PRECAST INDUSTRY MEETING

ACPA Suggested Revisions

Jason Thorenson, PE
North Dakota State Bridge Engineer
Wed, October 29, 2025

NORTH Dakota
Be Legendary.

REVISIONS TO 714-1: REINFORCED CONCRETE PIPE CULVERTS AND END SECTIONS

- **D714-1:** Recommend adopting standard reinforcement tables for sizes/classes outside of AASHTO M170 such as MnDot's **3000M plate** for consistency, similar to what is shown for NDDOT's arch pipe on **714-2**.
  - >108" CL 2 or CL 3
  - >72" CL 4 Bwall
  - >84" CL 4 Cwall
  - >48" CL 5 Bwall
  - >66" CL 5 Cwall
  - NDDOT Response: We will review and revise as appropriate.

D-714-1

NOTES:

1. All reinforcing steel shall meet AASHTO M170 requirements.
2. All circular, longitudinal, and elliptical reinforcement shall be assembled and securely fastened in cage fashion so as to maintain reinforcement in exact shape and correct positions within the forms.
3. Laying length of pipe: 12" to 66" (incl.) = not less than 4 feet
   66" to 108" (incl.) = not less than 6 feet
4. Joints shall be sealed with rubber gaskets or with sealer approved by the engineer whenever pipe are specified for storm drain or sanitary sewers.
5. For Class IV and Class V reinforced concrete pipe and end section sizes which do not have reinforcement specified by AASHTO M170, shop drawings and design calculations shall be prepared and sealed by a Professional Engineer and submitted for the Engineer's review.

REVISIONS TO 714-1: REINFORCED CONCRETE PIPE CULVERTS AND END SECTIONS

Class III Reinforcement for End Sections

- Recommend changing to CL II to match other states. Rarely do end sections have traffic over them and generally have minimal soil loads.
- NDDOT Response: What is price difference between CL II & CL III? We currently specify CL III Bwall. How does this impact future pipe extensions? Would bell and spigot fit together?

REVISIONS TO 714-1: REINFORCED CONCRETE PIPE CULVERTS AND END SECTIONS

Joint Sealing for Concrete Pipe

- Recommend including the following table of allowable sealing methods for concrete pipe in 714.04-A.6 and Standard Drawing 714-1

Joint Sealing Method	Applicable Specifications
Filter Fabric	ASTM C990
Butyl Joint Sealant	ASTM C990
Rubber Gasket	ASTM C443, ASTM C1619

- NDDOT Response: We did not find any reference to filter fabric in ASTM C990, but 714.04-A.6 could be expounded on to be clarify what is required for pipe vs. storm drain vs. box culverts.

REVISIONS TO 714-1: REINFORCED CONCRETE PIPE CULVERTS AND END SECTIONS

Joint Sealing for Concrete Pipe

- Revise note to state, “Seal culverts and storm sewers using one of the listed methods. Engineer may elect to specify a particular joining method when stated in the project documents.”
- NDDOT Response: 714.04 A.6 of Standard Specs states:

6. **Joining Pipe.**
Provide rigid pipe with bell and spigot or tongue and groove joints. Join pipe sections so the ends are fully entered and the inner surfaces are flush and even. Wrap joints on concrete pipes in Type S2 geotextile fabric.

- NDDOT Response: Table 858-01 specifies ASTM test methods

D-714-1

NOTES:

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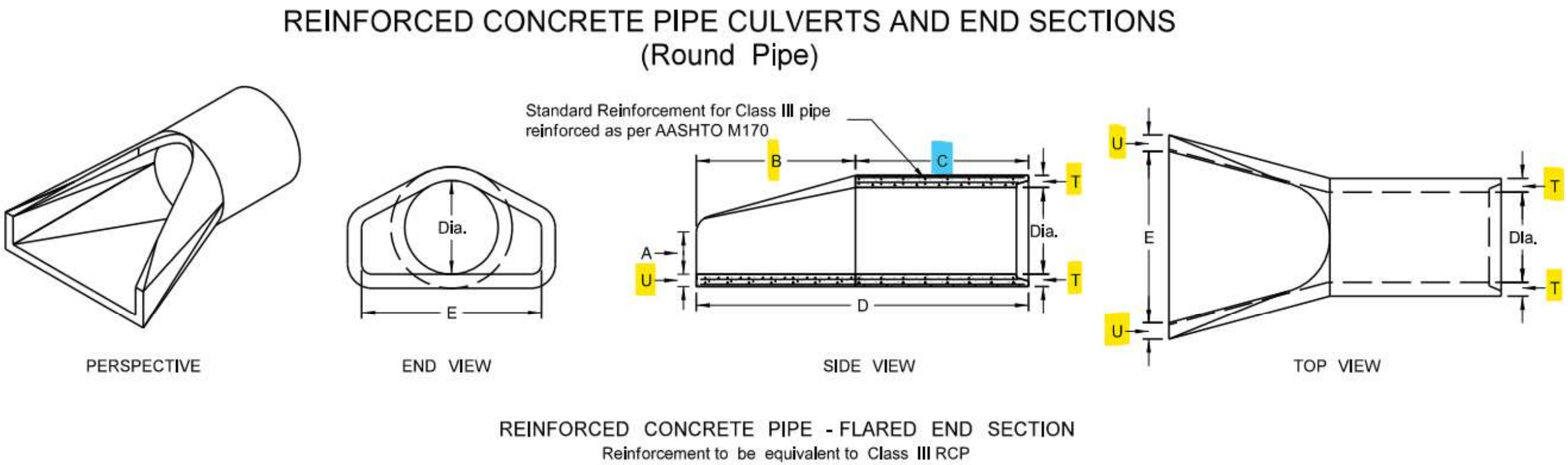
5. For Class IV and Class V reinforced concrete pipe and end section sizes which do not have reinforcement specified by AASHTO M170, shop drawings and design calculations shall be prepared and sealed by a Professional Engineer and submitted for the Engineer's review.

