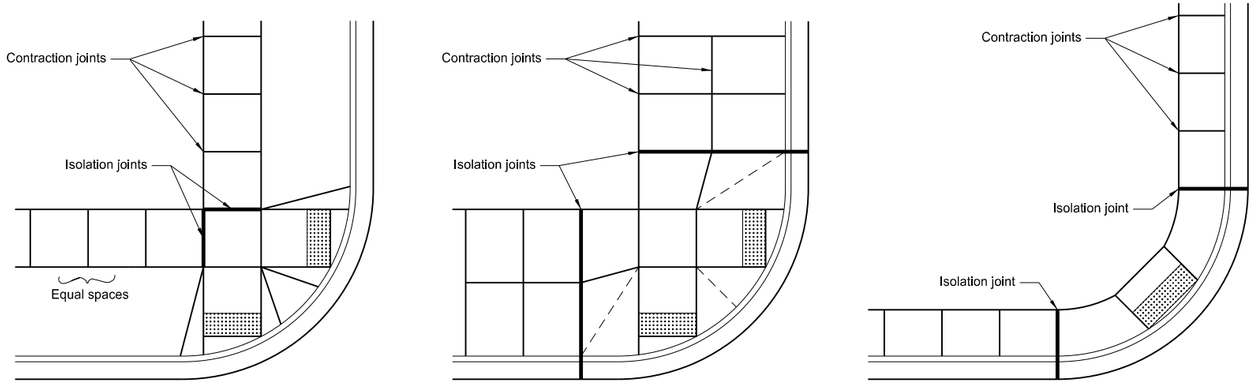
1. Use Curb and Gutter Type 1 (Sec. A & B). Use section "A" with (-) pavement slopes and section "B" with (+) pavement slopes.
2. Contraction Joints: Tool the Curb & Gutter 2" as shown on the contraction joint details.
3. Isolation Joints: Use ¾" expansion joint filler for isolation joint material. Form the backer rod and joint sealant opening with a pre-cut piece of wood or other material approved by the engineer. Dowel supports are not required on the second pour at a cold joint. Install plastic or metal caps and greased dowels in the cold joint for the second pour.
4. Joint Spacing: For hot bituminous pavements use a 10' max joint spacing for the curb and gutter with panels on each side of the inlets. For concrete pavements match the joint spacing for the curb and gutter to the pavement joint on PCC Pavements (approximately 15' spacing.)
5. Joint sealing: Seal contraction and isolation joints as shown in the details. Use joint sealant for contraction joints that conforms to section 826.02B. Use sealant for expansion joints specified in note 3 above. Tool and install sealant in accordance with the manufacturer's recommendations.
6. Face of Gutter Depth: For hot bituminous pavement use 7" gutter depth as shown. For PCC pavements, match the gutter depth to the depth of adjacent PCC pavement or to construct a 7" depth as shown.
7. Tie curb and gutter to abutting PCC pavement with No. 3 bars, 1'-6" in length, spaced at 4' centers.
8. On street returns and other locations where new curb and gutter ends and does not abut existing curb and gutter, taper the last two (2) feet of the curb from 6" in height to 0". Install a 1/2" premolded full depth isolation joint, the same shape as the curb and gutter just ahead of the taper. Install an 18" tie bar across the joint.
9. Valley Gutter Joints: Form, saw, or score ⅛" min. to ⅜" max. width contraction joints (a minimum 2" depth) at approx 10' intervals. Seal the joints with hot poured elastic type joint sealer (Section 826.02A.2 of the Standard Specifications.) Include all costs for the joint and sealant in the price bid for Valley Gutter.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
8-7-2013	
REVISIONS	
DATE	CHANGE
10-17-17	Updated to active voice.
08-27-19	New Design Engr PE Stamp.

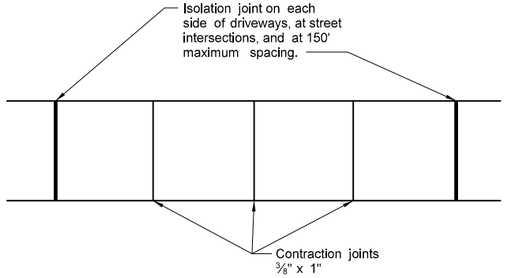
This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8-27-19 and the original document is stored at the North Dakota Department of Transportation

SIDEWALK

D-750-2



Typical Joint Layouts



NOTES:

1. Curb ramp and detectable warning panel layouts for informational purposes only. See Standard Drawing D-750-3 for curb ramp and detectable warning panel details.
2. Joint Spacing: Vary transverse contraction joint spacing from 4' to 6' to create approximate square panels.

   Use longitudinal contraction joints when sidewalk width is 8' or greater, and space at half the sidewalk width.

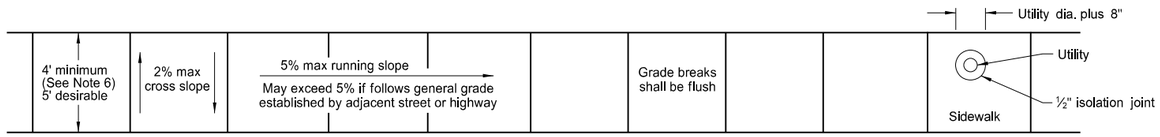
   Saw or groove contraction joints to a minimum depth of 1/3 the depth of the concrete.

   When sidewalk is adjacent to curb & gutter, vary the sidewalk joint spacing to match curb & gutter joints.

   Use isolation joints between separate concrete pours, or between old and new concrete.
3. Include all costs for labor, equipment, and material necessary to construct contraction and isolation joints in the price bid for sidewalk concrete.
4. Use 4" sidewalk concrete thickness unless otherwise specified.
5. Use 4" base material thickness unless otherwise specified. Include all costs for labor and materials necessary to place the base material in the price bid for "Salvage Base Course" or "Aggregate Base Course CL 5."

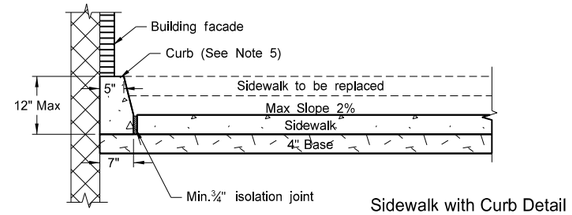
   Modify existing ground slope with landscaping as needed. If not possible, such as adjacent buildings, use a vertical curb as shown in the detail below. The Engineer will measure curb at the unit price bid for "Curb - Type I" per lineal foot.
6. Sidewalk Width & Grade: Provide a continuous 4' min clear width pedestrian access route with max 2% concrete cross slope, excluding flares. The width of the curb cannot be counted as part of the pedestrian access route.

   When clear width of pedestrian access routes is less than 5.0', provide passing spaces at a maximum of 200' with a minimum size of 5.0' by 5.0'.

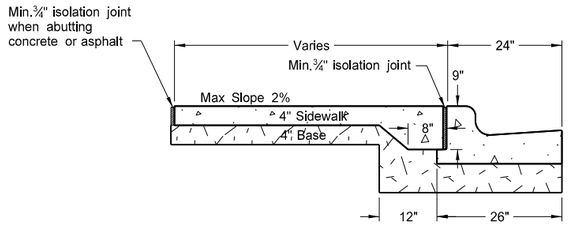


Sidewalk Width and Grade

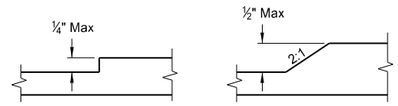
Utility Blockout



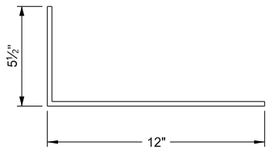
Sidewalk with Curb Detail
(Building face application)



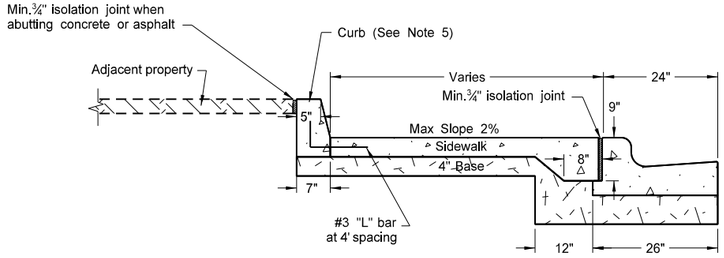
Sidewalk Detail
(Installed adjacent to curb and gutter)



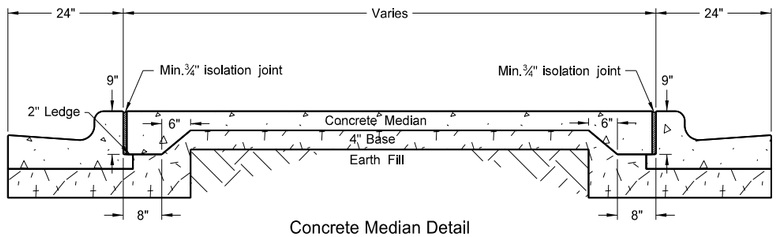
Vertical Discontinuities
(As needed for utility covers, vaults, grating, etc..)



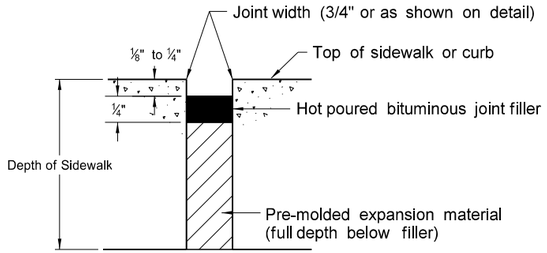
"L"Bar Detail
#3 Bar



Sidewalk with Curb Detail
(Adjacent property application)



Concrete Median Detail



Typical Isolation Joint Seal
(longitudinal and transverse)

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
11-26-13	
REVISIONS	
DATE	CHANGE
10-17-17	Updated to active voice.
09-05-18	Added sidewalk details for width and grade and passing lane requirements.
08-27-19	New Design Engineer PE Stamp.

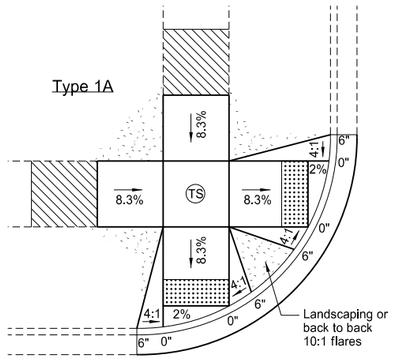
This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 08/27/19 and the original document is stored at the North Dakota Department of Transportation

CURB RAMP DETAILS

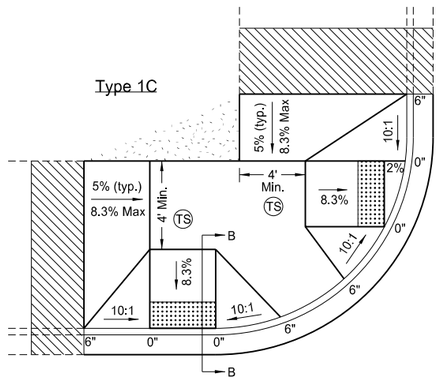
D-750-3

+More Right of Way — Less Right of Way-

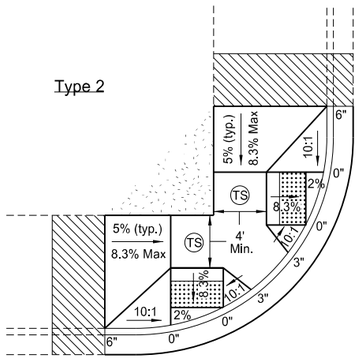
Type 1A



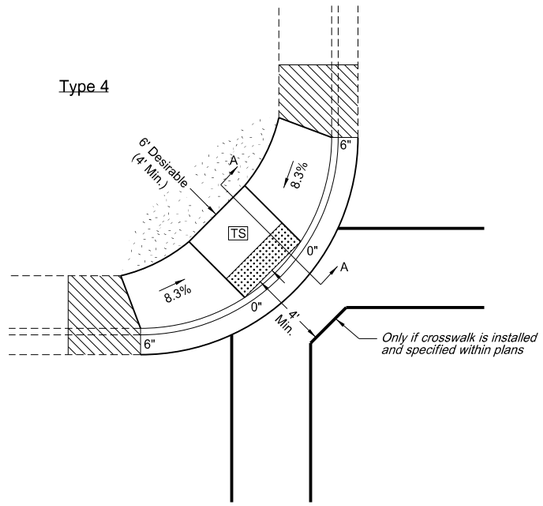
Type 1C



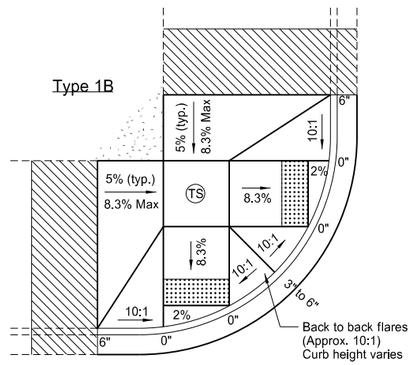
Type 2



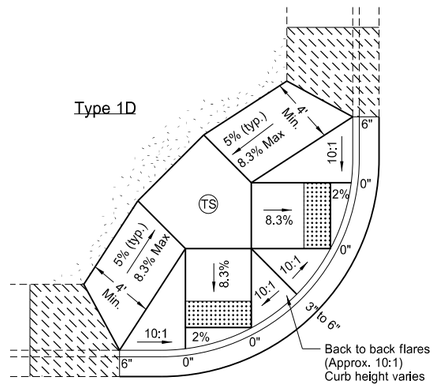
Type 4



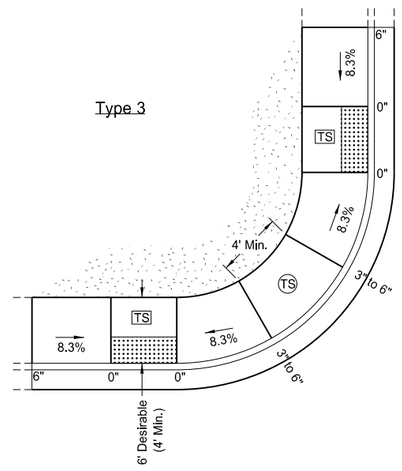
Type 1B



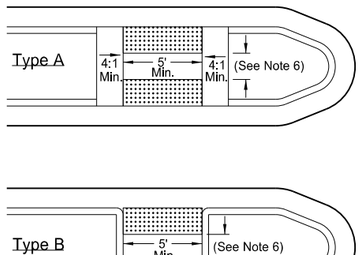
Type 1D

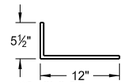


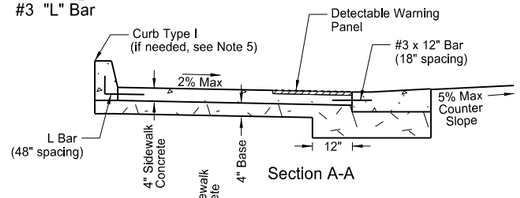
Type 3

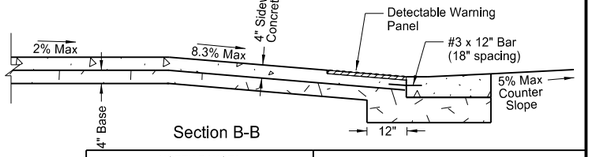


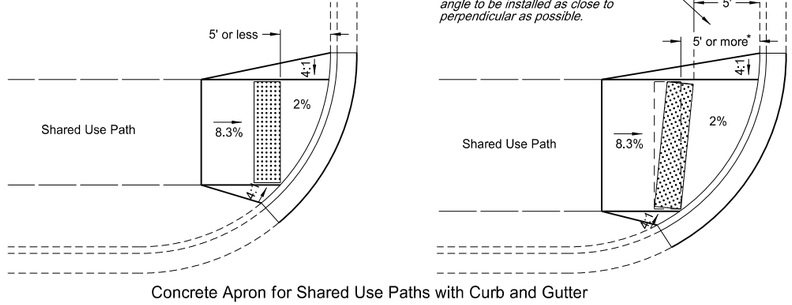
Median Refuge Islands (Cut-Through)



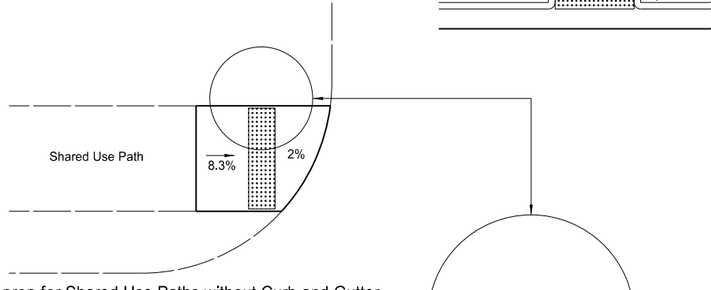




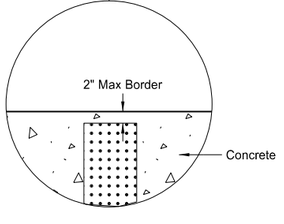


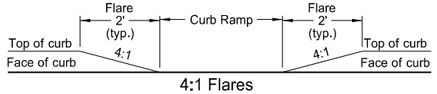


Concrete Apron for Shared Use Paths with Curb and Gutter

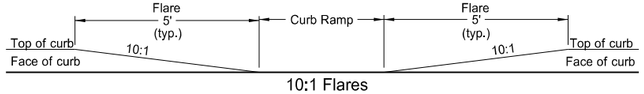


Concrete Apron for Shared Use Paths without Curb and Gutter





4:1 Flares
(To be used when flare is adjacent to landscaping)



10:1 Flares
(To be used when flare is adjacent to sidewalk)

NOTES:

1. Ramp width is the useable portion of the ramp, excluding flares. Match curb ramp width to existing sidewalk width (4' minimum or 5' for island ramps.) Match ramp width to existing shared use path width. Maximum ramp length is 15'.
2. Desirable turning space size is 5' x 5' or larger with a minimum size of 4' x 4'. The maximum slope for turning spaces is 2% in any direction.
3. Match detectable warning panel width to ramp width. Radial panels are allowed. Place detectable warning panel within the lower turning space.
4. Provide a continuous 4' minimum width pedestrian access route with max 2% concrete cross slope, excluding flares.
5. Modify existing ground slope with landscaping, as needed. If not possible, such as adjacent buildings, use a vertical curb as shown in the detail below. The Engineer will measure curb at the unit price bid for "Curb - Type I" per lineal foot.
6. Islands: If the grade of the island curb ramp is less than 2%, provide a minimum distance of 2' between warning panels. If the grade of the island curb ramp is steeper than 2%, provide a turning space between the ramps.

