SECTION 02502

SHARED USE PATHS

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes the work required for construction of a concrete or Hot Mix Asphalt (HMA) shared use path.

B. Provide Shared Use Path is areas indicated on Township Master Plan.

C. Definitions:
   1. Pavement Structure: All combinations of subbase, base course, and HMA or concrete surface course, including shoulders, placed on a subgrade. Pavement includes HMA or concrete surface.
   2. Subgrade: The portion of the earth grade upon which the pavement structure is placed.
   3. Subbase: The layer of specified material of designed thickness placed on the subgrade as a part of the pavement structure.
   4. Base Course: The layer or layers of specified material of designed thickness placed on a subbase or subgrade to support a surface course.
   5. Leveling Course: The layer of specified material of designed thickness placed on the base course in preparation for the surface course.
   6. Surface Course: The top layer of a pavement structure.
   7. Bond Coat: Asphalt emulsion used to enhance the adhesion between HMA courses.

1.02 REFERENCES:

A. MDOT - Michigan Department of Transportation, "*Standard Specifications for Construction", 2012 Edition.*

B. MDOT – Road Design Manual.

C. AASHTO – 2012 Guide for the Development of Bicycle facilities

D. ASTM - American Society of Testing Materials, latest edition.

E. ADAAG – Americans with Disabilities Act Accessibility Guidelines.

F. MTM – Michigan Test Methods, latest edition.

1.03 SUBMITTALS:

A. Certification of quality by producer for the following:
   1. Cement
   2. Aggregates
   3. Asphalt cement
   4. Bond coat

B. Test Specimens and samples: Deliver to the place of inspection and testing.

C. Mix Design: Provide job-mix formula prepared by independent lab or approved by MDOT one week prior to placement.

D. Submittal of as-built plans to the Township upon completion of project.

1.04 JOB CONDITIONS:

A. Weather and Seasonal Limitations:

1. Concrete shall not be placed between November 1 and April 1, unless authorized by the TOWNSHIP. Concrete shall not be placed when the air temperature in the shade is less than 40 degrees Fahrenheit and falling. Concrete shall not be placed if portions of the base, subbase, or subgrade are frozen, or if the grade exhibits poor stability from excessive moisture levels. Chemicals shall not be added to reduce the freezing point. Any deviation from the above, when authorized, will require protection from freezing until the concrete has attained a compressive strength of at least 1,000 psi (1,000 psi strength will typically be attained after 2 days of curing). Concrete damaged by frost action shall be removed and replaced.

2. HMA: Comply with MDOT 501.

B. Clean-up promptly following pavement installation.

C. Maintenance of Temporary Surfaces: Maintain temporary surfaces until permanent pavement installation is completed.

D. Driveway Closing: 24-hour maximum, plus an additional 96 hours (4 days) for curing of concrete, if applicable. Provide proper notice to property owner. Maintain access to property with aggregate or bituminous millings as necessary until the driveway is restored.

E. Protect areas under construction with lighted barricades and reflectorized fencing in accordance with applicable MDOT, MIOSHA and ASHA regulations.

F. Allow access to the hot mix asphalt plant for verification of mix proportions, aggregate gradation, and temperatures.

G. Provide easement to TOWNSHIP from public road right-of-way to minimum 2 feet from back edge of path.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Subbase: Granular material MDOT Class II, MDOT 902.

B. Aggregate Base: Aggregate 22A, MDOT 302 and 902.

C. Hot Mix Asphalt (HMA): Mix LVSP, MDOT 501.

D. Bond Coat: SS-1h, MDOT 501.

E. Concrete: Limestone aggregate, 5½ sack minimum, 4% to 7% entrained air, five (5) gallons per sack maximum water/cement ratio, 3-inch slump maximum, 3,500 psi minimum compressive strength at 28 days.

F. Concrete Curing Material: MDOT 903.

G. Concrete Joint Filler: MDOT 914.03.

H. Forms: Rigid in accordance with MDOT 803.03B, except at curved sections which shall utilize a bendable material to provide a uniform radius, supported at adequate intervals.