REVISIONS TO 714-1: REINFORCED CONCRETE PIPE CULVERTS AND END SECTIONS

Flared End Section Terminal Dimensions (Table)

- To accommodate other flared end variations set the B, U, and T dimensions as minimums and remove the C dimensions.
- NDDOT Response: Discuss with fabricators.



REVISIONS TO 714-1: REINFORCED CONCRETE PIPE CULVERTS AND END SECTIONS

All Classifications of Round Concrete Pipe (Table)

- Remove 102" size from table. This size is not manufactured.
- NDDOT Response: Discuss with fabricators.
- Create note for less-common/non-standard sizes [21", 27", 33"]: "These sizes are not readily available. Check with local producers for availability." May also make sense to remove these from the table and keep a separate table for historical reference when extensions may be needed.
- NDDOT Response: Discuss with fabricators.

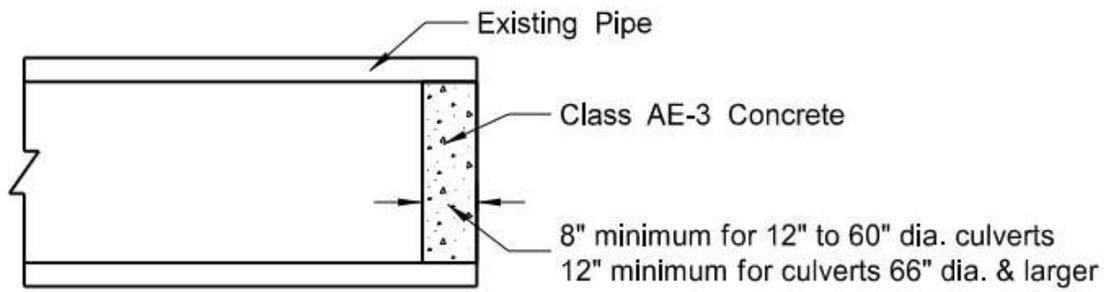
All Classifications of Round Concrete Pipe

Internal Dia.of pipe in Inches	Cross-Sectional Water Area	Weight per lin. foot of pipe Std. Wall	Joint J End Groove Min./Max.	Joint K Tongue End Min.	Minimum Wall Thickness (T)
Dia	Sq. ft.	Lbs.	In.	In.	In.
12	0.79	92	1⅝-2⅜	¾	2
15	1.23	127	1¾-2¾	⅞	2¼
18	1.77	168	1⅞-2⅞	1	2½
21	2.40	214	1⅞-3⅛	1⅛	2¾
24	3.14	265	2¾-3¾	1⅛	3
27	3.98	322	2¾-4	1¼	3¼
30	4.91	384	3¼-4¼	1¼	3½
33	5.94	452	3¼-4¼	1½	3¾
36	7.07	524	3¼-4¼	1½	4
42	9.62	685	3¾-4¾	1¾	4½
48	12.57	685	3⅝-4¾	1⅞	5
54	15.90	1070	4⅛-5¼	2	5½
60	19.63	1296	4½-5½	2¼	6
66	23.76	1542	5-6	2⅝	6½
72	28.27	1810	5⅝-6¾	2⅞	7
78	33.18	2098	6¼-7¼	2⅞	7½
84	38.48	2410	5⅝-7¾	3⅜	8
90	44.18	2793	6¾-8½	3⅛	8½
96	50.27	3092	7-8¼	3½	9
102	56.75	3466	7-8¼	3½	9½
108	63.62	3864	7¼-8½	3¾	10

REVISIONS TO 714-1: REINFORCED CONCRETE PIPE CULVERTS AND END SECTIONS

Concrete Pipe Plug Detail

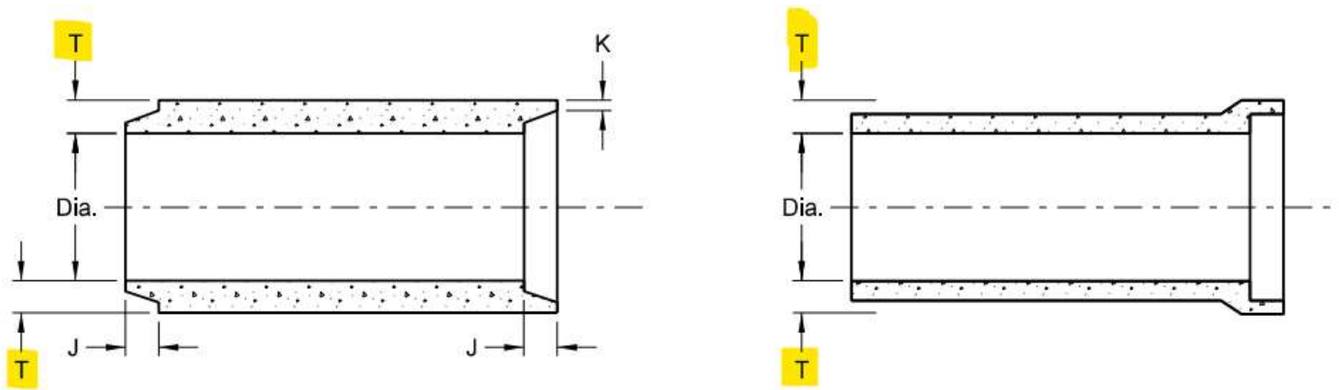
- Is there an option to use a precast plug/cap that would fit into the joint of the last section?
- NDDOT Response: Discuss with fabricators.



CONCRETE PIPE PLUG

Bell and Spigot Joint Detail

- T dimension should still be depicting the thickness of the wall. Recommend adding in a separate dimension for the distance that the bell protrudes past the barrel.
- NDDOT Response: We will revise.



TONGUE & GROOVE JOINT

BELL & SPIGOT JOINT

JOINTS FOR REINFORCED CONCRETE PIPE

REVISIONS TO 714-1: REINFORCED CONCRETE PIPE CULVERTS AND END SECTIONS

Fill Heights

- Recommending including a table for allowable fill heights of each class/size of pipe. Reference the ACPA LRFD fill height tables for concrete pipe. Reference MnDOT Technical Memorandum No. 20-05-B-01
  - NDDOT Response: We plan to review guidance in our drainage design manual rather than in contract documents since this is more of a design related issue.