LEGEND:

- : Detectable Warning Panel
- : Landscaping
- : Transitional tie-in segment if needed for retrofits. Max grade slope 8.3%.
- TS : Upper Turning Space
- TS : Lower Turning Space
- 0", 3", or 6" : Curb Height
- 8.3% : All slopes shown are max grades. Flatter slopes may be used.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

11-26-13

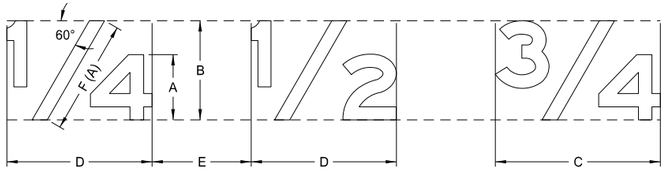
REVISIONS

DATE	CHANGE
10-17-17	Updated to active voice.
09-05-18	Revised Notes, Revision for Turning Space, Added Passing Space Requirements, Turned Detectable Warning Panel

This document was originally issued and sealed by Roger Weigel, Registration Number PE-2930, on 09-05-2018 and the original document is stored at the North Dakota Department of Transportation

LETTER AND ARROW DETAILS

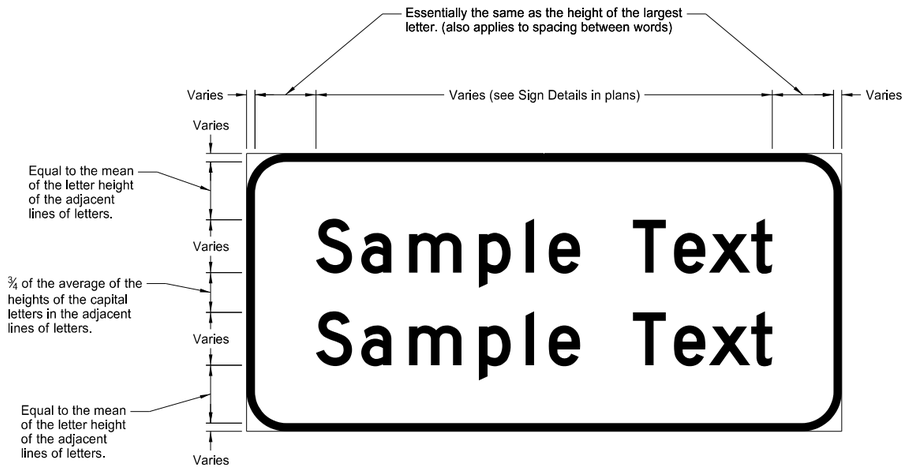
D-754-9



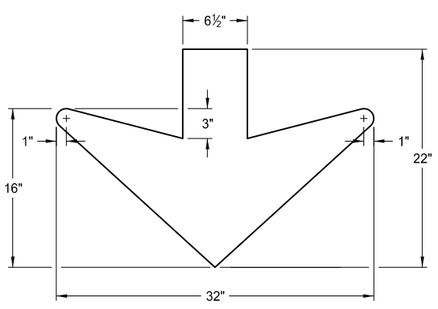
DETERMINE SIZE OF THE FRACTION AS FOLLOWS:

SYMBOL	TITLE	RATIO TO HEIGHT OF CAPITAL OR UPPER CASE
A	Letter height	1.0 of capital or upper case
B	Fraction height	1.5 X A
C	Fraction width	2.5 X A
D	Fraction width	2 X A
E	Space to next character	1 to 1.5 X A
F(A)	Length of diagonal	1.75 X A

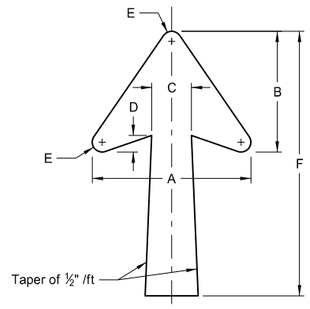
(A) Center diagonal stroke of fraction optically.



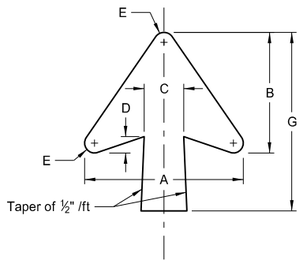
TYPICAL SPACING



DOWN ARROW



TYPE A

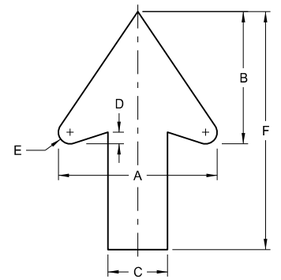


TYPE B

DESIGNATION	LETTER SIZE (Upper Case)	A	B	C	D	E	F	G
ND_6IN	6"	12"	9.125"	3"	1"	0.625"	20"	13.5"
ND_8IN	8"	15.125"	11.563"	3.75"	1.313"	0.813"	25"	17"
ND_10IN	10"	18.25"	14"	4.5"	1.5"	0.75"	30"	20"
ND_12IN	12"							
ND_13IN	13.3"							
ND_16IN	16"	22.25"	17"	5.375"	1.75"	1"	35"	25"
ND_20IN	20"							

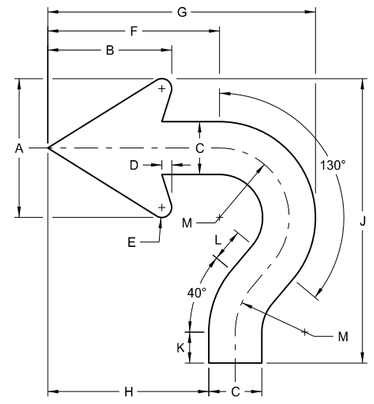
NOTE: Arrow size on gore signs is based on the letter size of "EXIT".

NOTE: Measure rotation angle of arrows counterclockwise from positions shown in details.



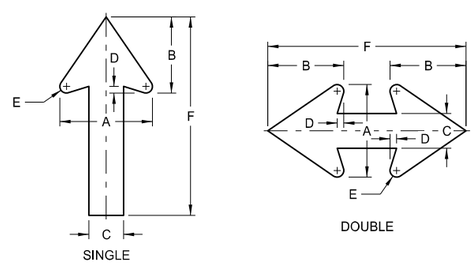
TYPE D

DESIGNATION	LETTER SIZE (Upper Case)	A	B	C	D	E	F
ND_2IN	2"	2"	1.625"	0.75"	0.125"	0.125"	3"
ND_4IN	4"	4"	3.313"	1.5"	0.25"	0.25"	6"
ND_6IN	6"	6"	4.875"	2.25"	0.375"	0.375"	9"
ND_8IN	8"	8"	6.625"	3"	0.5"	0.5"	12"
ND_10IN	10"	10"	8.375"	3.75"	0.75"	0.75"	15"
ND_12IN	12"	12"	10"	4.5"	0.875"	0.875"	18"



ROUNDABOUT

DESIGNATION	LETTER SIZE (Upper Case)	A	B	C	D	E	F	G	H	J	K	L	M
ND_6IN	6"	5.25"	4.688"	2"	0.375"	0.375"	6.5"	10.125"	6.094"	10.75"	1.168"	1.25"	2.625"
ND_8IN	8"	7"	5.75"	2.625"	0.5"	0.5"	8.688"	13.5"	8.166"	14.333"	1.557"	1.667"	3.5"



SPECIAL

DESIGNATION	A	B	C	D	E	F	USES
ND_0.75IN	2"	1.625"	0.75"	0.125"	0.125"	7.75"	Parking Signs (Regulatory)
ND_2.625IN	7"	5.75"	2.625"	0.5"	0.5"	15"	Frontage Road Signs

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

8-3-11

REVISIONS

DATE	CHANGE
7-8-14	Revised gore sign and added 4" D & D arrow
5-4-16	Revised Distance & Destination and Typical Spacing details
4-23-18	Revised arrow details
8-30-18	Updated notes to active voice.
8-29-19	New Design Engr PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/29/19 and the original document is stored at the North Dakota Department of Transportation

PERFORATED TUBE ASSEMBLY DETAILS

D-754-23

Notes:

1. Curbed Roadways: Use a 3' clearance from face of the curb except where right of way or sidewalk width is limited; Use a minimum 2' clearance. Increase the horizontal clearance if required to maintain a minimum sidewalk clear width of 4' from the sign support, not including any attached curb.

2. Minimum vertical clearance: Provide at least 5' measured from the bottom of the sign to the edge of the driving lane or auxiliary lane at the side of the road in rural districts. Provide at least 7' clearance to the bottom of the sign, where parking or pedestrian movements occur.

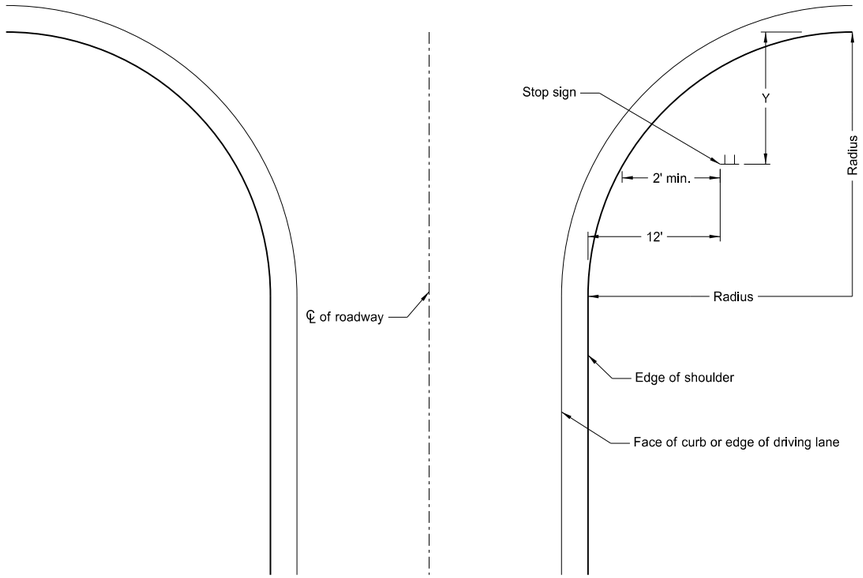
   Install signs on expressways a minimum height of 7'.

   Install adopt-a-highway signs on Freeways at least 7' above the edge of the driving lane.

   Maximum vertical clearance is 6" greater than the minimum vertical clearance.

3. Offset signs: Use a vertical clearance of 5' above the edge of the driving lane for signs placed 30 feet or more from the edge of the traveled way.

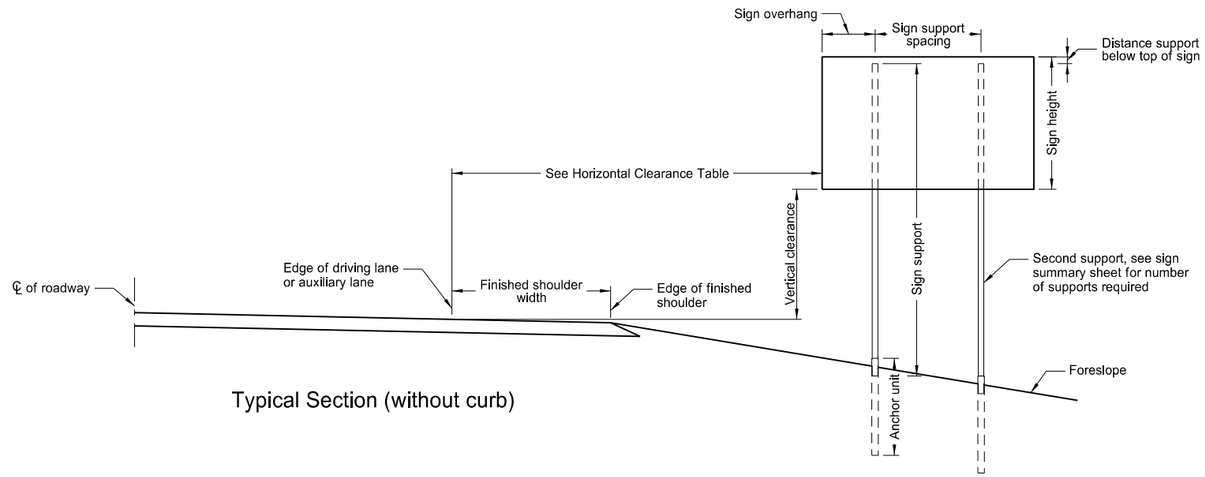
4. Provide a horizontal clearance from edge of shared use path to edge of sign of 3', except where width is limited. Provide a minimum clearance of 2'.



Stop Sign Location
Wide Throat Intersection

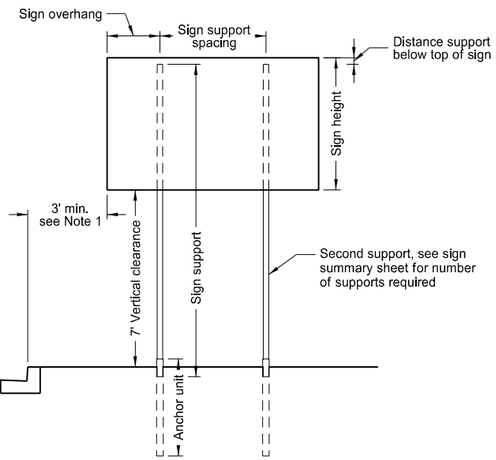
Use layout for the placement of "Stop" signs.

Radius ft.	Y-max. ft.	Y-min. ft.
40	50	15
45	50	18
50	50	21
55	50	25
60	50	28
65	50	32
70	50	35
75	50	39
80	50	43



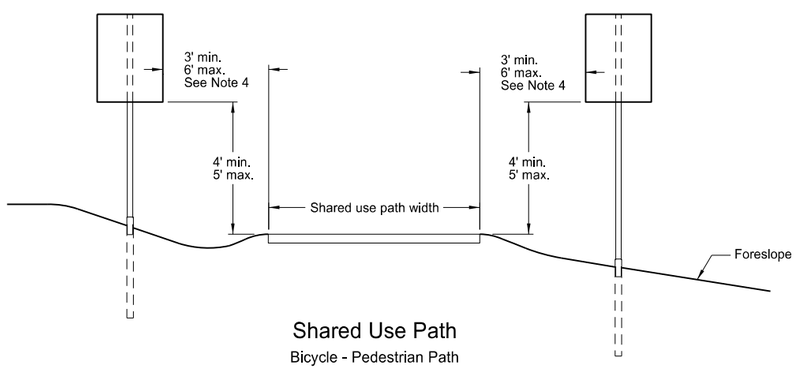
Typical Section (without curb)

Horizontal Clearance Table	
Shoulder Width ft	Offset ft
0 to 2	16
>2 to 4	18
>4 to 6	20
>6 to 8	22
>8 to 10	24



Typical Section (with curb)

Residential or Business District



Shared Use Path

Bicycle - Pedestrian Path

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-3-13	
REVISIONS	
DATE	CHANGE
7-8-14	Revised note 2, added note 4.
8-30-18	Updated notes to active voice.
8-29-19	New Design Engineer PE Stamp.

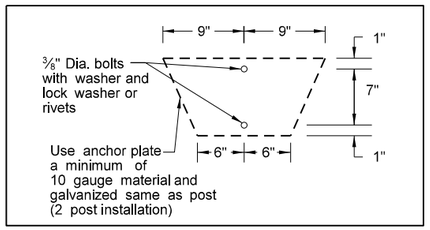
This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/29/19 and the original document is stored at the North Dakota Department of Transportation

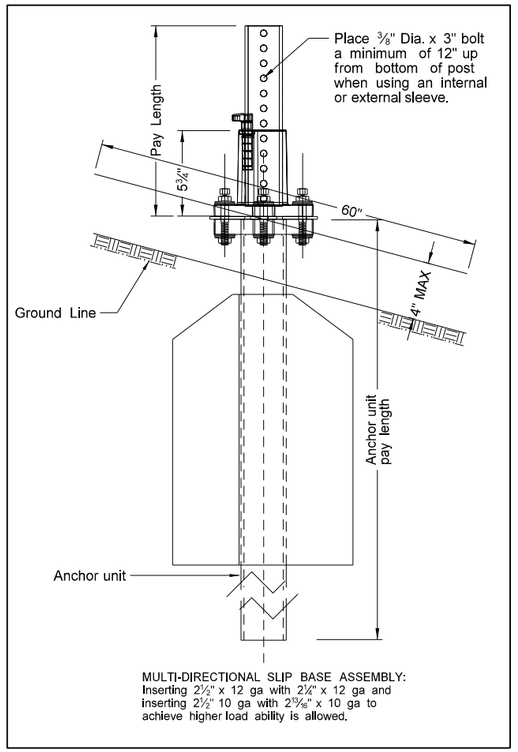
Mounting Details Perforated Tube

D-754-24

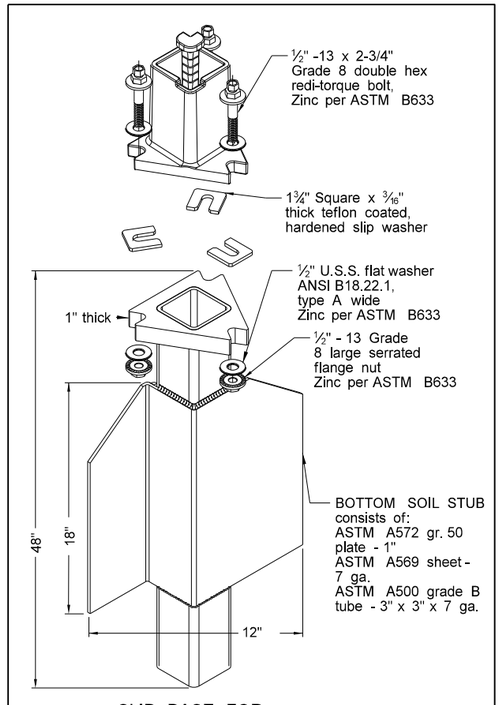
Number of Posts	Telescoping Perforated Tube						
	Post Size In.	Wall Thick-ness Gauge	Sleeve Size In.	Wall Thick-ness Gauge	Slip Base	Anchor Size Without Slip Base In.	Anchor Wall Thick-ness Gauge
1	2	12			No	2¼	12
1	2¼	12			No	2½	12
1	2½	12			(B)	3(C)	7
1	2½	10			Yes		7
1	2¼	12	2½(D)	12	Yes		7
1	2½	12	2¼	12	Yes		7
2	2½	10			Yes		7
2	2¼	12	2½(D)	12	Yes		7
2	2½	12	2¼	12	Yes		7
3 & 4	2½	12			Yes		7
3 & 4	2½	10			Yes		7
3 & 4	2½	12	2¼	12	Yes		7
3 & 4	2¼	12	2½(D)	12	Yes		7
3 & 4	2½	10	2⅜16	10	Yes		7

(B) - Provide a shim as specified by the manufacturer when placing 2½", 12 gauge posts in standard soils without breakaway bases. Provide breakaway base when placing the support in weak soils. The Engineer will determine if the soils are weak. Weak soils are classified as boggy, wet, or loose soil areas.
(C) - 3" anchor unit
(D) - 2½" x 12 ga. x 18" minimum length external sleeve required.