I. Detectable Warning Surfaces:
   1. Cast ductile iron plate with anchor lugs.
   2. Slip resistant textured surface.
   3. Color and finish: Black asphalt dip.
   4. Provide width to match path width.
   5. Meet ADAAG.
   6. Manufacturer: East Jordan Iron Works or Neenah Foundry Company.

PART 3 - EXECUTION

3.01 EQUIPMENT:

A. MDOT 806.

3.02 PREPARATION:

A. Removal: Remove or saw cut at the existing joint or line marked by OWNER's ENGINEER in area of removal.

B. Disposal of all removed material shall be performed by the CONTRACTOR. Keep all removed material off private property at all times.

C. For concrete path crossing asphalt drives: Saw cut and remove existing asphalt at specified path location and width, and use the saw cut pavement edges as forms, unless a clean straight edge of adequate thickness is not feasible. If the existing drive is concrete within 3 feet of the path edge, remove existing asphalt and replace with concrete.

D. Cut and protect tree roots as directed by the OWNER's ENGINEER and TOWNSHIP.

E. Excavation: Form subgrade by trenching, excavating or filling to the required elevation. Prepare base in accordance with MDOT 806.

F. Notify OWNER's ENGINEER and TOWNSHIP if unsuitable material exists below subgrade. Remove unsuitable material as directed by OWNER's ENGINEER and TOWNSHIP and replace with subbase to elevation required for bottom of aggregate base course or concrete. If depth of unsuitable material is greater than 2 feet, consult with OWNER'S ENGINEER and TOWNSHIP to obtain instructions on how to proceed.

G. Compact subbase to 95% maximum density.

H. Scheduling: Maximum time between removal and replacement, or between excavation and placement, shall be 7 days.

3.03 PERFORMANCE (HMA PATH): MDOT 806 and these specifications.

A. Shared Use Path and Ramp Requirements:
   1. All shared use paths shall be 10 feet minimum width, with the cross slope of ¼ inch per foot from the back of path towards the street, unless otherwise directed.
      a. Provide minimum 2-foot wide graded shoulders.
      b. Provide minimum 2-foot horizontal and 8-foot vertical clearance of obstructions.
   2. The elevation at the back of path shall be 6-inches above the road centerline, unless otherwise approved.
   3. All HMA shared use paths shall be a minimum of 250 lbs/syd HMA over 6 inches of aggregate base over 10 inches of subbase.
   4. Ramps shall have a uniform grade except as necessary for short grade changes and shall be in conformance with ADAAG and these specifications. Detectable warning surfaces shall be provided.
   5. Ramps shall be 8-inch thick concrete with WW mesh reinforcement.
   6. The space behind the curb and between ramps at intersection corners shall be concrete (8-inch thick with WW mesh reinforcement), brick pavers (concrete brick over sand bedding over 6-inch thick concrete with WW reinforcement) or pre-approved landscaping.
   7. Detectable warning surfaces:
      a. Provide for tactile and visual warning that contrast visually with adjacent walking surfaces, either light-on-dark or dark-on-light.
      b. Provide cast ductile iron detectable warning plates embedded into newly cast concrete. Provide same width as path, minimum. Install in accordance with manufacturer's recommendations, ADAAG and these specifications. Surface applied products will not be allowed. Do not construct detectable warnings by forming or stamping in newly cast concrete.
      c. Provide detectable warning plates on all ramps for path crossings of public roads, private roads that are stop sign controlled, and commercial driveways that are stop sign controlled or experience high traffic volumes that would warrant a safe path crossing of the drive. Ottawa County Road Commission requirements for providing detectable warning surfaces on ramps on public roads and at commercial drives shall be met.

B. Subbase:
   1. Thickness: Conform to design cross section.
   2. Construction method:
      a. Place in equal layers not exceeding 15-inches loose measure.
      b. Spread evenly and compact to not less than ninety-five percent (95%) maximum density according to Michigan Sand Cone Test.
   3. Tolerance: Construct subbase to plan grade within a tolerance of $\pm$ 0.5 inch.

C. Aggregate Base:
   1. Thickness: Conform to design cross section.
   2. Construction Method: MDOT 302.03.
   3. Tolerance: Shape the aggregate base course plan grade and cross section within a tolerance of 0.25 inch.