REVISIONS TO 714-2: REINFORCED CONCRETE PIPE ARCH CULVERTS AND END SECTIONS

Standard Drawing 714-2

- **Reinforcement Table:** Some values need to be modified slightly (0.01 in^2/ft) to match AASHTO M206. For size/classes outside of AASHTO, consider adopting the recently re-designed steel requirements according to Minnesota DOT plate 3014L. It would be good for these states to have compatible designs.
- NDDOT Response: We agree with comments and will revise as appropriate.
- **Maximum Stirrup Spacing:** Recommend changing to "Maximum spacing of stirrups shall conform to AASHTO LRFD Bridge Design Specifications section 12.10.4.2.6-4."
- NDDOT Response: We agree with comments and will revise as appropriate.
- **Class III Reinforcement for End Sections:** Recommend changing to Class II to match other states. Rarely do end sections have traffic over them and generally have minimal soil loads.
- NDDOT Response: What is price difference between CL II & CL III? We currently specify CL III Bwall. How does this impact future pipe extensions? Would bell and spigot fit together?

REVISIONS TO 714-2: REINFORCED CONCRETE PIPE ARCH CULVERTS AND END SECTIONS

Standard Drawing 714-2

- **Class IV & V Design Calculations:** Class V pipes fall into the category of special design and fall outside of standard classifications for arch pipe. Instead of listing Class V, designers should list required D-load. For Class IV pipes, stamped designs should not be required when standard tabulated designs are available.
- NDDOT Response: We plan to review and revise as appropriate.

f_c (KSI) = Minimum compressive strength of concrete in thousands of lbs. per square inch.

Laying length of pipe shall not be less than 6 feet for size 84" and larger.

¾" Minimum Reinforcement cover.

Reinforced Concrete Pipe Arch & End Sections shall conform to Sec. 714 of the Std. Specs.

Design of End Sections shall conform to Class III Reinforced Concrete Pipe Arch. For Class IV and Class V reinforced concrete pipe arches and end sections, shop drawings and design calculations shall be sealed by a Professional Engineer and submitted for Engineer's review.

Tolerance in Rise and Span = + 2% of Tabular values.

Tolerance in Wall thickness (T) = Not less than Design T by more than 7% or ¼".

Dimension "U" and "V" is measured on the ℄ of the Culvert wall.

REVISIONS TO 714-2: REINFORCED CONCRETE PIPE ARCH CULVERTS AND END SECTIONS

Standard Drawing 714-2

- **Wall Thickness Tolerance:** Please clarify between 7% and ¼" whether it is whichever is largest or smallest.
- NDDOT Response: We believe this should include, "whichever is less" at the end.

f_c (KSI) = Minimum compressive strength of concrete in thousands of lbs. per square inch.

Laying length of pipe shall not be less than 6 feet for size 84" and larger.

¾" Minimum Reinforcement cover.

Reinforced Concrete Pipe Arch & End Sections shall conform to Sec. 714 of the Std. Specs.

Design of End Sections shall conform to Class III Reinforced Concrete Pipe Arch. For Class IV and Class V reinforced concrete pipe arches and end sections, shop drawings and design calculations shall be sealed by a Professional Engineer and submitted for Engineer's review.

Tolerance in Rise and Span = + 2% of Tabular values.

Tolerance in Wall thickness (T) = Not less than Design T by more than 7% or ¼".

Dimension "U" and "V" is measured on the ℄ of the Culvert wall.

REVISIONS TO 714-22: CONCRETE PIPE, CATTLE PASS, OR PRECAST CONCRETE BOX CULVERT TIES

Standard Drawing 714-22

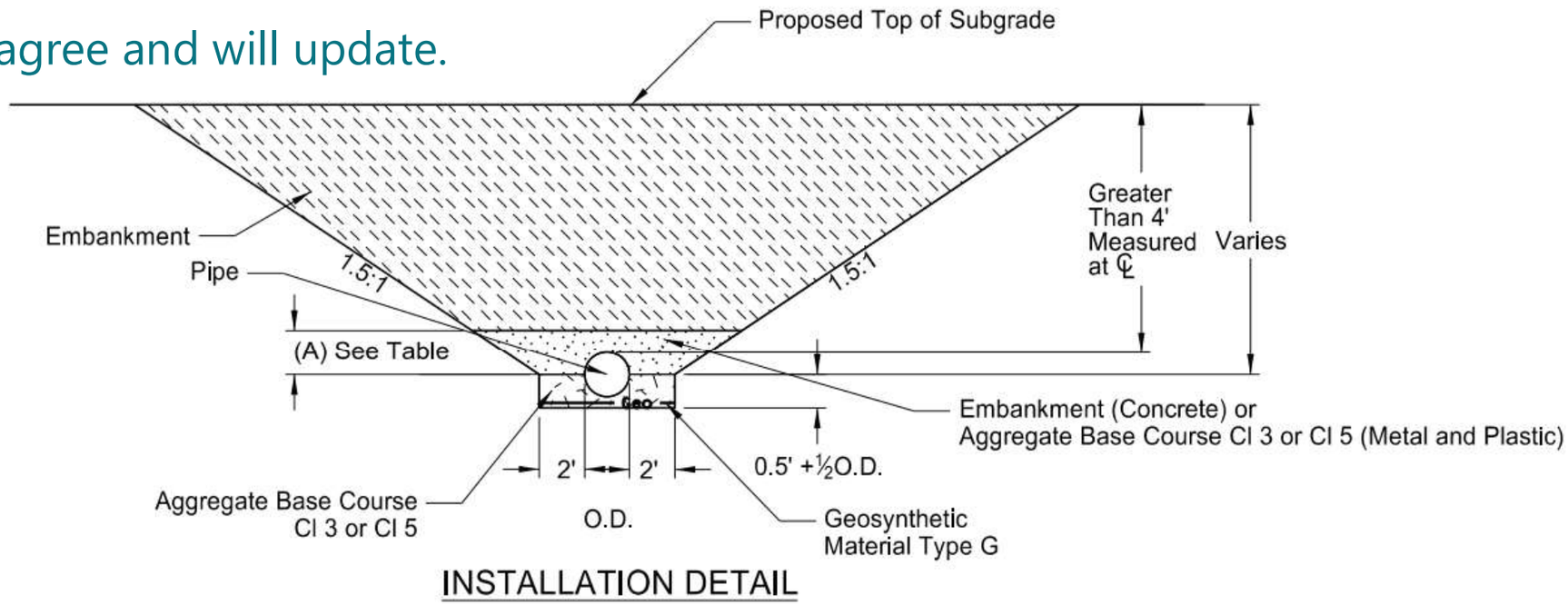
- **Detail A & Detail B:** Remove tack weld requirement for installed tie bolt nuts. No other state requires tack welding in-field or lock washers. There are no known issues with tie-bolts undoing themselves after installation, so it would not be justified to include this as an additional requirement. Lockwashers are a possibility but are more costly and hard to get domestically to meet Buy-America requirements.
- NDDOT Response: We revised to allow lock washers or burr threads but are planning to remove this requirement.
- **End View:** Show detail for box culverts with tie bolts. (MN and IA both use single tie bolts on each side) Include location of tie bolts at third points on sides of box but add note that for inside rises of 6’ or less that only single ties at a set location would be required.
- NDDOT Response: We agree with guidance to allow single ties for rises of 6’ or less.