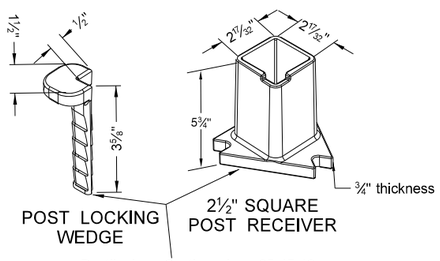




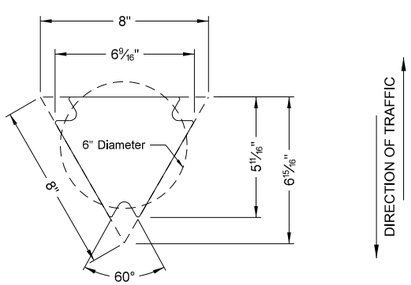
MULTI-DIRECTIONAL SLIP BASE ASSEMBLY:
Inserting 2½" x 12 ga with 2¼" x 12 ga and inserting 2½" 10 ga with 2⅜16" x 10 ga to achieve higher load ability is allowed.



SLIP BASE FOR 2½" POST



Ductile Iron Casting class 65-45-12.
Hot Dip Galvanize ASTM A153



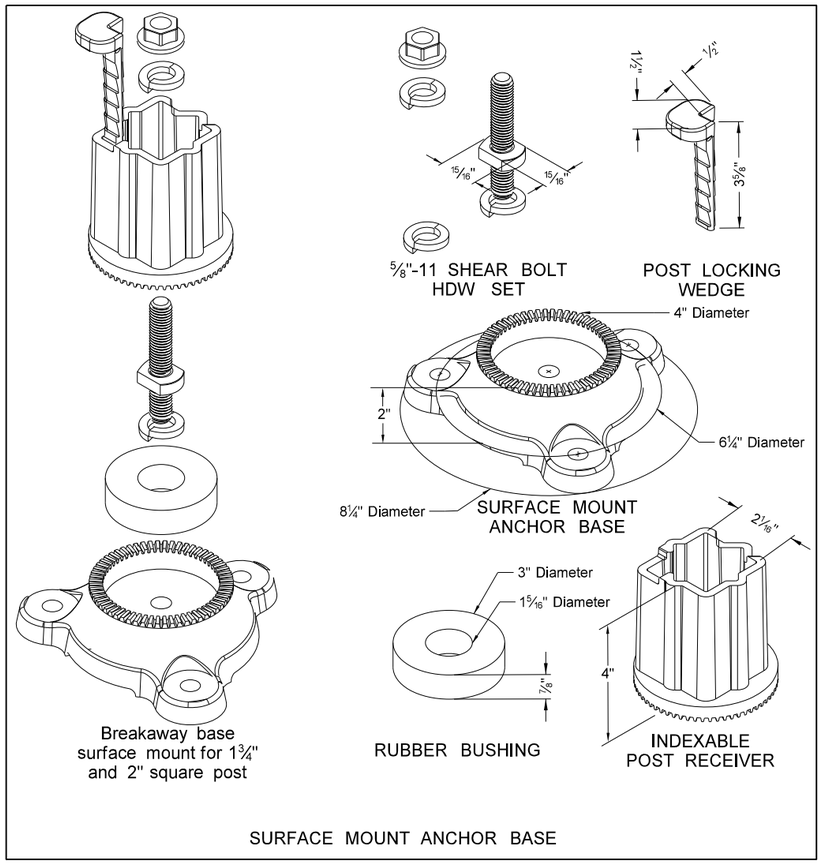
SLIP BASE DETAIL

Properties of Telescoping Perforated Tubes						
Tube Size In.	Wall Thickness in.	U.S. Standard Gauge	Weight Per Foot Lbs.	Moment of Inertia In.⁴	Cross Sect. Area In.²	Section Modulud In.³
1½ x 1½	0.105	12	1.702	0.129	0.380	0.172
2 x 2	0.105	12	2.416	0.372	0.590	0.372
2¼ x 2¼	0.105	12	2.773	0.561	0.695	0.499
2⅜16 x 2⅜16	0.135	10	3.432	0.605	0.841	0.590
2½ x 2½	0.105	12	3.141	0.804	0.803	0.643
2½ x 2½	0.135	10	4.006	0.979	1.010	0.783

The 2 ⅜16" size 10 gauge is shown as 2.19" size on the plans;
The 2½" size is shown as 2.51" size on the plans.

NOTE:

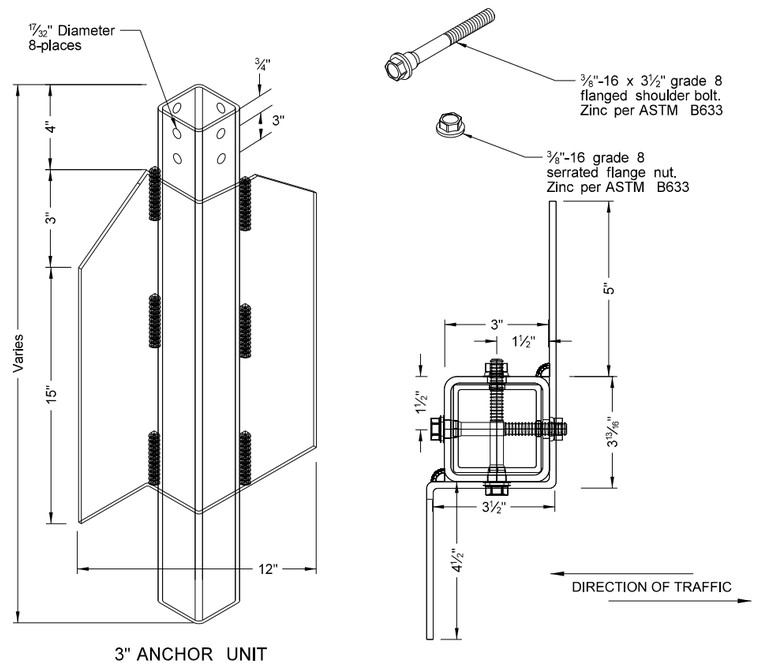
1. 4" Vertical clearance of anchor or breakaway base. The 4" x 60" measurement is above and below post location and also back and ahead of post.
2. Provide 7 guage HRPO commmercial quality ASTM A569 and 3" x 3" x 7" guage ASTM A500 grade B anchor material with 43.9 KSI yield strength and 59.3 KSI tensile strength. Hot dip galvanize anchor per ASTM A123/153. Tolerances on anchor unit and slip base bottom assembly are +/- 0.005" unless ortherwise noted.
3. Eliminate wings when anchor is used in concrete sidewalk.
4. Provide a minimum 8' distance between the first and fourth post on four post signs.
5. Install in accordance with manufacturers recommendation.
6. Use a minimum ½" diameter x 4" grade 8 concrete fastener for surface mount breakaway base.



SURFACE MOUNT ANCHOR BASE

SHOULDER BOLT

Shimming agent to reduce tolerance between 3" anchor unit and 2½" post.
(use standard ⅜" diameter grade 8 bolt with proper shim)



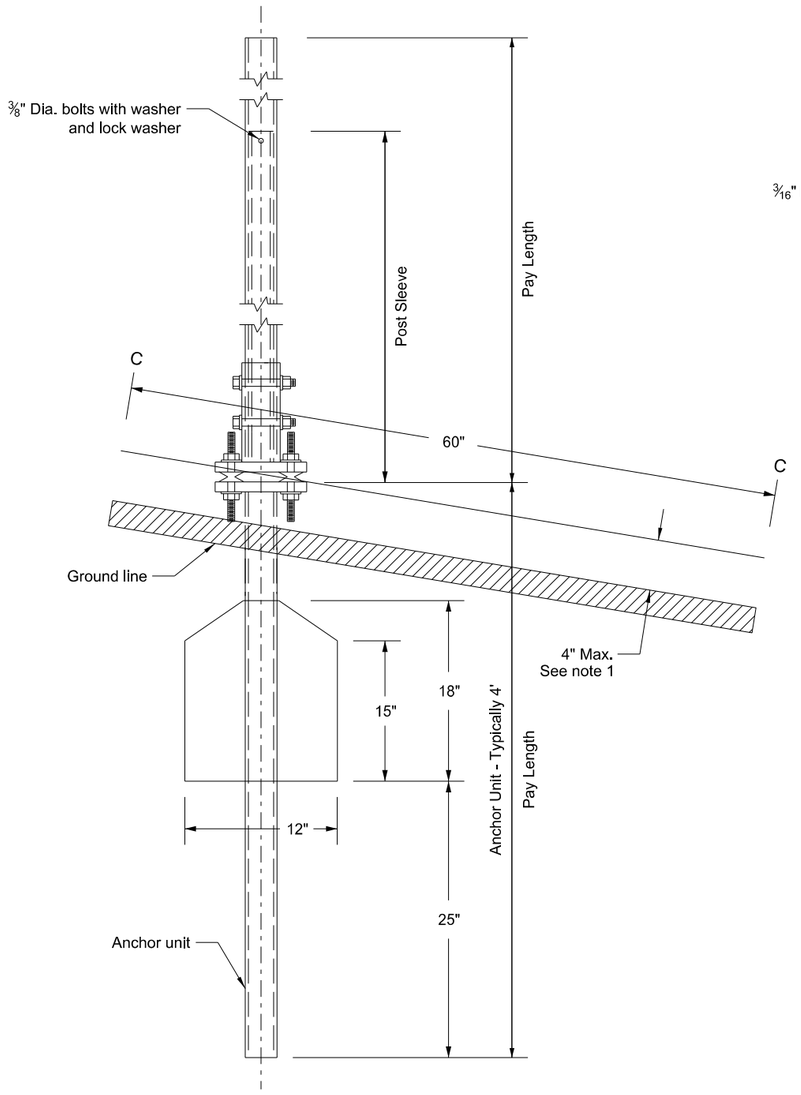
3" ANCHOR UNIT

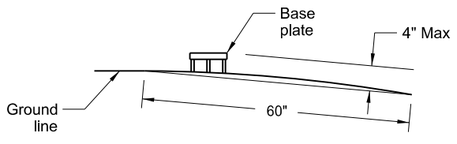
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
8-6-09	
REVISIONS	
DATE	CHANGE
8-30-18	Updated notes to active voice & corrected max height of base.
8-29-19	New Design Engineer PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE- 4683 on 8/29/19 and the original document is stored at the North Dakota Department of Transportation

Breakaway Coupler System for Perforated Tubes

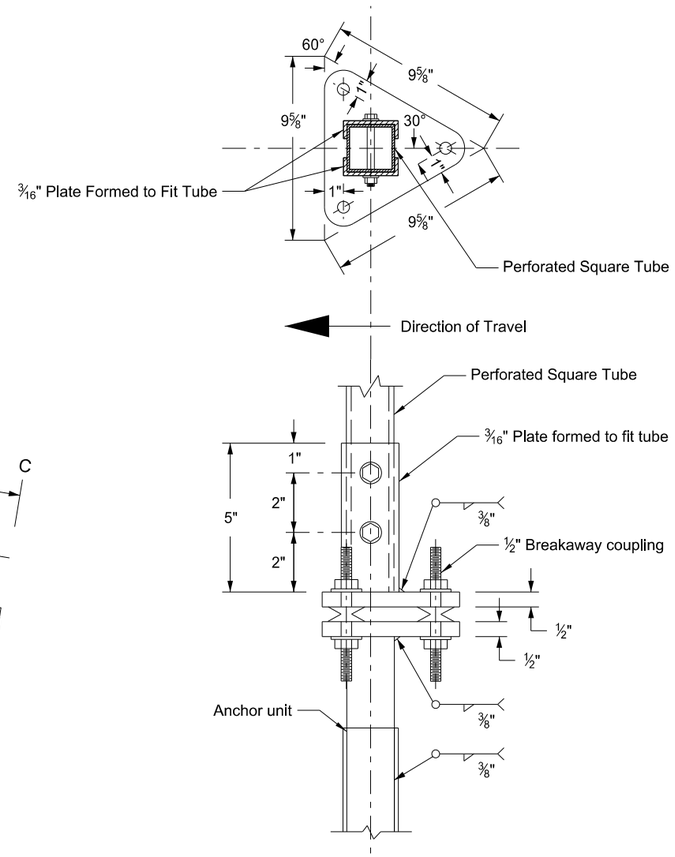
D-754-24A





Section C-C

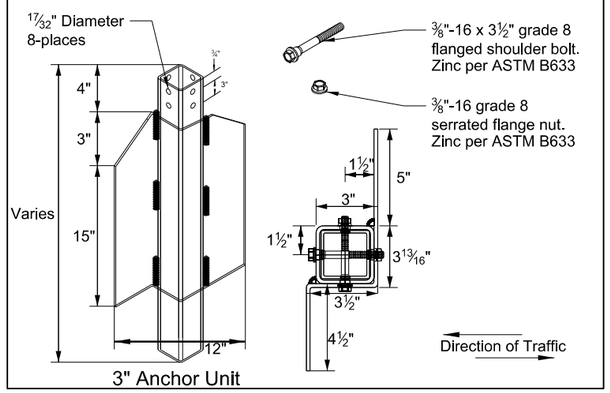
Max protection of the stub post is 4" above a 60" chord aligned radially to the center line of the highway and connecting any point, within the length of the chord, on the ground surface on one side of the support to a point in the ground surface on the other side.



Base Plate with Breakaway Coupler

Shoulder Bolt

Shimming agent to reduce tolerance between 3" anchor unit with 2½" post. (use of standard ⅜" diameter grade 8 bolt allowed with proper shim)



3" Anchor Unit

Notes:

1. 4" Vertical clearance of anchor or breakaway base. The 4" x 60" measurement is above and below post location and also back and ahead of post.
2. Use anchor unit of the same size and specification as the post.
3. Provide a minimum 8' distance between the first and fourth post on four post signs.
4. Use the breakaway base system on standard D-754-24 or the breakaway coupling system manufactured from material meeting the requirements of ASTM A325 fasteners with the special requirements specified by DENT BREAKAWAY IND., INC. which meets the test requirements of NCHRP Report 350.

Number of Posts	Telescoping Perforated Tube						
	Post Size In.	Wall Thick-ness Gauge	Sleeve Size In.	Wall Thick-ness Gauge	Slip Base	Anchor Size Without Slip Base In.	Anchor Wall Thickness Guage
1	2	12			No	2¼	12
1	2¼	12			No	2½	12
1	2½	12			(B)	3(C)	7
1	2½	10			Yes		7
1	2¼	12	2	12	Yes		7
1	2½	12	2¼	12	Yes		7
2	2½	10			Yes		7
2	2¼	12	2	12	Yes		7
2	2½	12	2¼	12	Yes		7
3 & 4	2½	12			Yes		7
3 & 4	2½	10			Yes		7
3 & 4	2½	12	2¼	12	Yes		7
3 & 4	2¼	12	2	12	Yes		7
3 & 4	2½	10	2 3/16	10	Yes		7

(B) - 2½" 12 gauge posts do not need breakaway bases unless support is placed in boggy, wet, or loose soil areas.

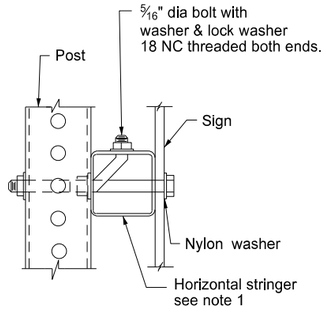
(C) - 3" anchor unit

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-3-2013	
REVISIONS	
DATE	CHANGE
8-30-18	Updated notes to active voice.
8-30-19	New Design Engr PE Stamp.

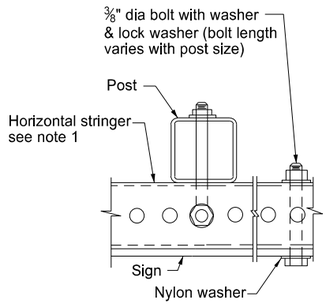
This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/30/19 and the original document is stored at the North Dakota Department of Transportation

Mounting Details Perforated Tube

D-754-25

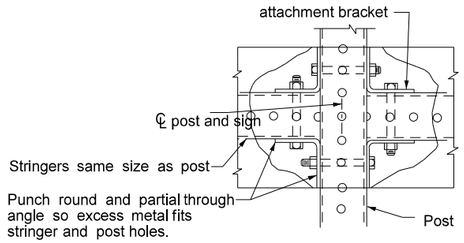


Side View



Top View

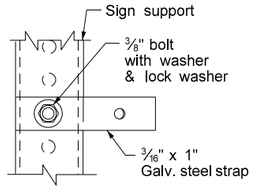
STRINGER MOUNTING
(WITH STRINGER IN FRONT OF POST)



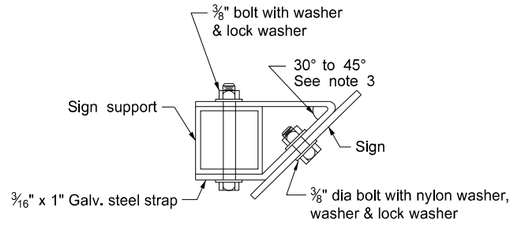
STREET NAME SIGNS AND ONE WAY SIGNS
SINGLE POST ASSEMBLY
ONE STRINGER OR BACK TO BACK MOUNTING

Note:

1. Horizontal stringers - Use perforated tubes or 1¾" x 3/16" thick, 1.08 lbs./ft aluminum or 3.16 lbs./ft steel z bar stringers.
2. Use minimum outside diameter 15/16" ±1/16" and 10 gauge thick metal washers on sign face.
3. Place No Parking signs with directional arrows at a 30 to 45 degree angle with the line of traffic flow. Turning the support to the correct angle for No Parking signs requiring the above angles is allowed. If the No Parking sign is placed with another sign that requires placement at a 90 degree angle with the line of traffic flow, use the detailed angle strap to mount the No Parking sign. Use flat washers and lock washers with all nylon washers.
4. Punching the sign backing and placing the bolt through the sign, the stringer and the post is allowed in lieu of using the bent bolt to attach the post to the stringer.
5. 4" vertical clearance of anchor or breakaway base. The 4" x 60" measurement is above and below post location and also back and ahead of post.