D. Bond Coat:
   1. Construction Method: MDOT 501.03.D.
   2. Application Rate: Provide 0.15 gallon per square yard.

H. Hot Mix Asphalt Leveling and Surface:
   1. Cutting: Saw vertically in straight lines parallel or perpendicular to pavement centerline.
   2. Thickness: Do not place hot mixed asphalt surface course mixture in lifts exceeding 2 inches unless otherwise approved. Provide design thickness.
   3. Construction Methods:
      a. Paving: Conform method of paving to MDOT 501.03.
      b. Prior to placement of hot mixed asphalt surface, verify crowns and grades of path for positive drainage. Any deficiencies in grade or crown shall be corrected prior to placement of surface course.

I. Hot Mix Asphalt (HMA) Patching:
   1. Preparation: Saw cut vertically in straight lines parallel or perpendicular to pavement centerlines. Minimum dimension of area to be patched shall be 2 feet for placement and compaction of materials.
   2. Aggregate Base: Provide a minimum of 6 inches of Aggregate 22A compacted in place.
   3. HMA Mixture: MDOT Mix LVSP.
      a. Thickness: Match existing pavement thickness (minimum 2 inches).

3.04 PERFORMANCE (CONCRETE PATH): MDOT 806 (except for joint spacing) and these specifications.

A. Shared Use Path and Ramp Requirements:
   1. All shared use paths shall be 10 feet minimum width, with the cross slope of ¼ inch per foot from the back of path towards the street, unless otherwise directed.
      a. Provide minimum 2-foot wide graded shoulders.
      b. Provide minimum 2 foot horizontal and 8-foot vertical clearance of obstructions.
   2. The elevation at the back of path shall be 6 inches above the road centerline, unless otherwise approved.
   3. All concrete shared use paths shall be a minimum of 5-inch thick over 10 inches of subbase. The concrete path thickness shall be 6 inches across all residential drives and 8 inches across all commercial/industrial drives.
   4. Ramps shall have a uniform grade except as necessary for short grade changes and shall be in conformance with ADAAG and these specifications. Detectable warning surfaces shall be provided.
   5. Ramps shall be 8-inch thick concrete with WW mesh reinforcement.
   6. The space behind the curb and between ramps at intersection corners shall be concrete (8-inch thick with WW mesh reinforcement), brick pavers (concrete brick over sand bedding over 6-inch thick concrete with WW reinforcement) or pre-approved landscaping.
   7. Detectable warning surfaces:
      a. Provide for tactile and visual warning that contrast visually with adjacent walking surfaces, either light-on-dark or dark-on-light.
      b. Provide cast ductile iron detectable warning plates embedded into newly cast concrete. Provide same width as path, minimum. Install in accordance with manufacturer's recommendations, ADAAG and these specifications. Surface applied products will not be allowed. Do not construct detectable warnings by forming or stamping in newly cast concrete.
      c. Provide detectable warning plates on all ramps for path crossings of public roads, private roads that are stop sign controlled, and commercial driveways that are stop sign controlled or experience high traffic volumes that would warrant a safe path crossing of the drive. Ottawa County Road Commission requirements for

providing detectable warning surfaces on ramps on public roads and at commercial drives shall be met.

B. Concrete Mixing and Delivery: Transit mix concrete conforming to MDOT 601.03E.

C. Placing and Finishing Concrete:
   1. Place concrete on a moist base in one (1) lift to the specified thickness. The concrete shall be thoroughly spaded along the faces of the forms before finishing operations are started. The concrete shall be struck off to the required grade and cross section.
   2. The surface shall be slightly broomed transversely to roughen the surface after the concrete has received a float finish. Ramps shall be textured with a coarse broom transversely to the ramp slope.
   3. All edges and joints shall be rounded to ½-inch radius.

D. Curing and Protection:
   1. Concrete shall be cured and protected as specified under MDOT 602.03M and 602.03T except that pedestrian traffic may be allowed after 48 hours.