REVISIONS TO 714-25-28M: TRANSVERSE MAINLINE PIPE INSTALLATION DETAIL-PIPE > 4’ BELOW TOP OF SUBGRADE

Standard Drawing 714-25, 25M, 27, 27M, 28, 28M

- **Backfill Dimensions (Table):** ‘A’ dimension should be 0, not 0.5*OD to match national standards and surrounding states. Structurally this does not need to be up to top of pipe. Concrete pipe only benefits from the soil beneath the springline or mid-height of the pipe cross section. See ASTM C1479, (Fig 2) and AASHTO Section 27 (Fig 27.5.2.2.1) for reference.
- NDDOT Response: We agree and will update.

Backfill Dimensions	
Pipe Materials	Dimension (A)
Concrete	0.5 O.D.
Metal and Plastic	0.5 O.D. + 1 Foot



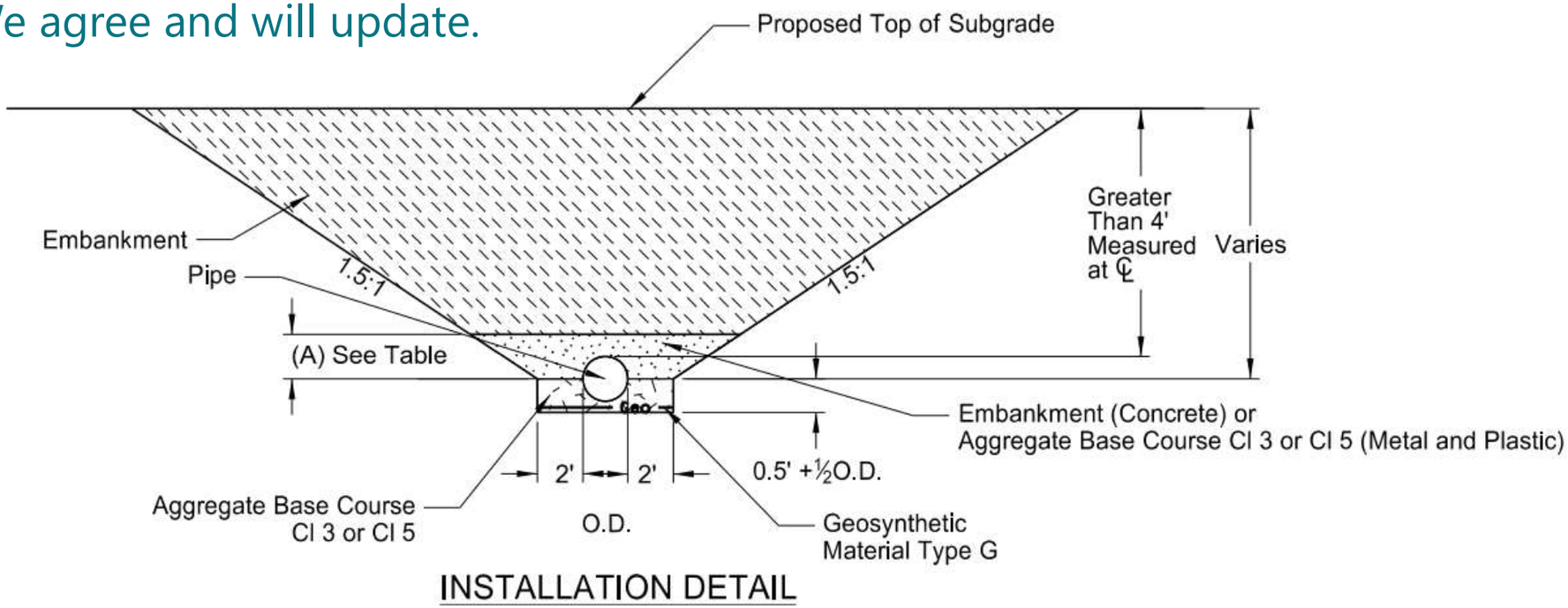
INSTALLATION DETAIL

REVISIONS TO 714-25-28M: TRANSVERSE MAINLINE PIPE INSTALLATION DETAIL-PIPE > 4’ BELOW TOP OF SUBGRADE

Standard Drawings <u>714-25</u>, 25M, 27, 27M, 28, 28M

- **Installation Detail:** Would make more sense to include a dimension for the transitional material (from mid point to 1’ above top of pipe) and then keep the note to use embankment material for concrete and Aggregate Base Course Class 3/5 for plastic and metal.
- NDDOT Response: We agree and will update.