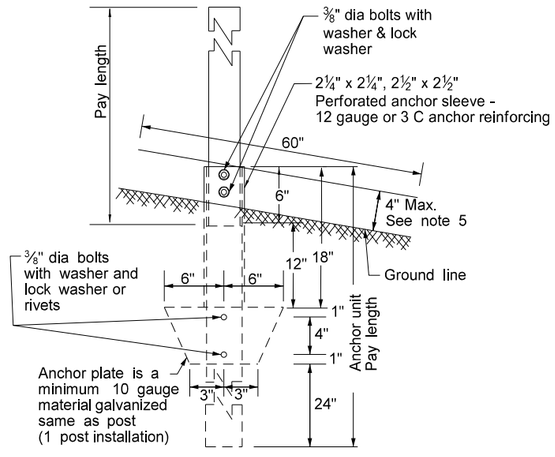


Side View



Top View

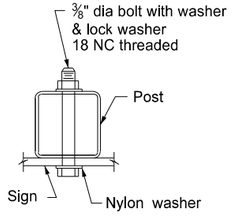
STRAP DETAIL



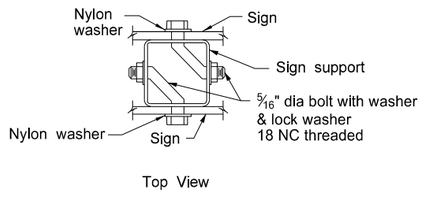
ANCHOR UNIT AND POST ASSEMBLY

Number of Posts	Telescoping Perforated Tube						
	Post Size In.	Wall Thick-ness Gauge	Sleeve Size In.	Wall Thick-ness Gauge	Slip Base	Anchor Size Without Slip Base In.	Anchor Wall Thick-ness Gauge
1	2	12			No	2¼	12
1	2¼	12			No	2½	12
1	2½	12			(B)	3(C)	7
1	2½	10			Yes		7
1	2¼	12	2½(D)	12	Yes		7
1	2½	12	2¼	12	Yes		7
2	2½	10			Yes		7
2	2¼	12	2½(D)	12	Yes		7
2	2½	12	2¼	12	Yes		7
3 & 4	2½	12			Yes		7
3 & 4	2½	10			Yes		7
3 & 4	2½	12	2¼	12	Yes		7
3 & 4	2¼	12	2½(D)	12	Yes		7
3 & 4	2½	10	2 3/16	10	Yes		7

(B) - When placing 2½", 12 gauge posts in standard soils without breakaway bases, provide a shim as specified by the manufacturer. Provide breakaway base when placing the support in weak soils. Engineer will determine if soils are weak. Weak soils are classified as boggy, wet, or loose soil areas.
(C) - 3" anchor unit
(D) - 2½" x 12 ga. x 18" minimum length external sleeve required.

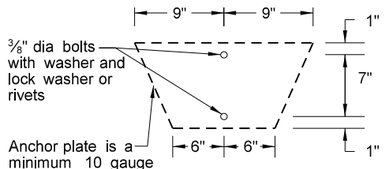


BOLT MOUNTING



Top View

BACK TO BACK MOUNTING



Properties of Telescoping Perforated Tubes						
Tube Size In.	Wall Thickness In.	U.S. Standard Gauge	Weight Per Foot Lbs.	Moment of Inertia In.⁴	Cross Sect. area In.²	Section Modulus In.³
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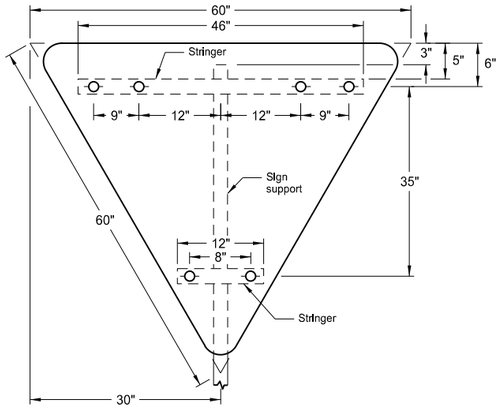
2 x 2	0.105	12	2.416	0.372	0.590	0.372
2¼ x 2¼	0.105	12	2.773	0.561	0.695	0.499
2 3/16 x 2 3/16	0.135	10	3.432	0.605	0.841	0.590
2½ x 2½	0.105	12	3.141	0.804	0.803	0.643
2½ x 2½	0.135	10	4.006	0.979	1.010	0.783

The 2 3/16" size 10 gauge is shown as 2.19" size on the plans.
The 2½" size is shown as 2.51" size on the plans.

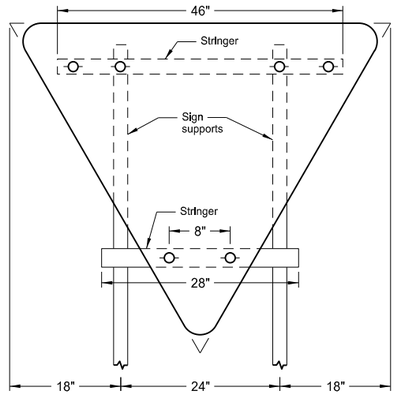
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
8-6-09	
REVISIONS	
DATE	CHANGE
7-8-14	Revised Note 3.
8-30-18	Updated notes to active voice.
8-30-19	New Design Engr PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE- 4683 , on 8/30/19 and the original document is stored at the North Dakota Department of Transportation

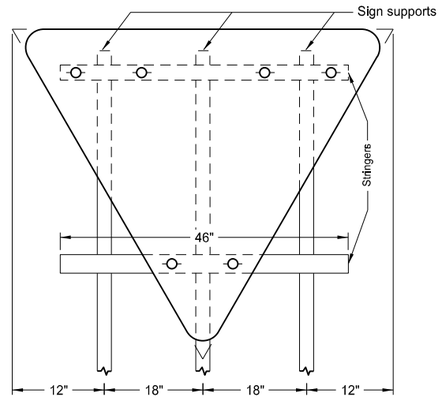
SIGN PUNCHING, STRINGER AND SUPPORT LOCATION DETAILS REGULATORY, WARNING AND GUIDE SIGNS



1 Post



2 Posts

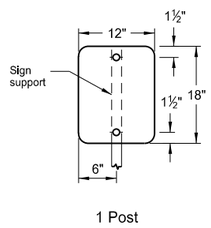


3 Posts

Assembly No. 6

Notes:

1. Use 0.100 inch minimum thickness sign backing material.
2. Use 1½" x 1½" perforated square tube stringers.
3. Punch holes round for ⅜" bolt.



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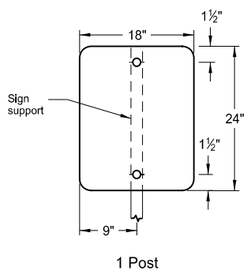
Assembly No. 7



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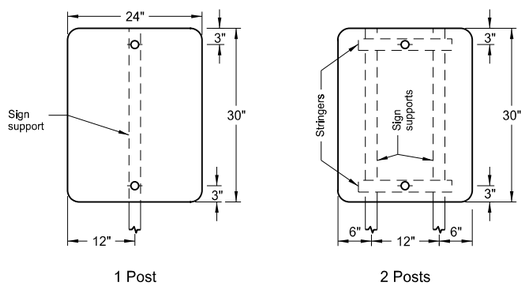
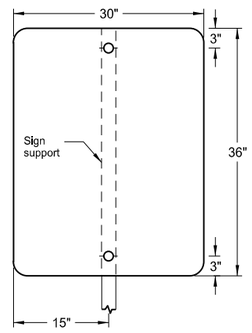
Assembly No. 8



1 Post

2 Posts

Assembly No. 9



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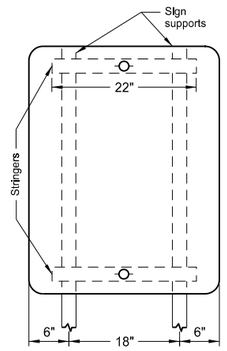
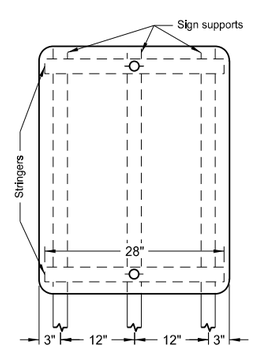
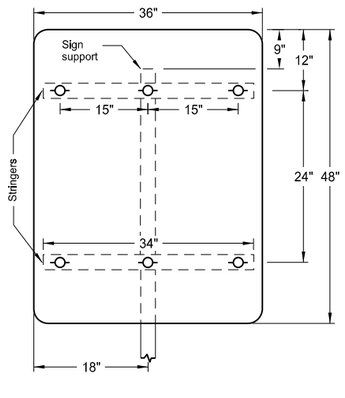


2 Posts



3 Posts

Assembly No. 10



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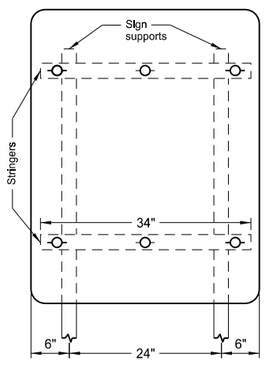
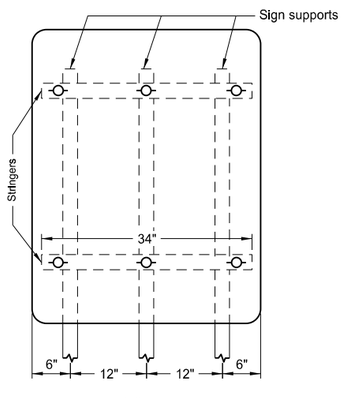


2 Posts



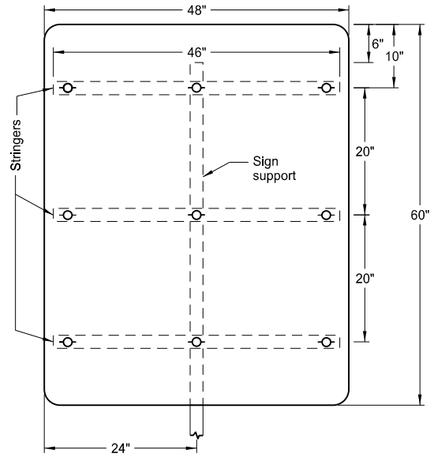
3 Posts

Assembly No. 11

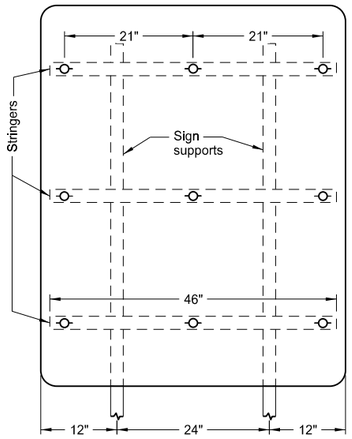
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
12-1-10	
REVISIONS	
DATE	CHANGE
8-30-18 8-30-19	Updated notes to active voice. New Design Engineer PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/30/19 and the original document is stored at the North Dakota Department of Transportation

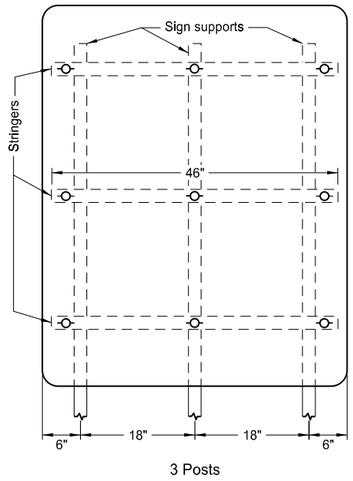
SIGN PUNCHING, STRINGER AND SUPPORT LOCATION
DETAILS REGULATORY, WARNING AND GUIDE SIGNS



1 Post

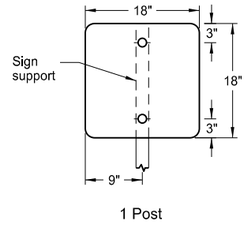


2 Posts



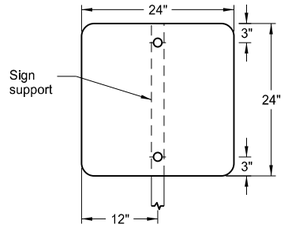
3 Posts

Assembly No. 12

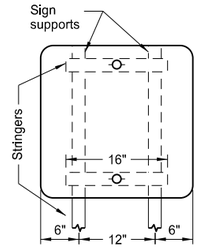


1 Post

Assembly No. 13

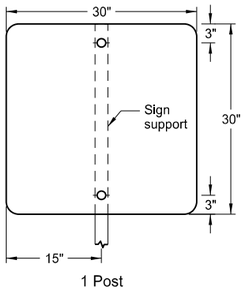


1 Post

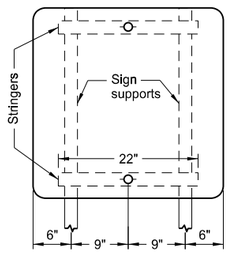


2 Posts

Assembly No. 14

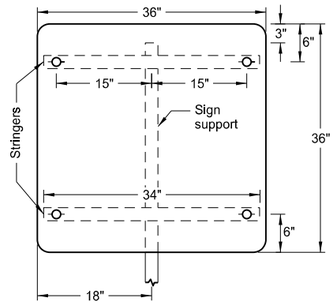


1 Post

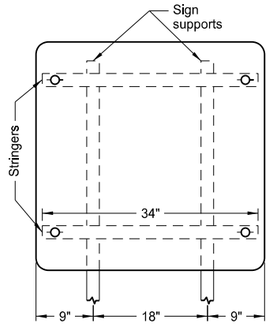


2 Posts

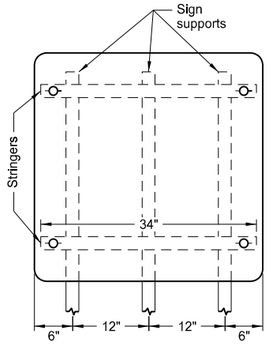
Assembly No. 15



1 Post

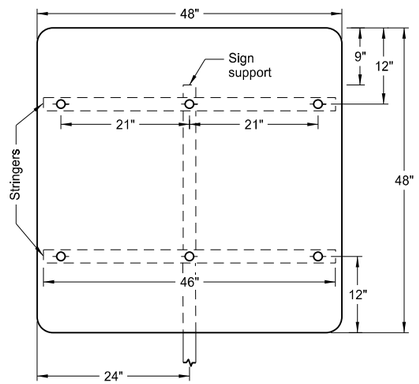


2 Posts

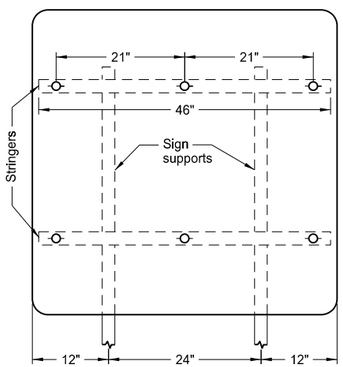


3 Posts

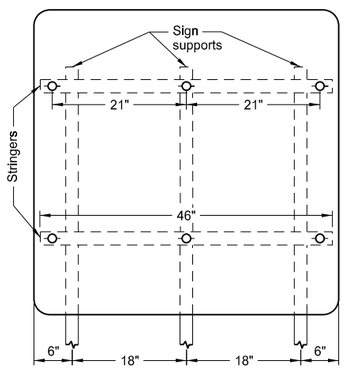
Assembly No. 16



1 Post



2 Posts



3 Posts

Assembly No. 17

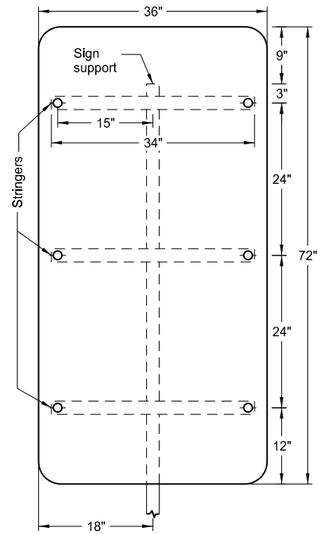
Notes:

1. Use 0.100 inch minimum thickness sign backing material.
2. Use 1½" x 1½" perforated square tube stringers.
3. Punch holes round for ⅜" bolt.

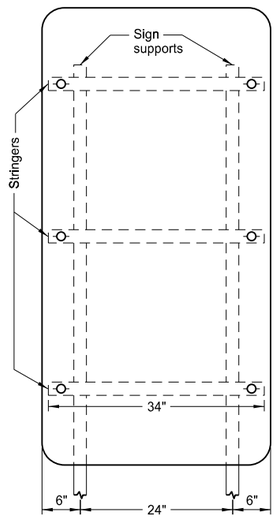
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
12-1-10	
REVISIONS	
DATE	CHANGE
8-30-18	Updated to active voice & changed Assembly 16 post spacing.
8-30-19	New Design Engineer PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/30/19 and the original document is stored at the North Dakota Department of Transportation

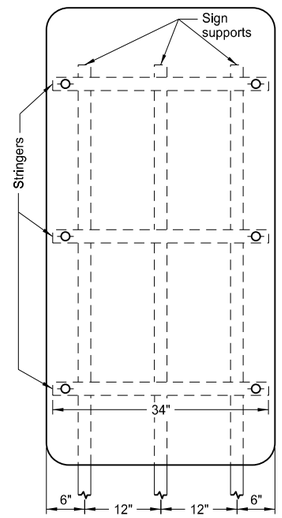
SIGN PUNCHING, STRINGER AND SUPPORT LOCATION
DETAILS REGULATORY, WARNING AND GUIDE SIGNS



1 Post

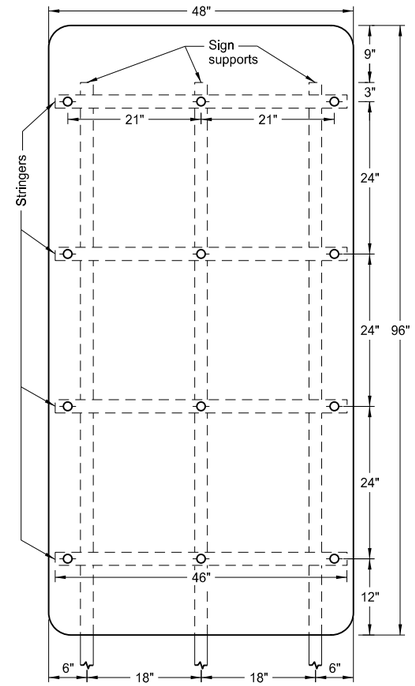


2 Posts



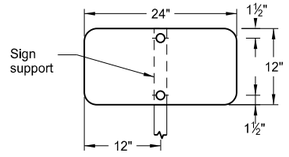
3 Posts

Assembly No. 24



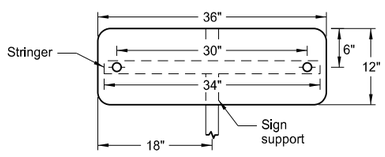
3 Posts

Assembly No. 25



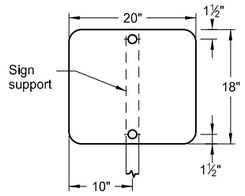
1 Post

Assembly No. 26



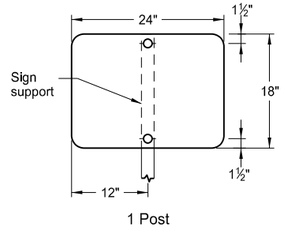
1 Post

Assembly No. 27



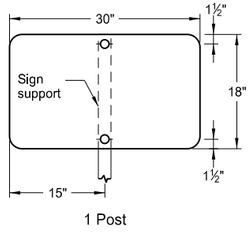
1 Post

Assembly No. 28

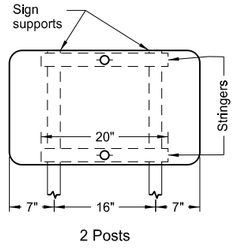


1 Post

Assembly No. 29



1 Post



2 Posts

Assembly No. 30

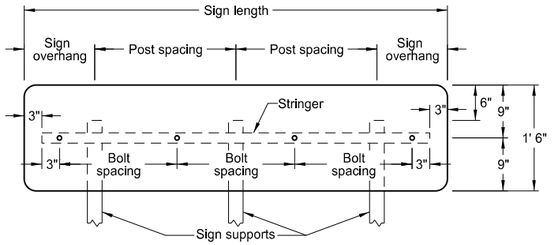
Notes:

1. Use 0.100 inch minimum thickness sign backing material.
2. Use 1½" x 1½" perforated square tube stringers.
3. Punch holes round for ⅜" bolt.