E. Joints:
   1. Joints shall be constructed to true line with their face's perpendicular to the surface of the path and shall not vary more than ¼ inch from their designated position. Transverse joints shall be constructed at right angles to centerline of the path and longitudinal joints shall be constructed parallel to the centerline unless otherwise required.
   2. The concrete at the faces of all joints shall be thoroughly spaded or vibrated and compacted to fill all voids and the surface shall be finished smooth and substantially true to grade.
   3. One-half (½) inch transverse expansion joints shall be placed in line with all expansion joints in abutting curb, gutter or combination curb and gutter. When the path is not adjacent to such pavement, ½ inch transverse expansion joints shall be placed at intervals not exceeding 100 feet and at all transitions between 4-inch and 6-inch thick path. Expansion joint filler shall extend the full depth of the joint with the top slightly below the finished path surface. The filler shall be supported temporarily until concrete is poured against it.
   4. One-half (½) inch longitudinal expansion joints shall be placed between the path and the back of abutting parallel curb or gutter, between the path and buildings, or other rigid structures.
   5. Contraction joints shall be placed at 10-foot intervals. They shall divide sidewalk into areas not more than 100 square feet nor less than 30 square feet. Contraction joints will be produced by slab division forms extending to the full depth of concrete or by cutting joints in the concrete after floating to a depth of not less than ¼ the thickness of the concrete. The cut joints shall not be less than 1/8-inch or more than ¼ inch in width and shall be finished smooth and substantially true to line.

F. Backfilling:
   1. After concrete has gained sufficient strength (70% of design), all rails, forms, stakes and supports shall be removed in a manner as not to injure finished concrete and all exposed edges of the concrete shall be backfilled, compacted and leveled immediately.

G. HMA Patching: See Paragraph 3.03 above.

H. Concrete curb and gutter: TOWNSHIP's, Ottawa County Road Commission's or MDOT's Standard.
   1. Match existing curb and gutter.
   2. Construction methods: MDOT 802.03.

3.05 TESTING AND INSPECTION (HMA PATH): MDOT 501 and these specifications.

A. Observation: By TOWNSHIP, TOWNSHIP's ENGINEER or designated representative.

B. Aggregates:
   1. Sampling and Analysis: Michigan Testing Methods, Series 100.
   2. Exception: Provide certification of approved stockpiled material.

C. Hot Mix Asphalt Pavement Density:
   1. Density acceptance of HMA mixtures will be measured with a nuclear density gauge using the Gmm from the approved Job-Mix Formula for the density control target.
   2. The Contractor is responsible for determining Quality Control Density and establishing a rolling pattern that will achieve the required in place density.

D. Hot Mix Asphalt Mix Composition:
   1. Sampling:
      a. Acceptance sampling shall include a minimum of two samples per mix type for each day of production with no less than three samples for each mix type per project.
      b. Method of sampling shall be determined by the ENGINEER.
   2. Extraction: ASTM D2172
   3. Sieve Analysis: ASTM C117 and ASTM C136

3.06 TESTING AND INSPECTION (CONCRETE PATH):

A. Observation: By TOWNSHIP, TOWNSHIP's ENGINEER or designated representative.
   1. Inspection of forms is required prior to pouring concrete.

B. Acceptance Testing:
   1. Cement: Certification of quality by producer.
   2. Concrete:
      a. Sample: ASTM C172
      b. Frequency: Once for each 50 cubic yards of each class of concrete placed.
      c. Perform following from sample:
         (1) Mold three 6-inch cylinder compressive strength specimens: ASTM: C31
         (2) Slump test: ASTM C143
         (3) Air test: ASTM C231
         (4) Yield test: ASTM C138
         (5) Strength test: ASTM C139
   3. If initial testing indicates failure or nonconformance to specifications, additional testing shall be paid for by the CONTRACTOR. Replace nonconforming material.

C. Aggregates: Provide certification of approved stockpiled material.

D. Concrete:
   1. Limestone aggregate.
   2. Slump: 3-inches maximum.

3. Entrained Air: 4 percent to 7 percent.
4. Strength: 3500 psi, at 28 days.

3.07 TREE ROOT CUTTING:

A. The following information shall be used as a guide when trimming tree roots:
   1. Excavate as shallow as possible in the area adjacent to the tree root.
   2. Make clean cuts with a saw or sharp chisel. Do not bury jagged or torn roots.
   3. Do not allow the exposed root ends to dry out. If exposed for more than a day, they can dry out. Cover all exposed roots with soil at the end of the day.
   4. Avoid cutting roots larger than 3.5 inches.