Backfill Dimensions	
Pipe Materials	Dimension (A)
Concrete	0.5 O.D.
Metal and Plastic	0.5 O.D. + 1 Foot



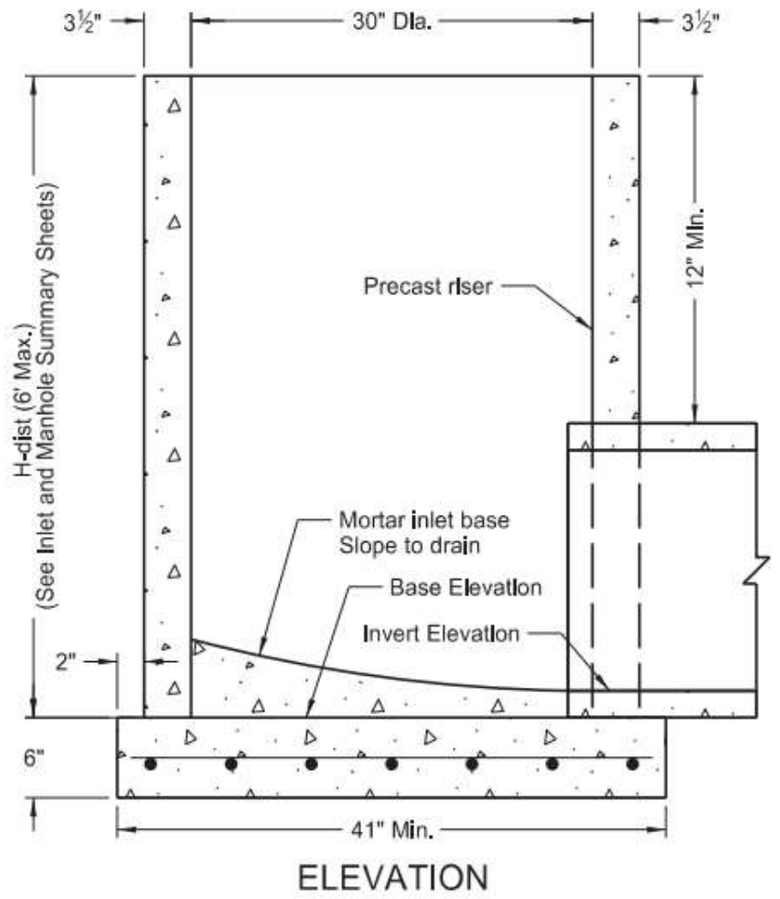
INSTALLATION DETAIL

REVISIONS TO 722-1, 1A, 1B, 2, 3, 3A, 5: INLET-TYPE 1, CATCH BASIN, INLET-SPECIAL, INLET-TYPE 2, INLET-MOUNTABLE CURB, INLET-SLOTTED DRAIN, MANHOLE DETAILS

Standard Drawings 722-1, 1A, 1B, 2, 3, 3A, & 5

- **Manhole/Inlet Detail (Elevation View):** Add note "Use mortar to connect concrete pipes to concrete structures. Use flexible connections conforming to ASTM C923, when connecting flexible (plastic or metal) pipes to concrete structures." Flexible pipes do not bond well to concrete and have other issues related to deflection and thermal expansion/contraction that can cause issues at the connection point."
- NDDOT Response: Plan to update 722.04C and Standard Specification 714.04 A.9.

C. Pipe Connections.
Place pipe so that the inside end protrudes through the inside wall a minimum of 2 inches. Place mortar around the pipe.



ELEVATION

REVISIONS TO 722-1B: INLET-SPECIAL

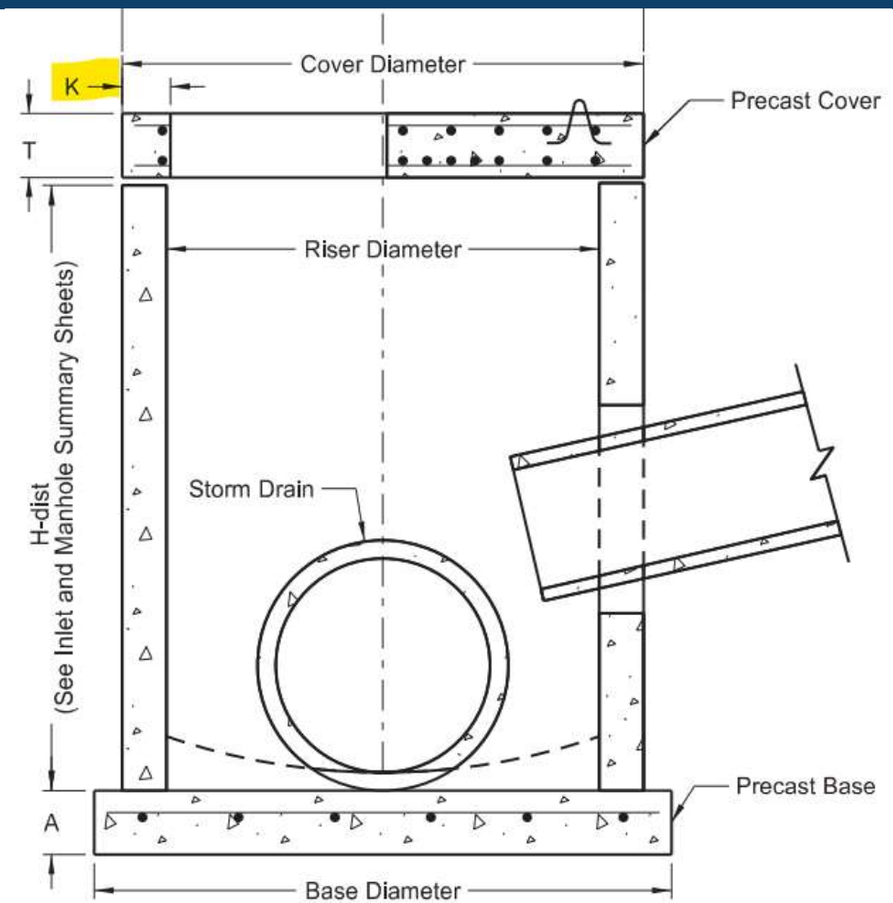
Standard Drawing <u>722-1B</u>

- **Manhole/Inlet Detail (Elevation View):** K dimension should be defined somewhere (typically manhole wall thickness + 1")
- NDDOT Response: This dimension is defined on D-722-5 which is referenced below the detail. However, it would make sense to have on this standard as well. There's plenty of room.