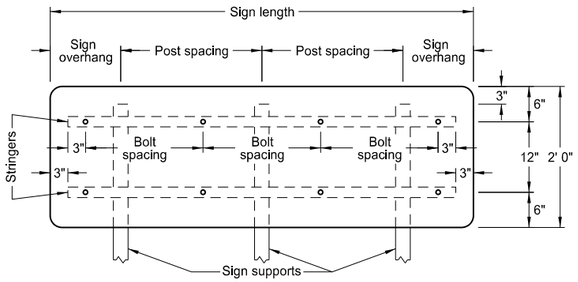
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
12-1-10	
REVISIONS	
DATE	CHANGE
8-30-18 8-30-19	Updated notes to active voice. New Design Engineer PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/30/19 and the original document is stored at the North Dakota Department of Transportation

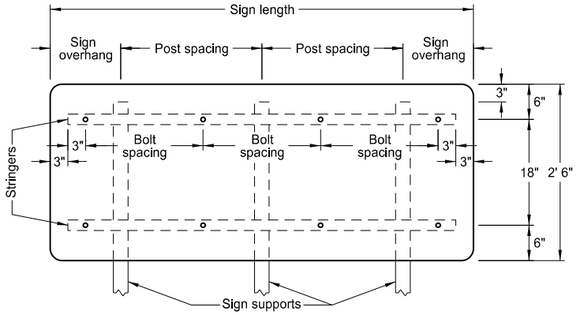
SIGN PUNCHING, STRINGER AND SUPPORT LOCATION DETAILS FOR VARIABLE LENGTH SIGNS



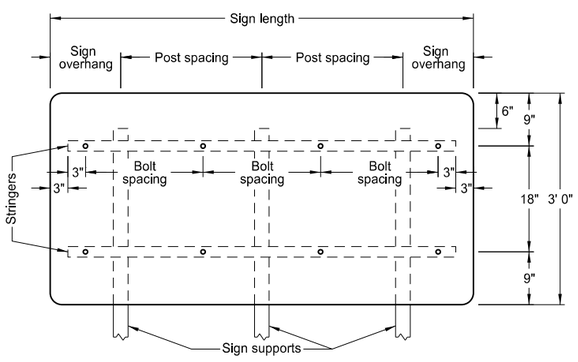
VARIES X 1'-6"



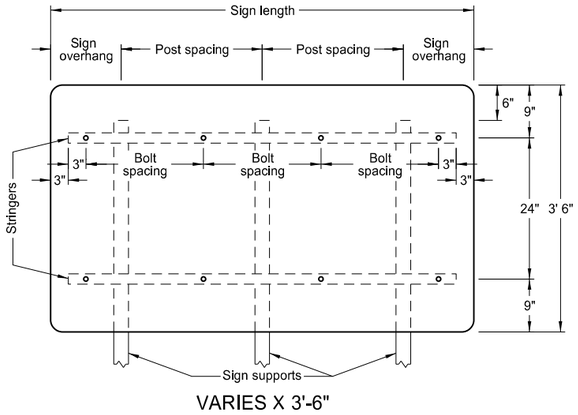
VARIES X 2'-0"



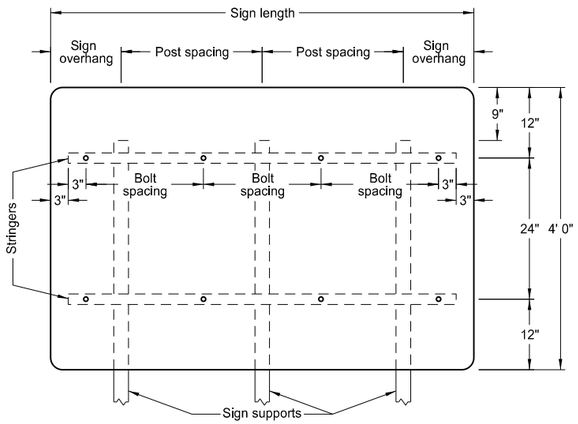
VARIES X 2'-6"



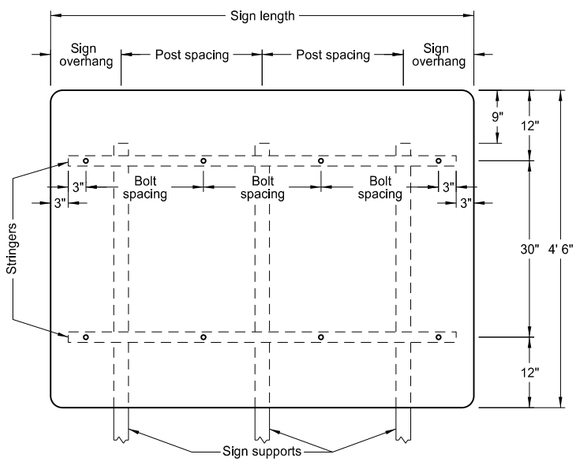
VARIES X 3'-0"



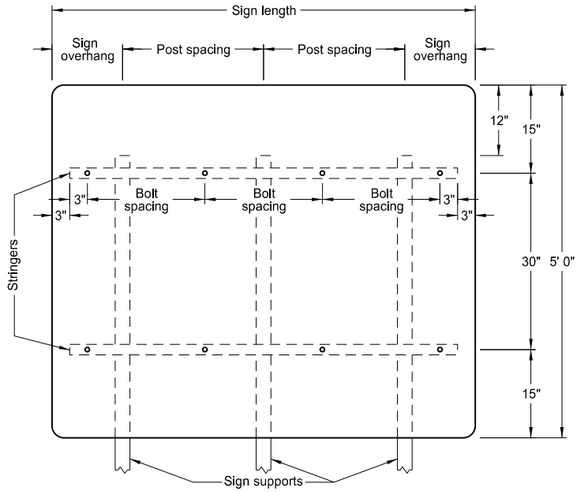
VARIES X 3'-6"



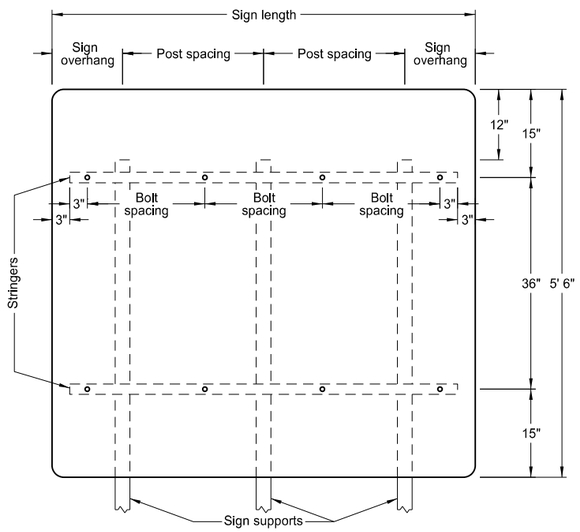
VARIES X 4'-0"



VARIES X 4'-6"



VARIES X 5'-0"



VARIES X 5'-6"

3 POSTS			
Sign Length	Sign Overhang	Post Spacing	Bolt Spacing
4'-0"	0'-6"	1'-6"	18"
4'-6"	0'-6"	1'-9"	21"
5'-0"	0'-6"	2'-0"	24"
5'-6"	1'-3"	1'-6"	18"
6'-0"	1'-0"	2'-0"	20"
6'-6"	1'-3"	2'-0"	22"
7'-0"	1'-6"	2'-0"	24"
7'-6"	1'-6"	2'-3"	2-20" & 2-19"
8'-0"	1'-9"	2'-3"	21"
8'-6"	2'-0"	2'-3"	2-22" & 2-23"
9'-0"	1'-6"	3'-0"	24"
9'-6"	1'-9"	3'-0"	4-20" & 1-22"
10'-0"	1'-9"	3'-3"	2-21" & 3-22"
10'-6"	1'-9"	3'-6"	4-23" & 1-22"
11'-0"	2'-0"	3'-6"	24"
11'-6"	2'-3"	3'-6"	21"
12'-0"	2'-4"	3'-8"	22"
12'-6"	2'-5"	3'-10"	23"
13'-0"	2'-6"	4'-0"	24"
13'-6"	2'-9"	4'-0"	3-22" & 4-21"
14'-0'	3'-0"	4'-0"	2-23" & 5-22"
14'-6"	3'-3"	4'-0"	6-23" & 1-24"
15'-0"	3'-6"	4'-0"	24"
15'-6"	2'-4"	5'-5"	6-22" & 2-21"
16'-0"	2'-5"	5'-7"	4-23" & 4-22"
16'-6"	2'-5"	5'-10"	6-23" & 2-24"
17'-0"	2'-6"	6'-0"	24"
17'-6"	3'-3"	5'-6"	22"
18'-0"	3'-6"	5'-6"	6-23" & 3-22"
18'-6"	3'-9"	5'-6"	6-23" & 3-24"
19'-0"	3'-6"	6'-0"	24"
19'-6"	4'-3"	5'-6"	8-22" & 2-23"
20'-0"	4'-4"	5'-8"	8-23" & 2-22"

Notes:

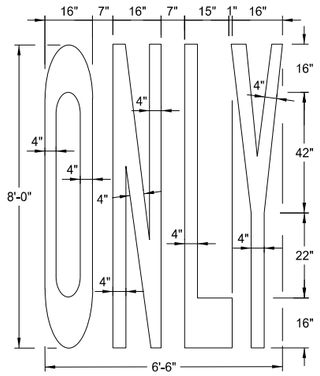
1. Use 0.100 minimum thickness sign backing material.
2. Use 1½" x 1½" perforated square tube stringers.
3. Punch holes round for ⅜" bolt.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
9-25-12	
REVISIONS	
DATE	CHANGE
8-30-18	Updated notes to active voice.
9-04-19	New Design Engineer PE Stamp.

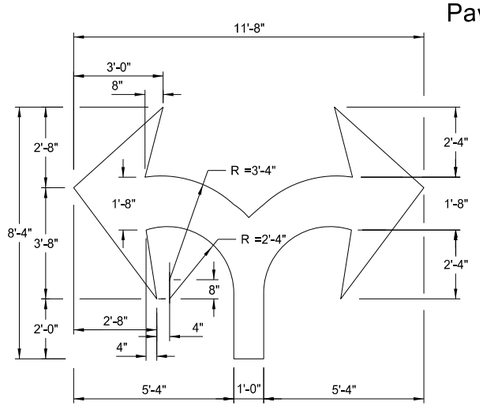
This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 9/04/19 and the original document is stored at the North Dakota Department of Transportation

Pavement Marking Message Details

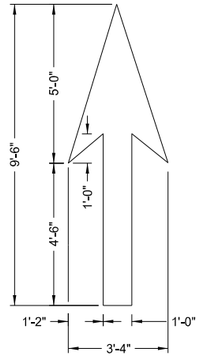
D-762-1



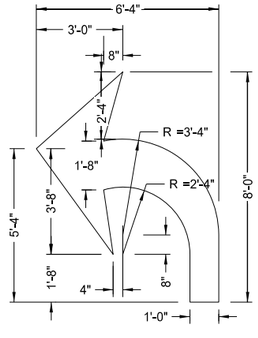
22 S. F.



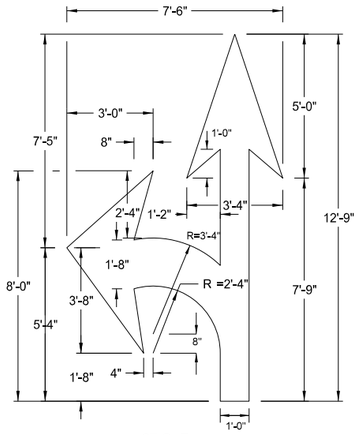
29 S. F.



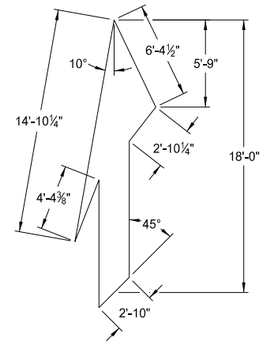
12 S. F.



16 S. F.

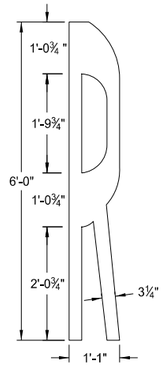


27 S. F.

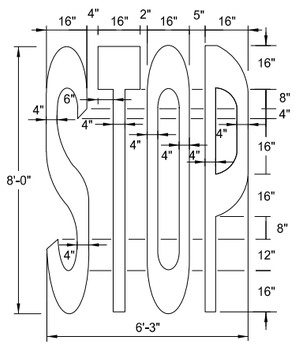


41 S. F.

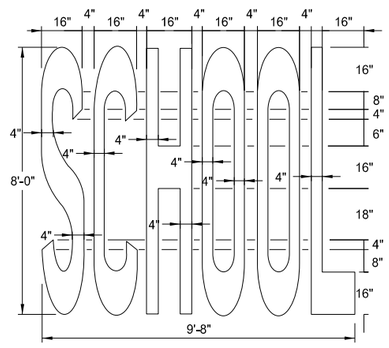
Note: Rotate merge arrow 20° from edge of roadway.



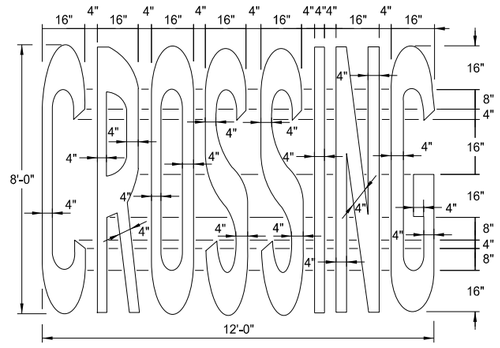
4 S. F.



22 S. F.



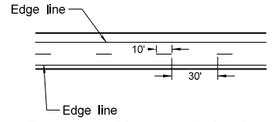
34.5 S. F.



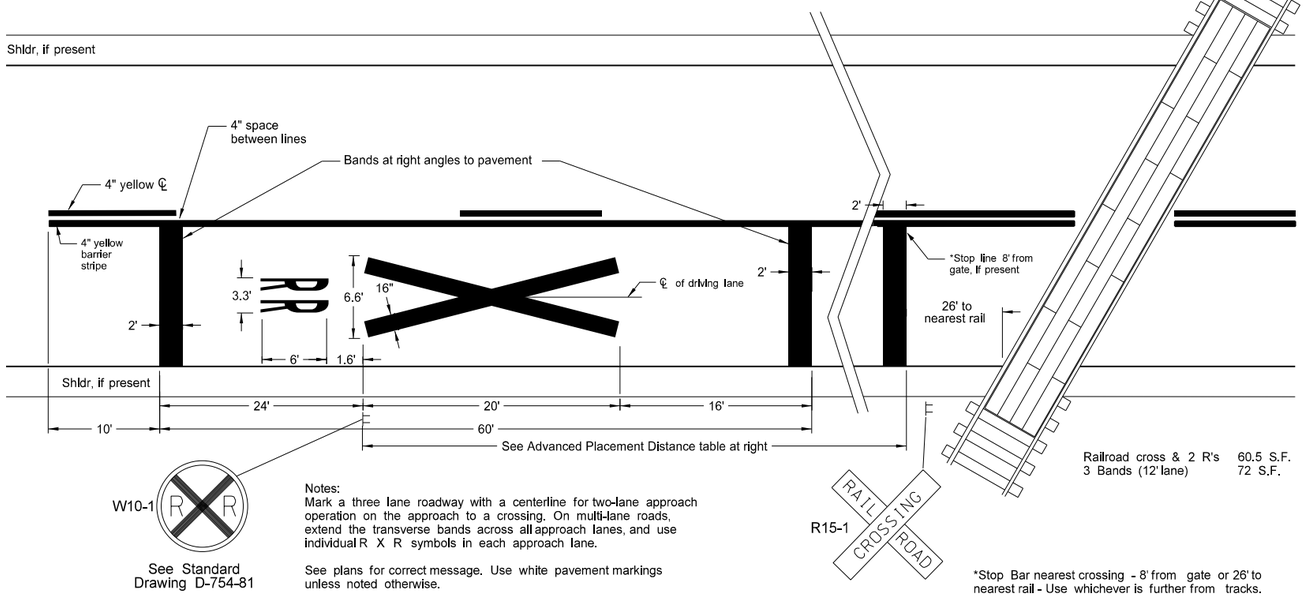
46 S. F.

Speed Limit	Chevron Width	Chevron Spacing 45° to Traffic
0-25 mph	8"	5'
30-40 mph	8"	15'
45 mph and above	12"	25'

Chevron Crosshatching Table



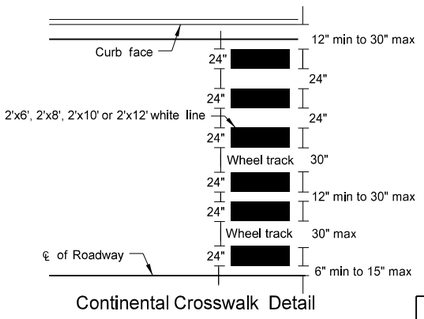
Centerline Pavement Marking Skip Spacing Detail



Notes:
Mark a three lane roadway with a centerline for two-lane approach operation on the approach to a crossing. On multi-lane roads, extend the transverse bands across all approach lanes, and use individual R X R symbols in each approach lane.

See plans for correct message. Use white pavement markings unless noted otherwise.

*Stop Bar nearest crossing - 8' from gate or 26' to nearest rail - Use whichever is further from tracks.



Continental Crosswalk Detail

Advance Placement Distance for Railroad Warning Signs	
Posted or 85th Percentile Speed	Advance Distance
20 mph	min. 100 ft
25 mph	min. 100 ft
30 mph	min. 100 ft
35 mph	min. 100 ft
40 mph	125 ft
45 mph	175 ft
50 mph	250 ft
55 mph	325 ft
60 mph	400 ft
65 mph	475 ft
70 mph	550 ft

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

12-6-11

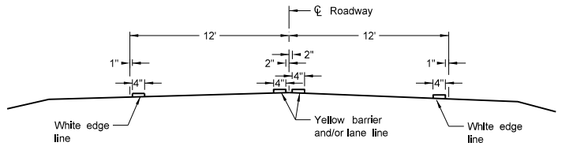
REVISIONS

DATE	CHANGE
10-17-17	Updated to active voice.
08-27-19	New Design Engineer PE Stamp.
01-28-2020	Revised min Stop Bar distance to rail.