3.08 TREE ROOT BARRIER:

A. Install tree root barrier along the path adjacent to trees to reduce future damage by tree roots in areas determined by the TOWNSHIP or TOWNSHIP ENGINEER. Installation shall be in accordance with manufacturer's recommendations.

B. Install in 4-inch wide trench (with roots removed) adjacent to the path between the path and tree to a minimum depth of 30 inches. Secure with pins. Backfill carefully to avoid dislodging the barrier, and compact firmly.

C. Manufacturer: Typar Biobarrier or approved equal.

3.09 SCHEDULES:

A. MDOT Standard Plan R-28-J SIDEWALK RAMP AND DETECTABLE WARNING DETAILS (7 sheets).

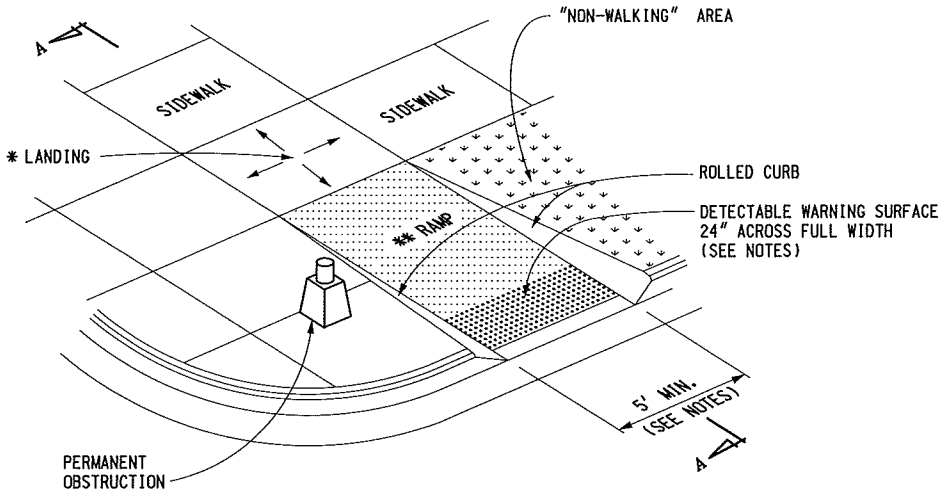
B. Typical Cross-Section for HMA Shared Use Path.