PRECAST MANHOLE COVERS

RISER DIAMETER	COVER DIAMETER	WEIGHT OF SECTION	T	K	L	BOTTOM * BARS	TOP * BARS
48"	58"	1,080 Lb	6"	6"	8"	#4 at 6"	—
54"	65"	1,910 Lb	8"	6"	8"	#4 at 6"	—
60"	72"	2,430 Lb	8"	7"	9"	#4 at 6"	#4 at 11"
66"	79"	3,010 Lb	8"	7"	9"	#4 at 6"	#4 at 11"
72"	86"	3,640 Lb	8"	8"	10"	#4 at 6"	#4 at 11"
84"	100"	5,060 Lb	8"	9"	11"	#5 at 6"	#5 at 11"
96"	114"	6,695 Lb	8"	9"	11"	#5 at 6"	#5 at 11"
108"	128"	12,810 Lb	12"	10"	12"	#5 at 6"	#5 at 11"
120"	142"	15,900 Lb	12"	11"	13"	#5 at 6"	#5 at 11"

* - Place reinforcement listed in each direction.



ELEVATION

MANHOLE

(See Standard Drawing D-722-5)

REVISIONS TO SECTION 606 PRECAST REINFORCED CONCRETE BOX (PRCB) CULVERTS

- **606.03-A:** Replace “Steel Strand, Uncoated Seven-Wire for Concrete Reinforcement 836.03E” with “Reinforcing Steel, Dowel Bars, and Tie Bars 836.02 or 836.03”
- NDDOT Response: We agree with recommended language and will revise.
- **606.04-A:** Recommend adoption of either MnDOT or Iowa DOT box standards with any variations or special provisions listed here. Use of a consultant to verify designs and recommend revisions could be an easy way to expedite.
- NDDOT Response: We are working toward development of box culvert standards

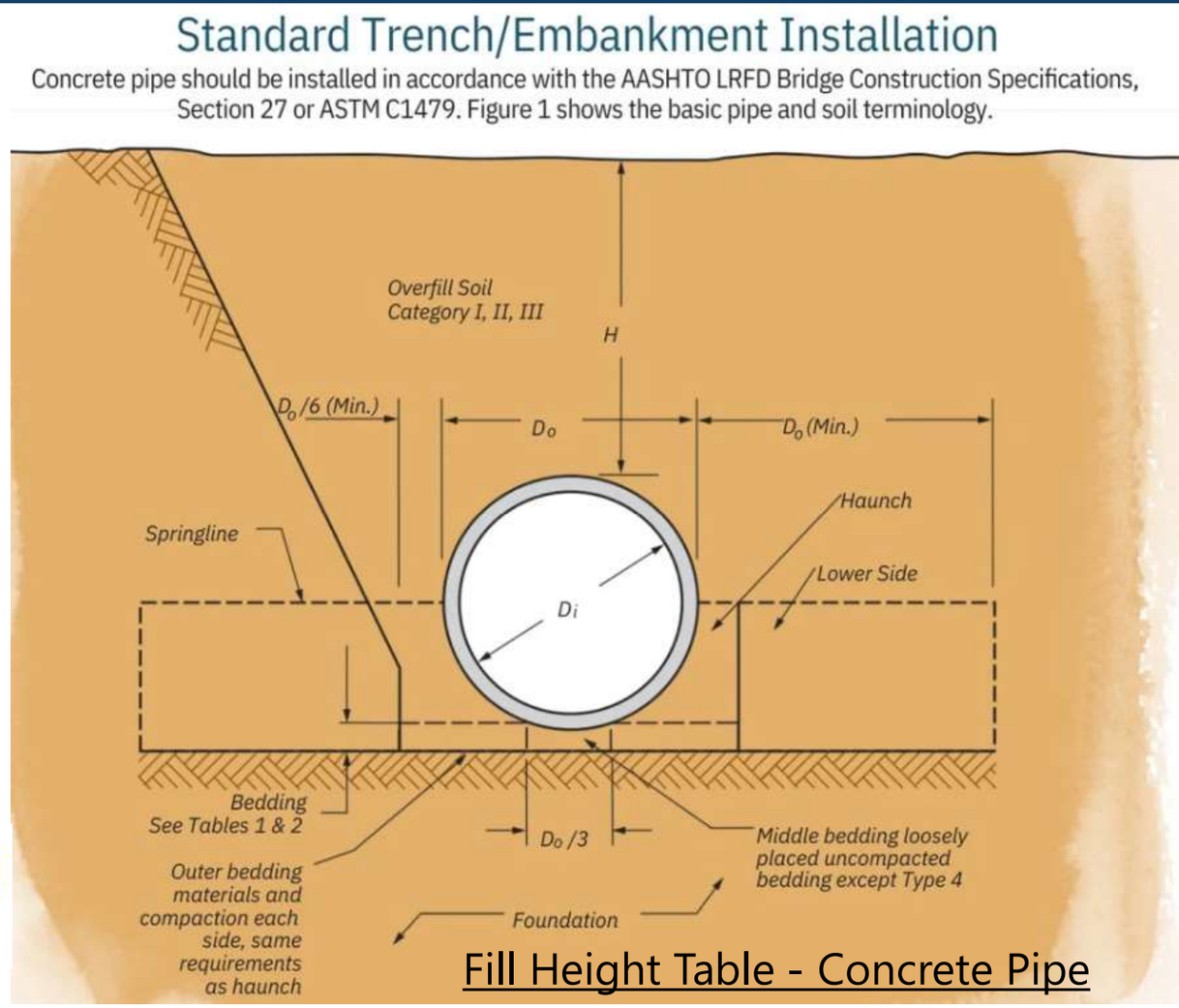
REVISIONS TO SECTION 606 PRECAST REINFORCED CONCRETE BOX (PRCB) CULVERTS

- **606.04-B:** Revise note to state, “Precast sections shall meet 3,000 psi prior to shipment. Design strength should shall be 5,000 psi achieved prior to backfilling.” Reference to 28-days should be removed since precast design strengths are generally achieved much sooner than that.
- NDDOT Response: We have reached out to NCSC and are awaiting responses.
- **606.04-E.3:** Recommend replacing “watertight” with “soil tight”. ASTM C990 states: “This specification covers joints for precast concrete pipe and box, and other sections using preformed flexible joint sealants for use in storm sewers and culverts which are not intended to operate under internal pressure, or are not subject to infiltration or exfiltration limits. Joint material used in horizontal applications is intended to prevent the flow of solids through the joint.”
- NDDOT Response: We agree that this should be soil tight, not water tight.