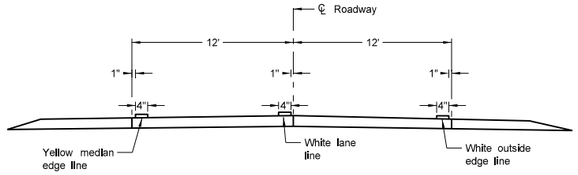
This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 1/28/2020 and the original document is stored at the North Dakota Department of Transportation

PAVEMENT MARKING

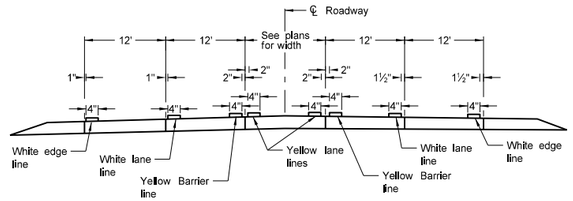
D-762-4



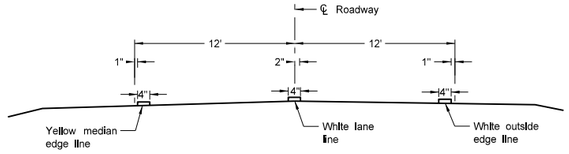
Two Lane Two Way
RURAL ROADWAY



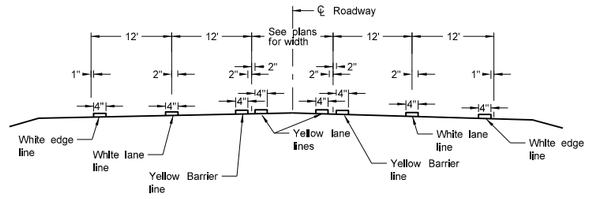
Two Lane Roadway
INTERSTATE HIGHWAY
Concrete Section



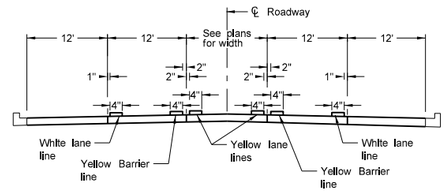
RURAL FIVE LANE ROADWAY
Concrete Section



Two Lane Divided
Rural Roadway
PRIMARY HIGHWAY
Asphalt Section



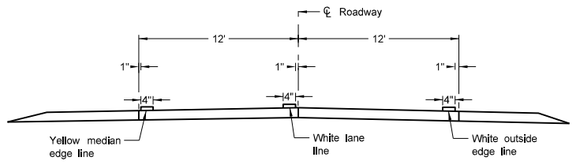
RURAL FIVE LANE ROADWAY
Asphalt Section



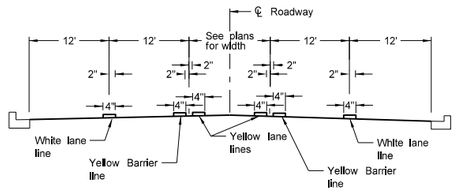
URBAN FIVE LANE SECTION
Concrete Section

NOTES:

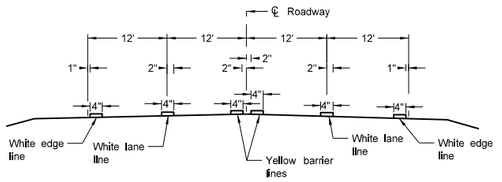
1. Continue edge lines through private drives and field drives. Break edge lines for intersections.



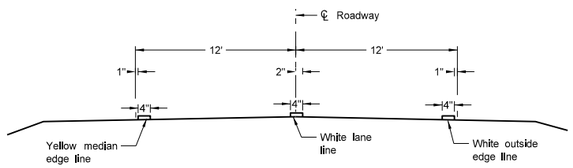
Two Lane Roadway
PRIMARY HIGHWAY
Concrete Section



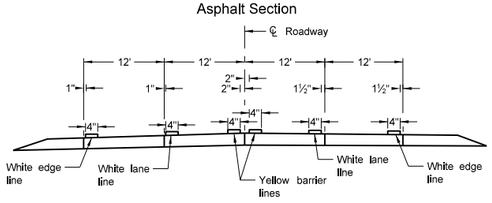
URBAN FIVE LANE SECTION
Asphalt Section



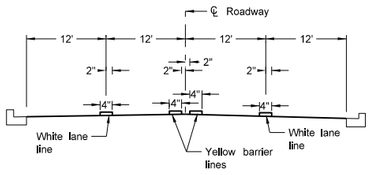
RURAL FOUR LANE ROADWAY
Asphalt Section



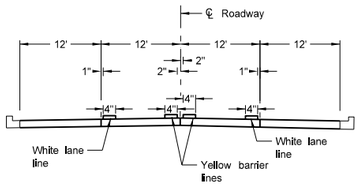
Two Lane Roadway
INTERSTATE HIGHWAY
Asphalt Section



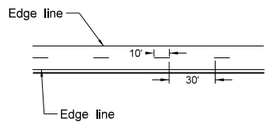
RURAL FOUR LANE ROADWAY
Concrete Section



URBAN FOUR LANE SECTION
Asphalt Section



URBAN FOUR LANE SECTION
Concrete Section



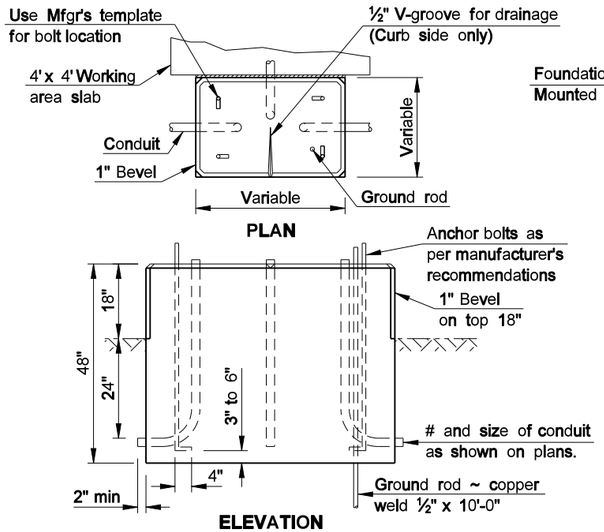
CENTERLINE PAVEMENT MARKING SKIP SPACING DETAIL

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
12-1-10	
REVISIONS	
DATE	CHANGE
10-17-17 08-27-19	Updated to active voice. New Design Engineer PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/27/19 and the original document is stored at the North Dakota Department of Transportation

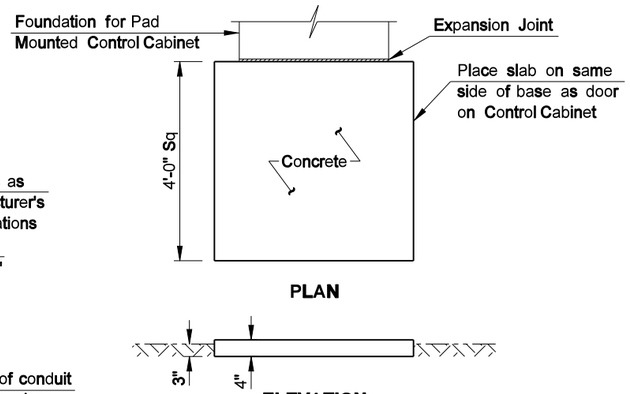
CONCRETE FOUNDATIONS
(TRAFFIC SIGNALS & HIGHWAY LIGHTING)

D-770-1



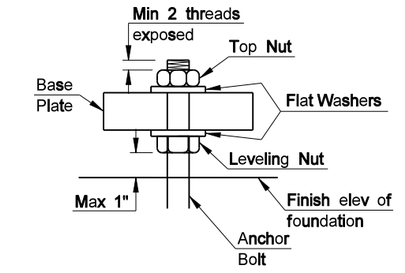
CONTROLLER CABINET FOUNDATION PAD MOUNT

The Controller Cabinet Foundation shall be bid as Concrete Foundation - Traffic Signals.

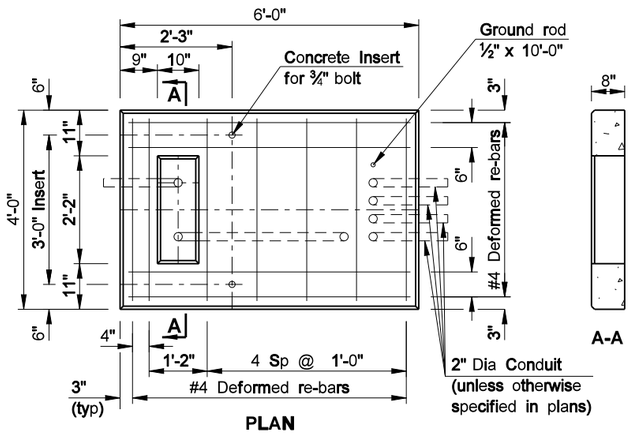


WORKING AREA SLAB

The Working Area Slab shall be installed where shown on the plans and shall not be bid separately but shall be included in the price bid for Concrete Foundation - Traffic Signals.

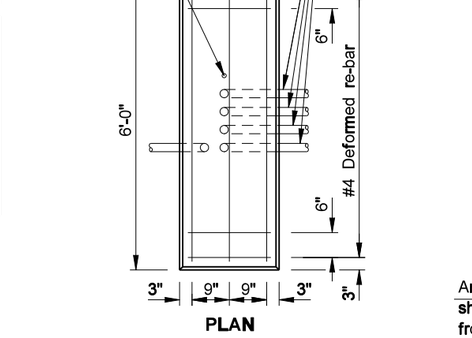


ANCHOR BOLT DETAIL



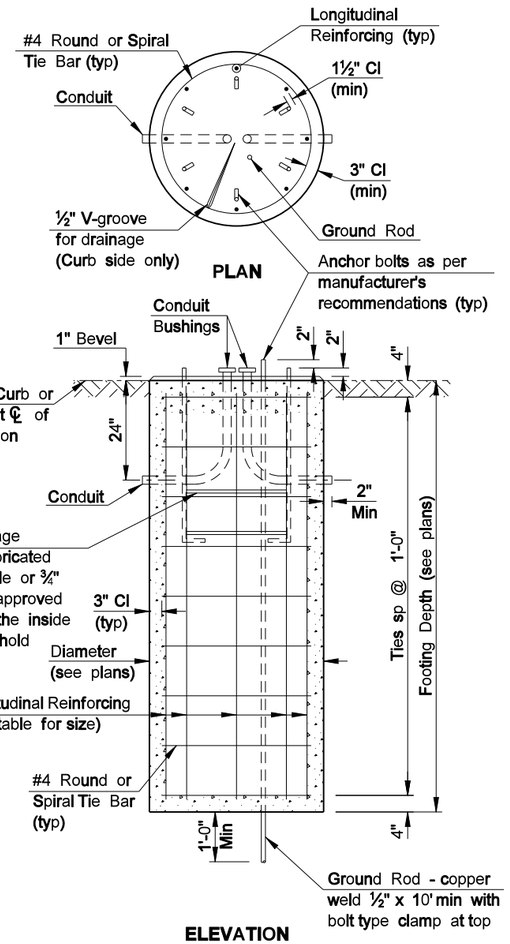
TRANSFORMER & FEED POINT CABINET FOUNDATION PAD MOUNT

The Transformer & Feed Point Cabinet Foundation Pad Mount shall be bid as Concrete Foundation ~ Feed Point ~ Type A.



FEED POINT CABINET FOUNDATION PAD MOUNT

The Feed Point Cabinet Foundation Pad Mount shall be bid as Concrete Foundation ~ Feed Point ~ Type B.



LIGHT & SIGNAL STANDARD FOUNDATION

NOTES:

LIGHT & SIGNAL STANDARD FOUNDATIONS: See plans for conduit size, number of bends and correct position for each foundation. When conduit does not continue beyond the foundation, conduit with a 105° bend and bushings on both ends may be substituted for the 90° bends shown. See plans for correct size & location of foundations. The grade and exact location shall be established by the Engineer in the field. All reinforcing shall be Grade 60. Tie bars shall have a minimum of a 12" lap. Reinforcing may be omitted for Type I, II, V, VI & VII signal standard foundations if the anchor bolts extend to within 3" to 6" above the bottom of the foundation. A minimum of 6 anchor bolts shall be used for cantilevered structures.

CONTROLLER CABINET FOUNDATION PAD MOUNT FOUNDATION: See plans for the number of 90° bends per foundation and correct positioning. The foundation for Pad Mounted Controller Cabinet shall be of sufficient size so that there is a minimum of 3" of clearance from the outside edge of cabinet to the outside edge of the foundation on any side. The contractor shall ensure a water-tight seal between the controler cabinet and the foundation by caulking, except for V-groove.

WORKING AREA SLAB: The materials and preparation of this slab shall be as approved by the Engineer in the field.

TRANSFORMER & FEED POINT CABINET FOUNDATION PAD MOUNTED: The foundation shall have a wood float finish. All conduits shown shall be installed. Conduit that is not used at this time shall be plugged with an expandable plug.

FEED POINT CABINET FOUNDATION PAD MOUNTED: The foundation shall have a wood float finish. All conduits shown shall be installed. Conduit that is not used at this time shall be plugged with an expandable plug.

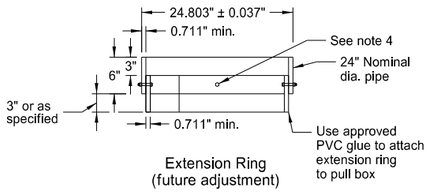
LIGHT & SIGNAL FOUNDATION TABLE	
FOOTING DEPTH (ft)	LONGITUDINAL REINFORCING
≤ 12	8 - #5
13 - 14	8 - #6
15 - 16	8 - #7
17 - 19	8 - #8

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
6-15-10	
REVISIONS	
DATE	CHANGE

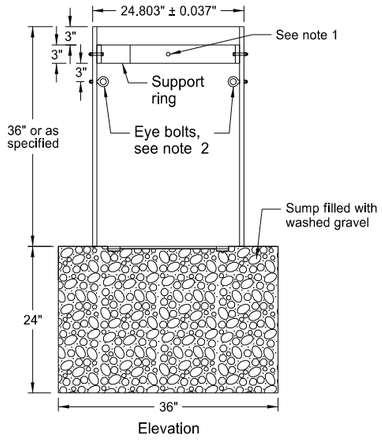
This document was originally issued and sealed by Terrence R. Udland Registration Number PE- 2674 , on 6/15/10 and the original document is stored at the North Dakota Department of Transportation

PULL BOX DETAILS

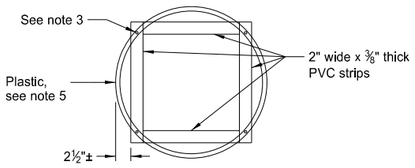
D-770-3



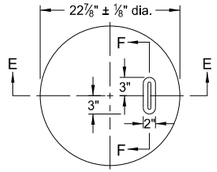
Extension Ring
(future adjustment)



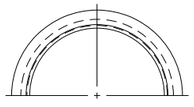
Elevation



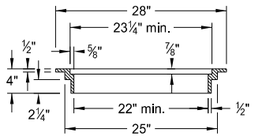
Bottom View



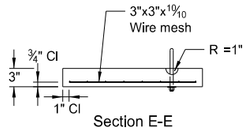
Concrete Cover



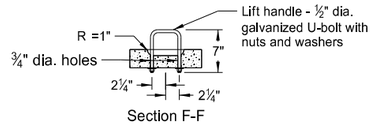
Half Top View



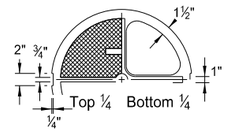
Section Frame

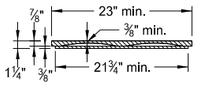


Section E-E



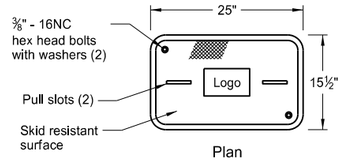
Section F-F



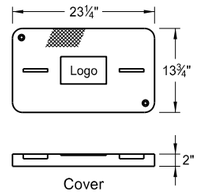


Section Cover

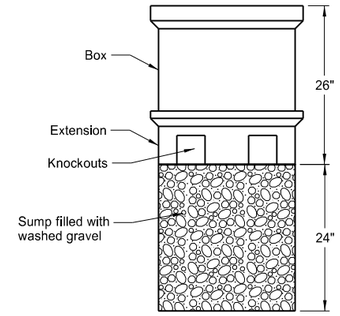
Cast Iron Frame and Cover



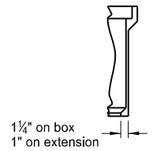
Plan



Cover



Elevation



Polymer Concrete Pull Box

Note: Polymer concrete reinforced by a heavy weave fiberglass

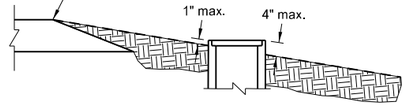
Polymer Concrete Pull Box Notes:

1. Place top of pull box flush with surfaced area and approximately one inch above earth or sodded areas on level surfaces.
2. Provide at least one knockout per side in pull box.
3. Provide Polymer Concrete pull box meeting Tier 22 as per ANSI / SCTE 77.

PVC Pull Box

PVC Pull Box Notes:

1. Attach split 24" nominal diameter PVC cover support ring with four ⅜" dia. x 2" long stainless steel hex head bolts with nuts at 90 degrees apart.
2. Two type 2 shoulder eye bolts, ⅜" dia. x 1¼" shank length with hex nuts 180 degrees apart (for lifting pull box and supporting electric cable).
3. Four ¼" x 1¼" long galvanized lag screws. Screw assembly together.
4. Attach split 24" nominal diameter PVC cover support extension ring with four ⅜" dia. x 2" long stainless steel hex head bolts with nuts at 90 degrees apart.
5. Bolt assembly together.
6. Size conduit holes in barrel section a maximum of 1" larger than size of conduit being used.
7. After pull box and conduit installation, make inside walls and cover water tight to the satisfaction of the Engineer.
8. PVC pipe to meet requirements of ASTM F679T-1 or equal.
9. Use austenitic stainless steel hex head bolts and nuts. Galvanize other fasteners as per AASHTO M-232.
10. Coat concrete cover on top and sides with an approved epoxy coating. Apply light gray, clear, or neutral color epoxy protective coating as recommended by the manufacturer. Clean the surfaces of concrete receiving the epoxy protective coating by wire brush and dry before application.
11. Cast Iron Cover castings shall be gray iron as per AASHTO M 105, Class 35B.

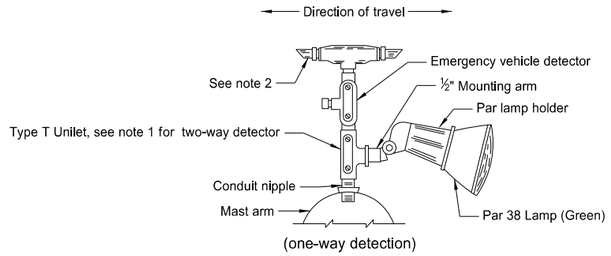


Typical Pull Box in Rural Section

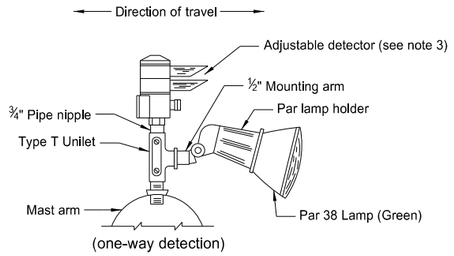
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-8-13	
REVISIONS	
DATE	CHANGE
7-8-14	Added Note 3
10-17-17	Updated to active voice.
8-28-19	New Design Engineer PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/28/19 and the original document is stored at the North Dakota Department of Transportation

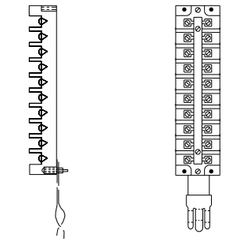
LIGHTING AND SIGNAL DETAILS



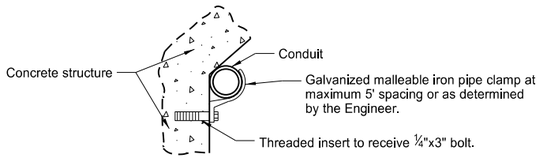
Emergency Vehicle Detector Detail



Alternate Emergency Vehicle Detector Detail (adjustable)

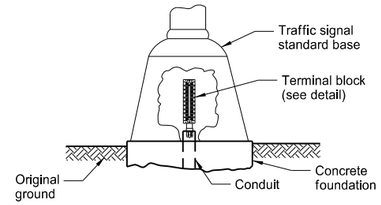


Terminal Block Detail

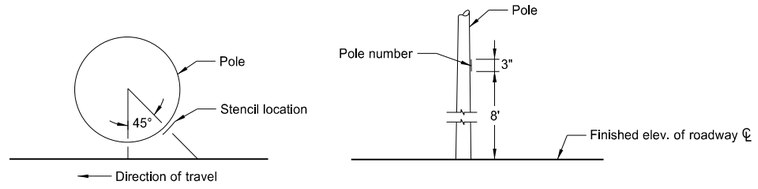


Bridge Mounted Conduit Hanger

Notes:
1. Use Type X Unilet with two Par lamp holders and lamps for Two-way Detectors. (one in each direction).
2. Plug unused end of One-way Detector with metal pipe plug.
3. Rotate detector lens to face direction of travel on Two-way Detectors.

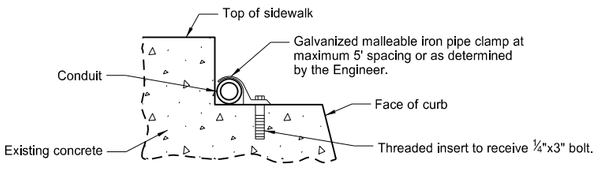


Terminal Block
(rigid mounted)

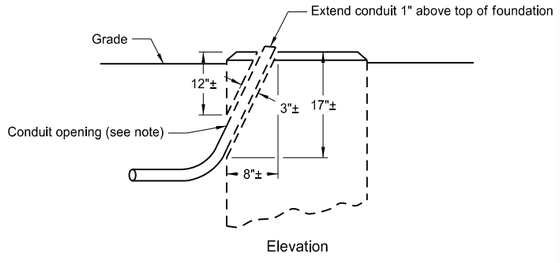


Light Standard Numbering

Note: On the roadway side of each light standard, stencil the pole number using black paint or an adhesive coated plastic such as Scotchcal by 3M or as approved by the Engineer. See layout sheets for pole numbers.

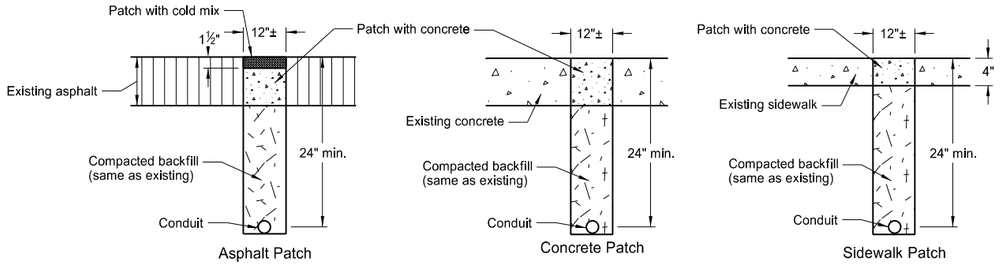


Bridge Curb Mounted Conduit



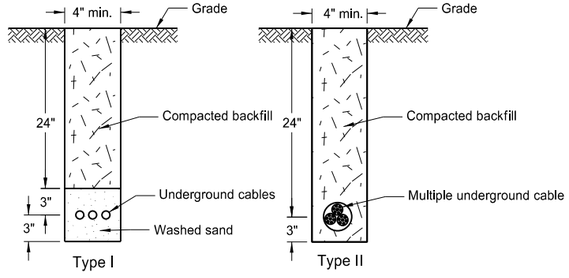
Revise Concrete Foundation

Note: Jackhammer or drill to remove material and provide a location for conduit. Make opening no larger than necessary. Place conduit, fill with concrete and finish foundation to original appearance.



Surface Patch Details

Note: Saw cut trenches. Use PCC pavement for replacement concrete with the coarse aggregate gradation, maximum size and method of curing as approved by the Engineer. Immediately prior to pouring replacement concrete, paint all surfaces with an approved epoxy compound.



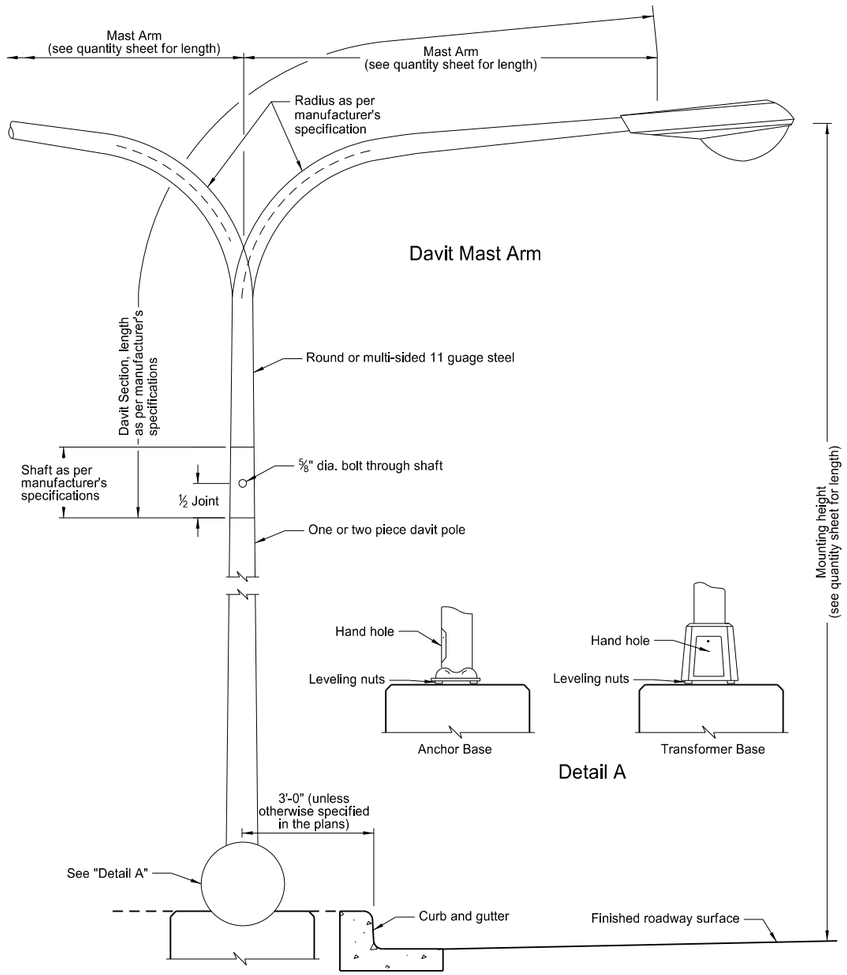
Cable Trench

Note: Sod entire area disturbed by trenching, unless directed otherwise by the Engineer.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-8-13	
REVISIONS	
DATE	CHANGE
10-17-17 10-25-19	Updated to active voice. Removed conduit under RR detail.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 10/25/19 and the original document is stored at the North Dakota Department of Transportation

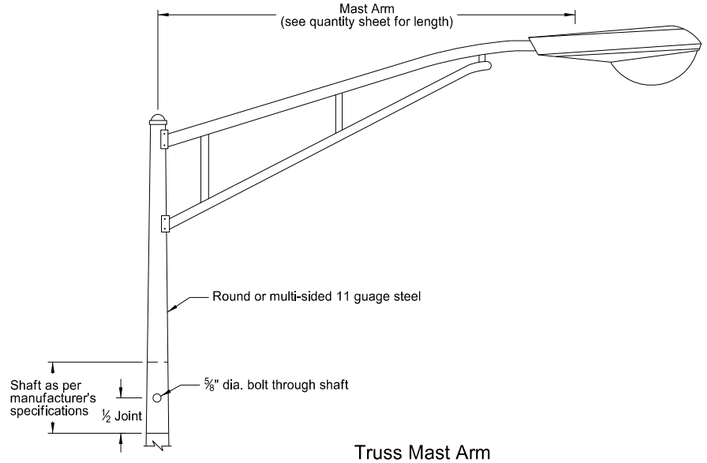
LIGHT STANDARD DETAILS



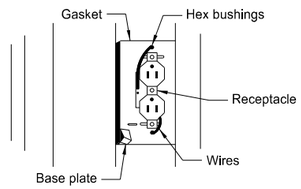
Davit Mast Arm

Detail A

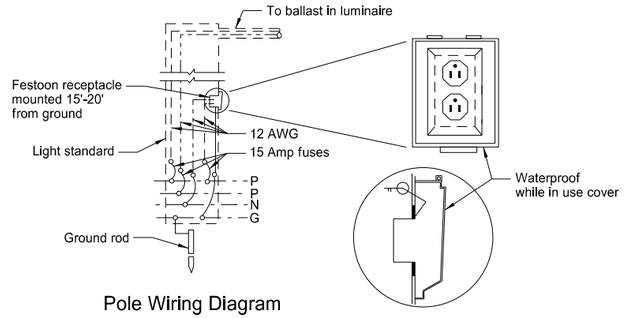
Light Standard Details



Truss Mast Arm



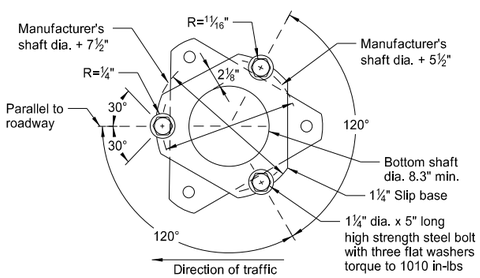
Optional: Festoon receptacle
mounted on multi-sided pole.



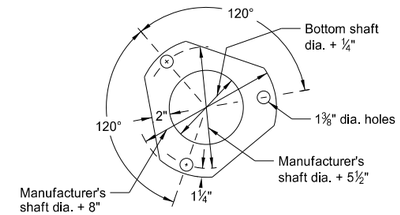
Pole Wiring Diagram

Receptacle Mounting Detail (B)

(B) Mount receptacle on side of pole that faces the street.
Install Festoon Receptacle only when specified in the plans.



Top View



Plan View

Keeper Plate Detail (A)

(A) ASTM A446 Grade "A" 28 gauge keeper plate on top of middle flat washer. Galvanize Keeper plate after fabrication.

Notes:

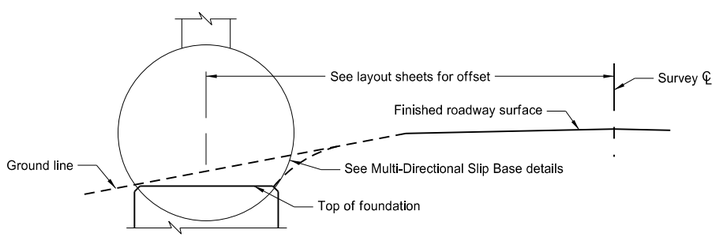
Light Standard Locations: The minimum offset distance from the curb face is 3 feet. Offset light standards at least 3 feet in urban areas and where speeds are less than 30 mph. Where speeds are 30 mph or more, place light standards at least 16 feet from the driving lane.

Steel Standards: Touch up marred or scratched areas after erection.

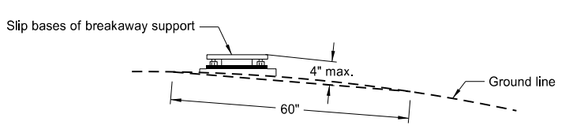
Luminaire: Use internal ballast-constant wattage 120x240 voltage. See layout sheets for type of luminaire, wattage, I.E.S. distribution, and operating system.

Fusing: Fusing in base, see specifications.

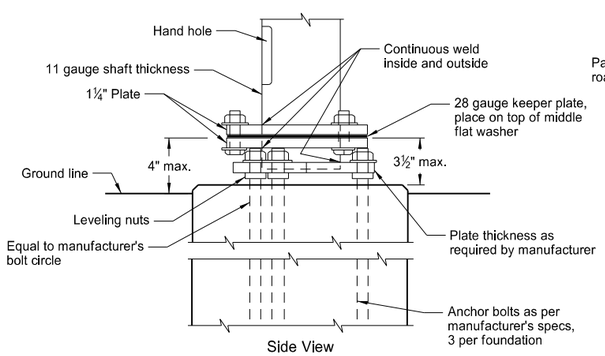
Slip Base Bolt Torque Procedure:
1. Tighten all bolts the maximum possible with 12" to 15" wrench to bed washers and to clean bolt threads, then loosen.
2. Retighten bolts with a systematic order to prescribed torque.
3. Loosen each bolt and retighten to prescribed torque in the same order as initial retightening.
4. Burr threads of junction with nut using center punch to prevent nut loosening.



Concrete Foundation Location

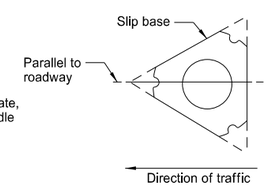


Breakaway Support Stub Clearance Diagram

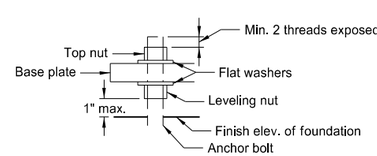


Side View

Steel Base Detail



Slip Base Placement Detail



Anchor Bolt Detail

Multi-Directional Slip Base

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-8-13	
REVISIONS	
DATE	CHANGE
10-17-17 8-28-19	Updated to active voice. New Design Engineer PE Stamp.

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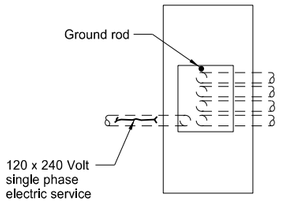
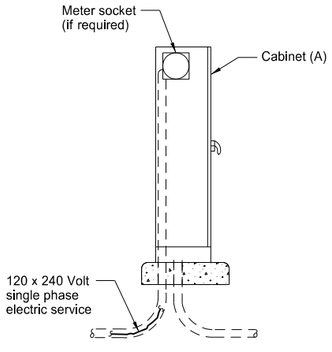
FEED POINT - TRAFFIC SIGNALS

D-772-1



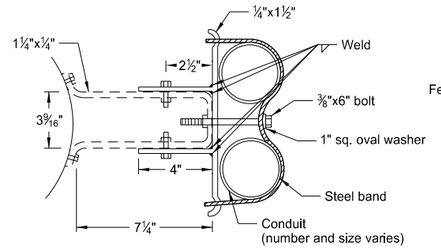
Plan

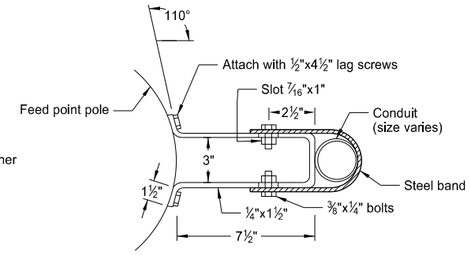


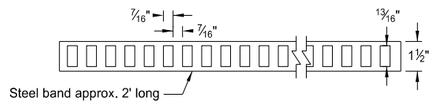
Elevation

Circuit Breaker Cabinet Pad Mounted

(A) Provide weatherproof cabinet, 56 in. high x 26 in. wide x 14 in. deep, 12 gauge steel (min.) or aluminum with provisions for padlock. Place one coat of primer and two coats of exterior dark green enamel on steel cabinet.

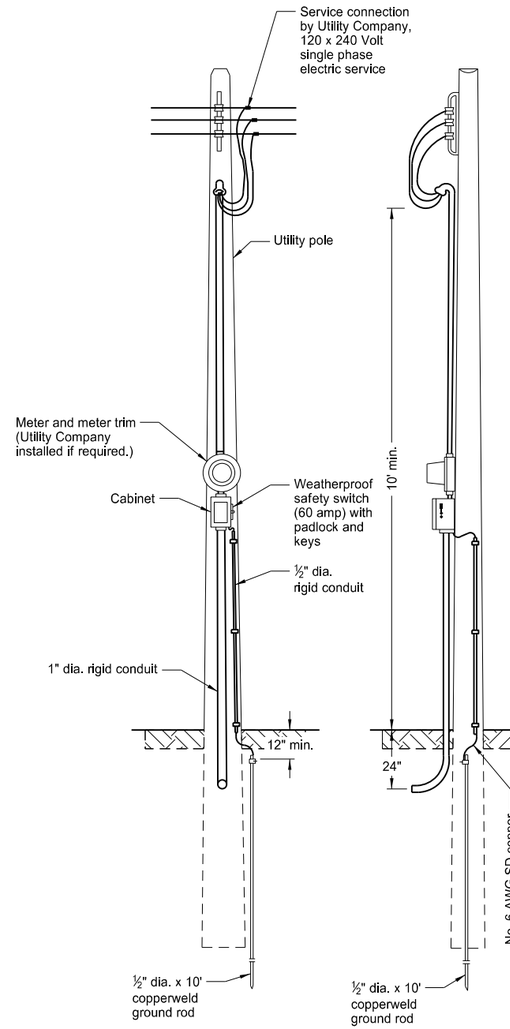






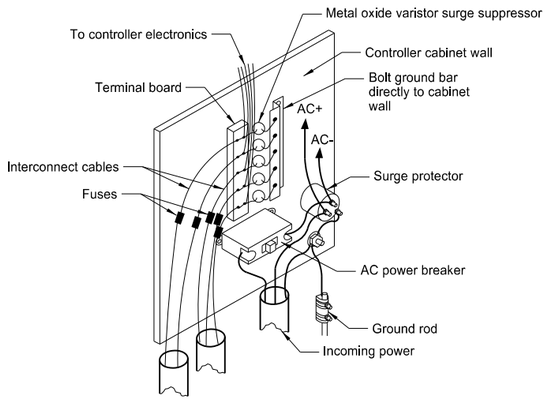
Conduit Standoff Bracket

Use when required by local Utility Company.

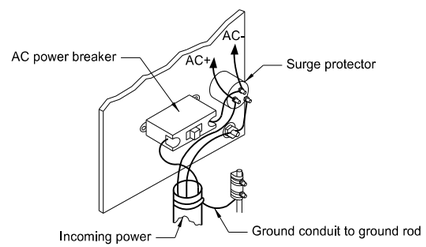


Front View

Side View



Controller Cabinet
Interconnect and Power Cable
Lightning Protection



Feed Point Cabinet
Lightning Protection

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
11-14-13	
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DATE	CHANGE
10-17-17 8-28-19	Updated to active voice. New Design Engineer PE Stamp.