REVISIONS TO SECTION 714 CULVERTS, STORM DRAINS, EDGEDRAINS, AND UNDERDRAINS

- **714.04-A.5:** Recommend removing reference to shaped bedding and replace with, "Bedding in the middle 1/3 of pipe O.D. shall be loosely placed." Use requirements of AASHTO sections 27 and 30 of the AASHTO LRFD Bridge Construction Specifications as a reference.
  - Section 27 (RCP) – Minimum 3" bedding with middle 1/3 uncompacted. 6" required with rocky foundation.
  - Section 30 (Thermoplastic) – Minimum not specified, maximum bedding thickness of 6" with the middle third uncompacted.
- NDDOT Response: Plan to review/revise as appropriate

5. Laying Pipe.
Begin laying pipe at the downstream end. Place the pipe in contact with the shaped bedding throughout its full length. Place bell or groove ends of rigid pipe and outside circumferential laps of flexible pipe facing upstream.



Fill Height Table - Concrete Pipe

REVISIONS TO SECTION 714 CULVERTS, STORM DRAINS, EDGEDRAINS, AND UNDERDRAINS

- **714.04-A.8:** Visual inspection cannot detect deflection until 12% - 15% deflection is in place. Mandrel should be pulled on these unpaved approaches as well as mainline and paved intersecting roadways.
- NDDOT Response: We're not certain a mandrel is necessary.

8. Deflection Testing.

Test all metal and thermoplastic pipe used for mainline and paved intersecting roadways for deflection a minimum of 30 days after the pipe is installed. Pass a nine point mandrel or other approved object through the pipe to check for deflection. Use a mandrel with a diameter not less than 95 percent of the inside diameter of the pipe. If the mandrel cannot be passed through the pipe, replace the pipe.

The Engineer will visually inspect all metal and thermoplastic pipe under unpaved approaches for deflection. If the Engineer sees any deflection, the Engineer will require the Contractor to pass a nine point mandrel or other approved object through the pipe to check for deflection. Use a mandrel with a diameter not less than 95 percent of the inside diameter of the pipe. If the mandrel cannot be passed through the pipe, replace the pipe.

Perform the deflection test under the observation of the Engineer.

REVISIONS TO SECTION 714 CULVERTS, STORM DRAINS, EDGEDRAINS, AND UNDERDRAINS

- **714.04-A.12:** Recommend using minimum construction cover per the AASHTO LRFD Bridge Construction Specifications. AASHTO Table 26.6-1 provides a table of minimum cover over corrugated metal pipe based on pipe span and axle load. AASHTO Section 27.5.4.4 requires 3’ minimum cover over reinforced concrete pipe. AASHTO Table 30.5.5-1 provides a table of minimum cover over thermoplastic pipe based on pipe diameter and axle loads.

12. Construction Cover.
Meet the pipe manufacturer’s recommendation cover requirements during construction operations.

Repair or remove and replace any pipe damaged by construction traffic.

- NDDOT Response: NDDOT Design Manual Appendix V-05 A includes minimum cover requirements for design purposes. This should be reviewed and revised as appropriate.
  - NDDOT Design Manual.docx

REVISIONS TO SECTION 724 WATER MAINS, WATER LINES, AND SEWER LINES

- **724.04-B.2:** Recommend removing reference to shaped bedding and replace with, "Bedding in the middle 1/3 of pipe O.D. shall be loosely placed." Use requirements of AASHTO sections 27 and 30 of the AASHTO LRFD Bridge Construction Specifications as a reference.
  - Section 27 (RCP) – Minimum 3" bedding with middle 1/3 uncompacted. 6" required with rocky foundation.
  - Section 30 (Thermoplastic) – Minimum not specified, maximum bedding thickness of 6" with the middle third uncompacted.
- NDDOT Response: We plan to review and revise as appropriate.

2. Bedding and Encasement.
Tamp the bedding to provide uniform bearing along the entire length of the pipe. Shape the bedding material so that after placing the pipe, the bedding extends up the sides of the pipe a distance of 1/3 the pipe diameter. Tamp the encasement without displacement of the pipe.

E. Sanitary Sewer Pipe.
Lay the sewer pipe from the lower end with the spigot ends pointing in the direction of flow. Place the lower segment of the pipe in contact with the shaped bedding throughout its full length and check for line and grade before placing the next segment. Remove all deleterious material from the pipe and bell before placing the pipe.

REVISIONS TO SECTION 802 PORTLAND CEMENT CONCRETE

- **802.01-A.1:** Recommend changing air entrainment note to read “All wet-cast concrete (slump > 0”) shall be air entrained” SECTION 804 CEMENT AND LIME
- NDDOT Response: We have removed note from 802.01 A.1. 802.01 D states the following:

3. Air Content.
Supply concrete with an air content between 5.0 and 8.0 percent of the volume of the concrete at the time of placement.

REVISIONS TO SECTION 804 CEMENT AND LIME

- **804.01:** Recommend removing MS designation from Type IL.
- NDDOT Response: We plan to review with Materials and Research Division

804.01 CEMENT

Use one of the following materials:

- Portland Cement that meets the requirements of AASHTO M 85, Type II; or
- Blended Hydraulic Cement that meets the requirements of AASHTO M 240, Type IL(MS); or
- Blended Hydraulic Cement that meets the requirements of AASHTO M 240, Type IS(MS).

REVISIONS TO SECTION 830 PIPE AND DRAINAGE STRUCTURES

- **830.01-B:** Recommend revising to address all pipe materials.
  - "Submit calculations for all pipe materials, according to Section 12 of the latest edition of the AASHTO LRFD Bridge Specifications. Loads and Load Factors shall be in accordance with AASHTO. Standard Class II, III, IV, and V concrete pipes are preapproved provided they are in accordance with ACPA LRFD Fill Height Tables for Type 3 installations (or reference standard details 714-1 and 714-2 if fill height tables are adopted there). Calculations for all other pipe runs must be signed, sealed, and dated by a Professional Engineer registered in the State of North Dakota as set forth in NDCC Title 43."
  - NDDOT Response: We plan to review and revise as appropriate.

B. Work Drawings.

Provide work drawings for Class IV and V Pipes that include:

- Reinforcing steel layouts;
- Type and strength of concrete and reinforcing steel;
- All concrete and reinforcing dimensions;
- Installation and handling instructions; and
- Design calculations.

Submit calculations and work drawings that are signed, sealed, and dated by a Professional Engineer registered in the State of North Dakota as set forth in NDCC Title 43.

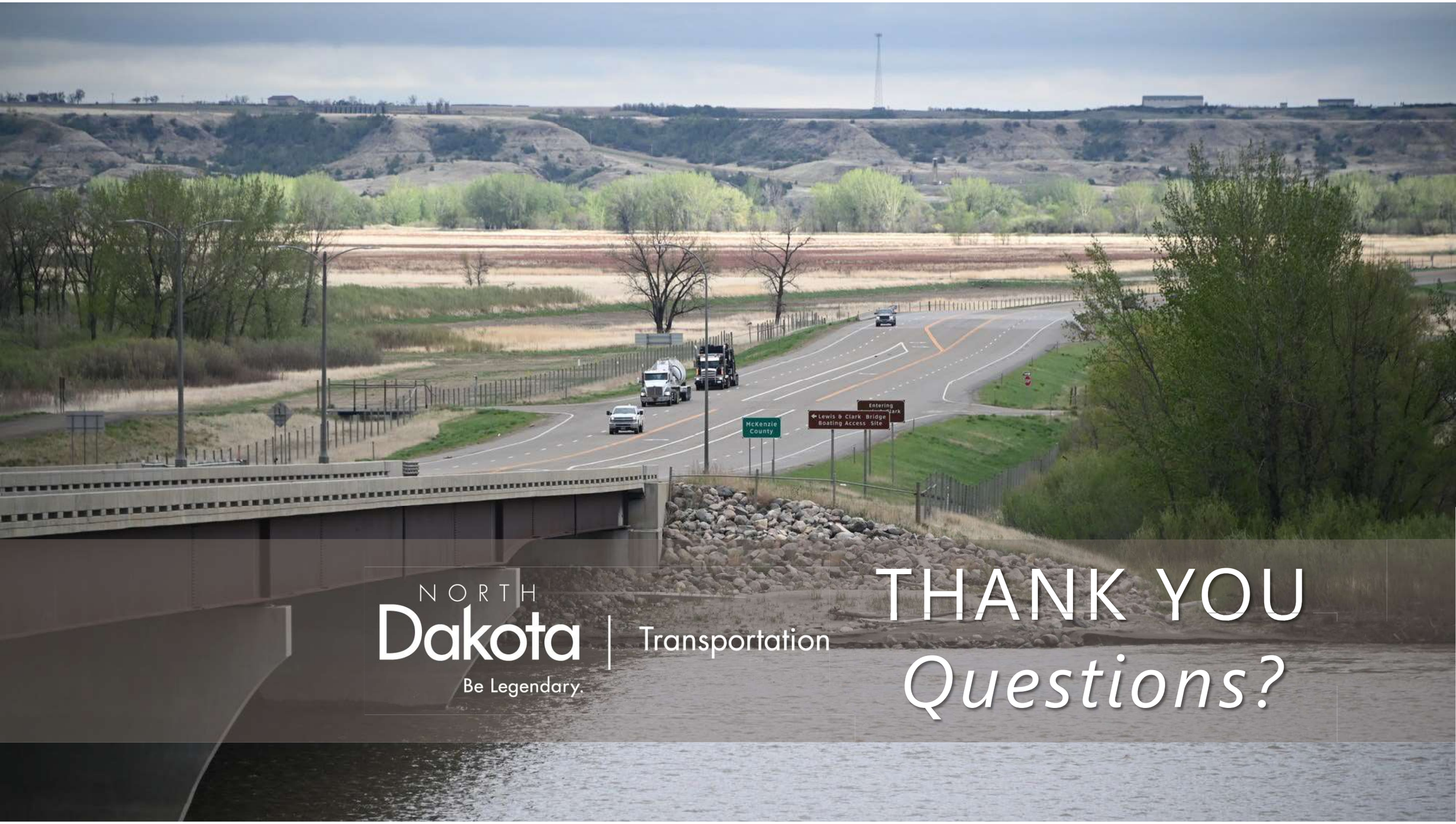
REVISIONS TO SECTION 830 PIPE AND DRAINAGE STRUCTURES

- **830.03-F:** Provide corrugated polyethylene culverts that meet AASHTO M252, Type S using only virgin material.
- NDDOT Response: This should be discussed with relative industry suppliers prior to making any changes.

F. Corrugated Polyethylene Culverts.
Provide corrugated polyethylene culverts that meet AASHTO M 294, Type S.

REFERENCE INFORMATION

- Standard Specifications for Road & Bridge Construction
- NDDOT Design Manual Chapter IV: Structural Design
- NDDOT Design Manual Chapter V: Hydraulic Studies and Drainage Design
- NDDOT Standard Drawings
- MnDOT Design Standards
- MnDOT Technical Memorandum No. 20-05-B-01
- ACPA LRFD Fill Height Tables



NORTH Dakota | Transportation

Be Legendary.

THANK YOU

Questions?