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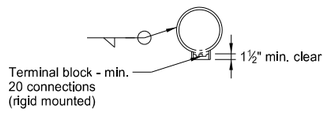
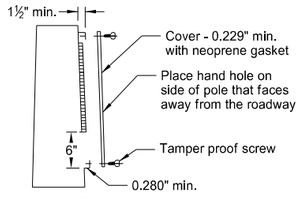
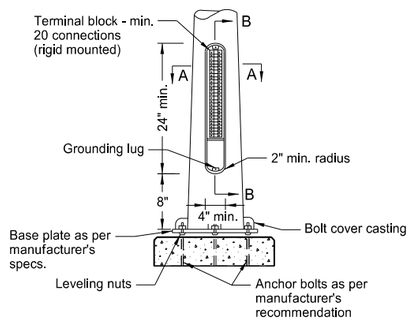
TRAFFIC SIGNAL STANDARDS



Section A-A

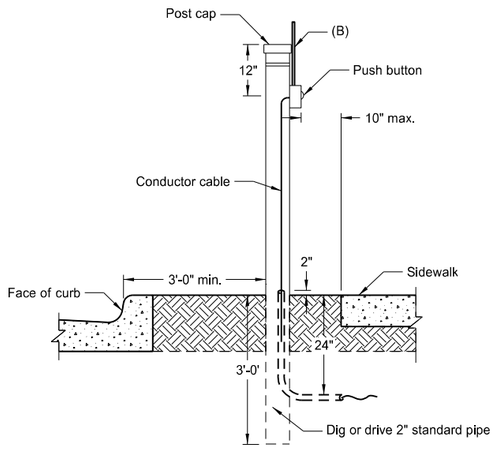


Section B-B

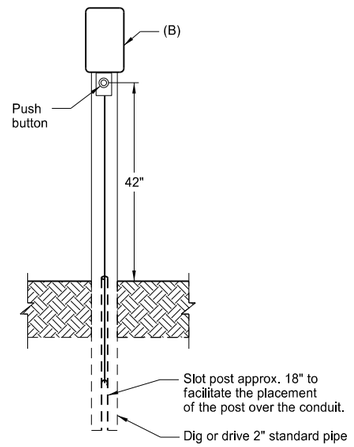


Alternate Signal Standard Base

For use only with Type V, VI, and VII signal standards.

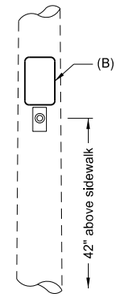


Side View

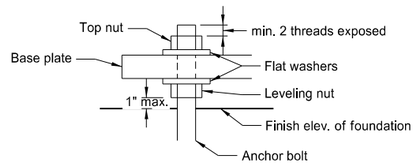


Front View

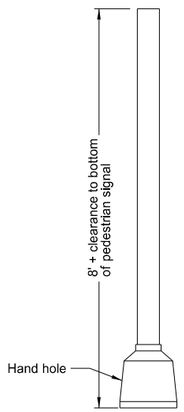
Pedestrian Push Button Post Details (A)



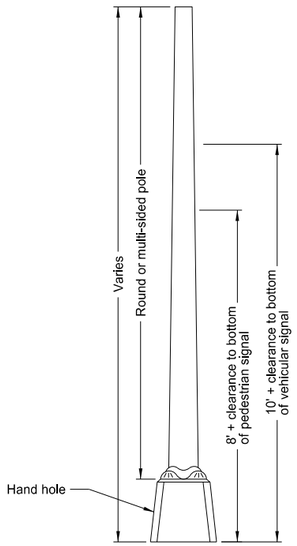
Signal Standard Mounted
Pedestrian Push Button Detail



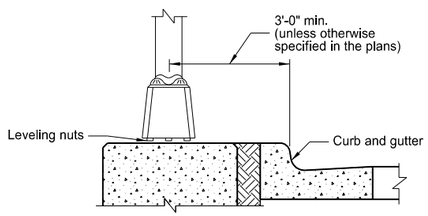
Anchor Bolt Detail

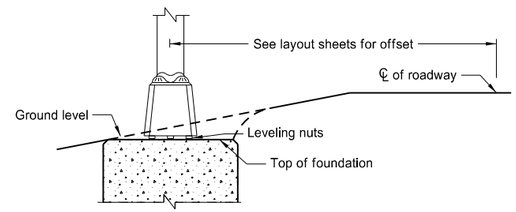


Type II



Type V, VI, VII





Signal Standard
Minimum Clearance Details

(A) Use positioning of the sign, pushbutton, and direction of arrow to clearly indicate which crosswalk is actuated by the push button. Place type of sign based on the jurisdiction in which placed.

(B) Attach sign to post using rust resistant 0.081 aluminum bracket and banding. See Standard Signs book for dimensions and legend series. See plans for type of sign.

Notes:

Signal Heads: See traffic signal layout for correct mounting position, number, size, and arrangement of lenses.

Steel Standards: Place signal standard a minimum of 3 ft. from the face of the curb to center of signal standard, unless shown otherwise on layout sheets.

Paint: See note sheet for required color of paint.

Transformer Base: In lieu of transformer base use alternate signal standard base.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
11-14-13	
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DATE	CHANGE
10-17-17 10-25-19	Updated to active voice. Added 10" dim for ped pushbutton.

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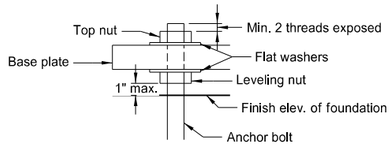
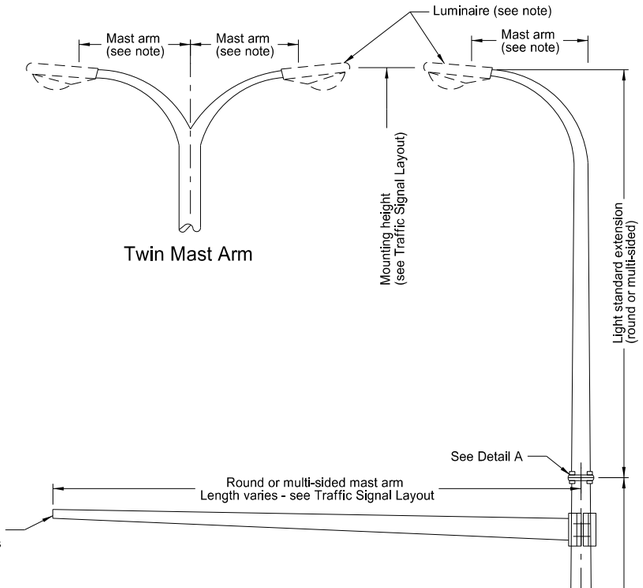
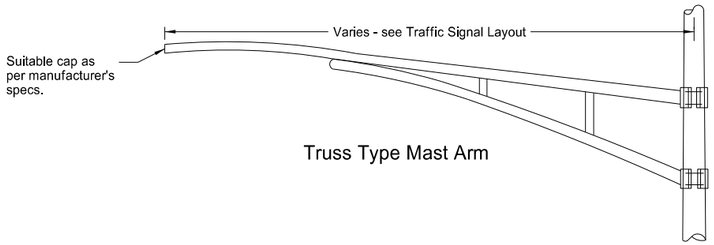
TRAFFIC SIGNAL STANDARDS
(MAST ARM TYPE)



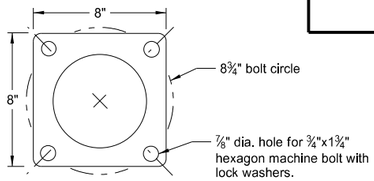
Anchor Bolt Detail



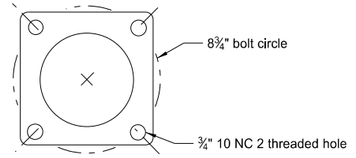
Twin Mast Arm



Truss Type Mast Arm



¾" Top Plate



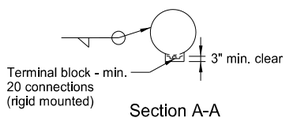
¾" Bottom Plate

Detail A

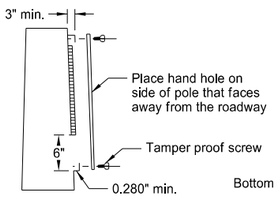
Note: In lieu of the plate type connection, use a telescoping clamp type extension.

Combination Signal and Light Standard			
Signal Standard Type	Luminaire Mounting height (ft)	Install Light Standard Extension and Luminaire	Luminaire Mast Arm
A	30	yes	single
B	30	(A)	single
C	40	yes	single
D	40	(A)	single
E	30	yes	twin
F	30	(A)	twin
G	40	yes	twin
H	40	(A)	twin
I	50	yes	single
J	50	yes	twin

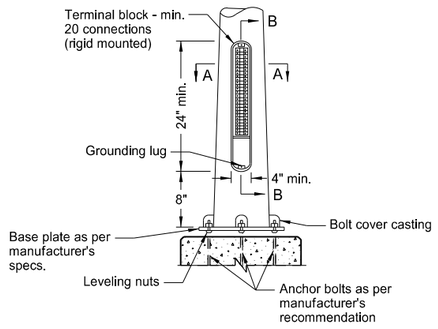
(A) Install the light standard extension for these signal standards at a later date under a separate contract.



Section A-A

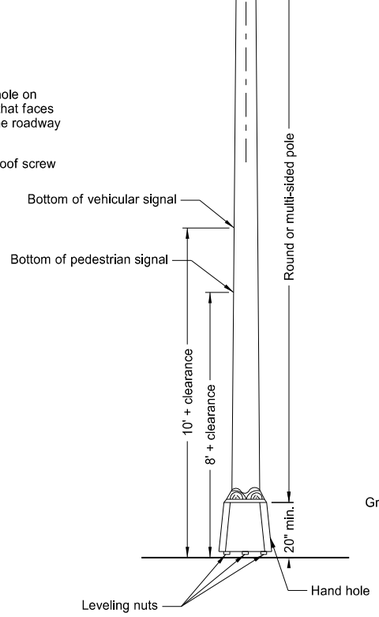


Section B-B

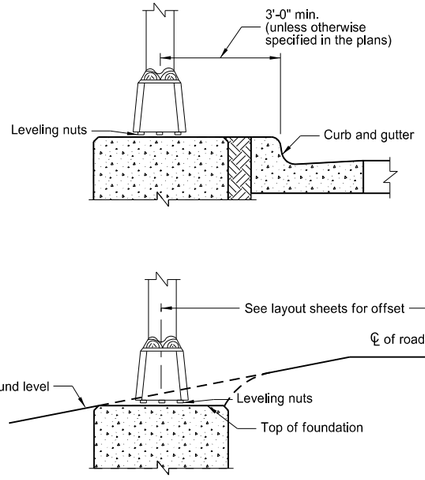


Alternate Signal Standard Base

Note: For use with Type IV and combination signal standards only



Combination Signal and Light Standard



Signal Standard Minimum Clearance Detail

Type IV Signal Standard

(B) On combination signal and light standards Type B, D, F, and H, and on all Type IV signal standards install a suitable pole cap as per manufacturer's specifications.

Notes:

Light standard extension: Mast arm is 6 ft. unless otherwise noted on the plans. Use light standard extension galvanized in accordance with ASTM A 123.

Luminaire: Use internal ballast - constant wattage 120 x 240 voltage luminaires. See layout sheets for type of luminaire, wattage, and I.E.S. distribution.

Signal head: See Traffic Signal Layout for correct mounting position, number, size, and arrangement of lenses. Place mast arm mounted signal heads with a clearance between 17 ft. and 19 ft. from the ℄ of the roadway to the bottom of signal heads.

Multi-sided poles: Provide a means, other than friction, that will not allow the mast arm to be rotated by wind forces. Fabricate the pole so the mast arm is rotatable. This feature to be as approved by the Engineer.

Transformer base: In lieu of the transformer base, use the alternate signal standard base.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
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10-17-17	Updated to active voice.
08-28-19	New Design Engineer PE Stamp.

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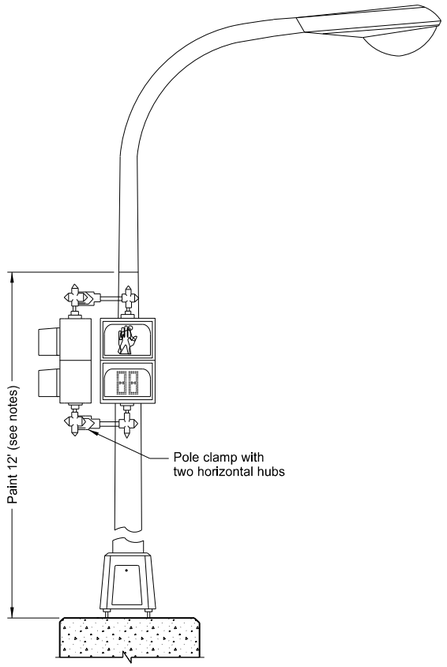
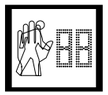
TRAFFIC SIGNAL HEAD MOUNTING

D-772-4

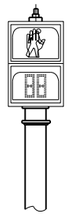


Light Standard Mounted
Pedestrian Signal Head (A)



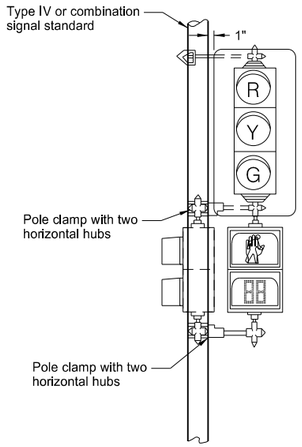
Pedestrian countdown timer

(A) See plans for the appropriate orientation and type of pedestrian signal head to use.



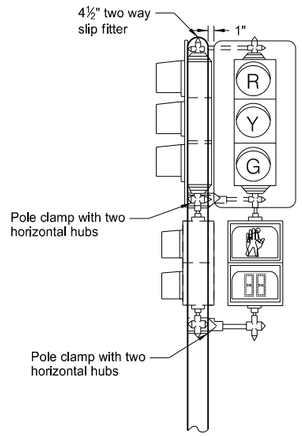
Type II

Pedestal Mounted - Pedestrian (A)



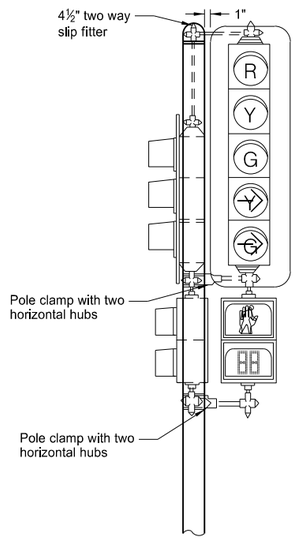
Type IV

Post Mounted - Vehicular
Post Mounted - Pedestrian (A)



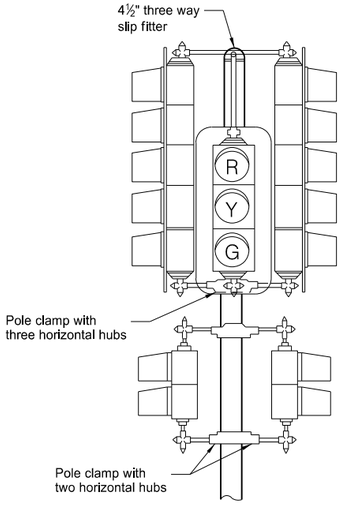
Type V

Post Mounted - Vehicular
Post Mounted - Pedestrian (A)



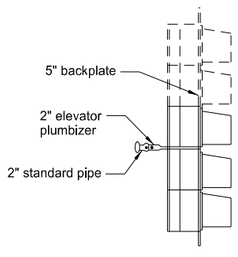
Type VI

Post Mounted - Vehicular
Post Mounted - Pedestrian (A)



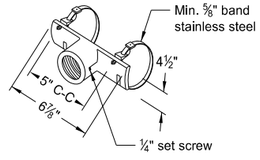
Type VII

Post Mounted - Vehicular
Post Mounted - Pedestrian (A)

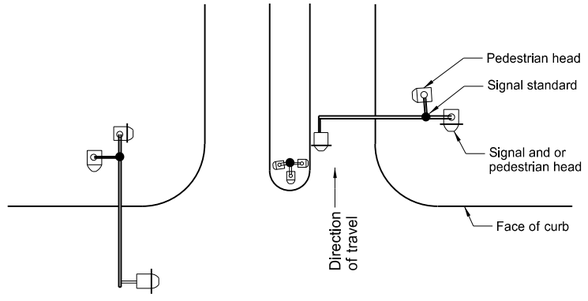


Side View

Mid-Span Mounted and
Mast Arm Rigid Mounted
Signal Heads

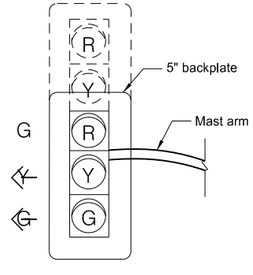


Mast Arm Signal
Head Bracket

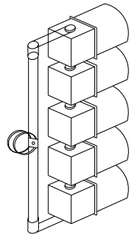


Plan Layout
(typical)

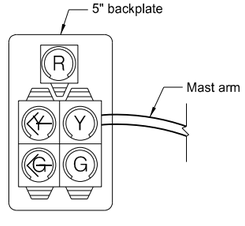
Note: Place signal heads behind the face of the curb.



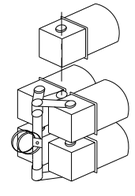
Front View



Isometric View



Front View



Isometric View

End Mounted and Mast Arm Rigid Mounted
Signal Heads

Notes:

Reinforcing Plates: Install reinforcing plates where mounting hardware attaches to signal heads when using polycarbonate signal heads. Where a plumbizer is used, place reinforcing plates on each side of the plumbizer.

Clearance: Place the bottom of post or pedestal mounted vehicular signal heads a minimum of 10 ft. and pedestrian signal heads a minimum of 8 ft. above the ground line or sidewalk.

Signal Heads: See traffic signal layout for correct mounting position, numbers, size, and arrangement of lenses.

Pole Clamps: A pole plate with suitable banding material, as approved by the Engineer, is allowed in place of pole clamps. Where traffic signal heads and pedestrian signal heads are mounted one above the other, one pole clamp assembly is allowed.

Paint: Paint signal housing yellow and backplates dull black. Paint pole clamps and signal head mounting hardware the same color as the signal standard shaft.

When pedestrian heads are light standard mounted, paint the lower 12 ft. the same color as the other traffic signal standards.

Mounting Details: All signal heads shown viewed from direction of travel.

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REVISIONS	
DATE	CHANGE
7-8-14 10-17-17 8-28-19	Added reinforcing plate note Updated to active voice. New Design Engineer PE Stamp.

This document was originally issued and sealed by Kirk J Hoff, Registration Number PE-4683, on 8/28/19 and the original document is stored at the North Dakota Department of Transportation