C. Typical Cross-Section for Concrete Shared Use Path.

END OF SECTION

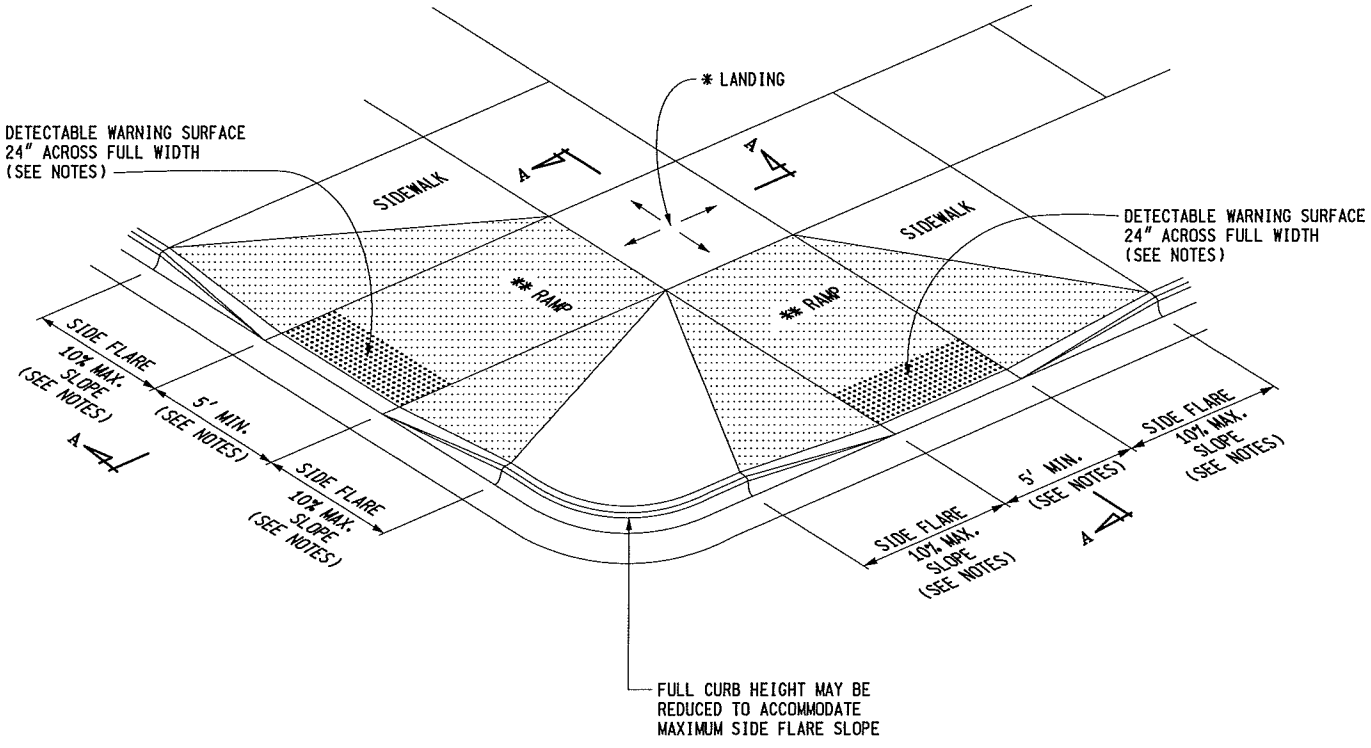
* MAXIMUM LANDING SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. LANDING MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



SIDEWALK RAMP TYPE R

(ROLLED SIDES)



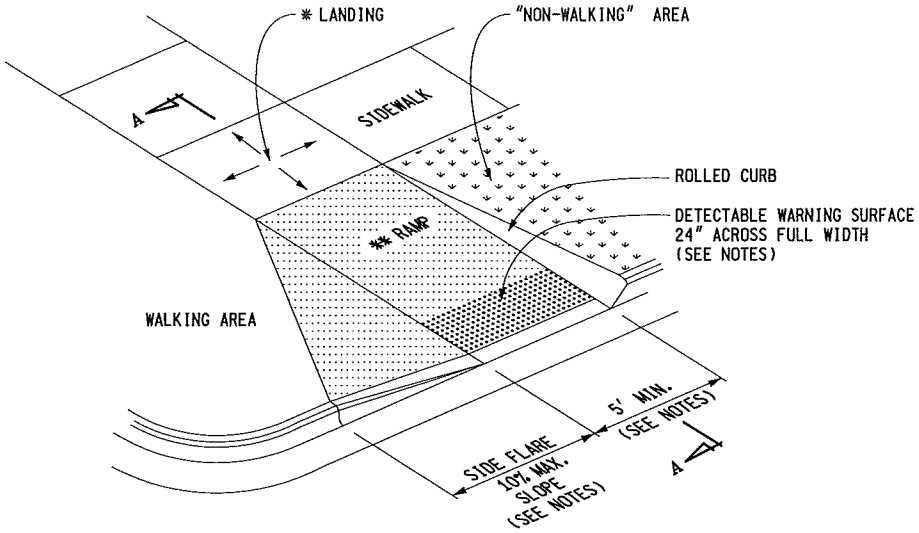
SIDEWALK RAMP TYPE F

(FLARED SIDES, TWO RAMPS SHOWN)

MDOT Michigan Department of Transportation PREPARED BY DESIGN DIVISION DRAWN BY: B.L.T. CHECKED BY: W.K.P.	DEPARTMENT DIRECTOR Kirk T. Steudle APPROVED BY: _____ DIRECTOR, BUREAU OF FIELD SERVICES APPROVED BY: _____ DIRECTOR, BUREAU OF DEVELOPMENT	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT STANDARD PLAN FOR SIDEWALK RAMP AND DETECTABLE WARNING DETAILS F.H.W.A. APPROVAL | 12-11-2017 PLAN DATE | R-28-J | SHEET 1 OF 7

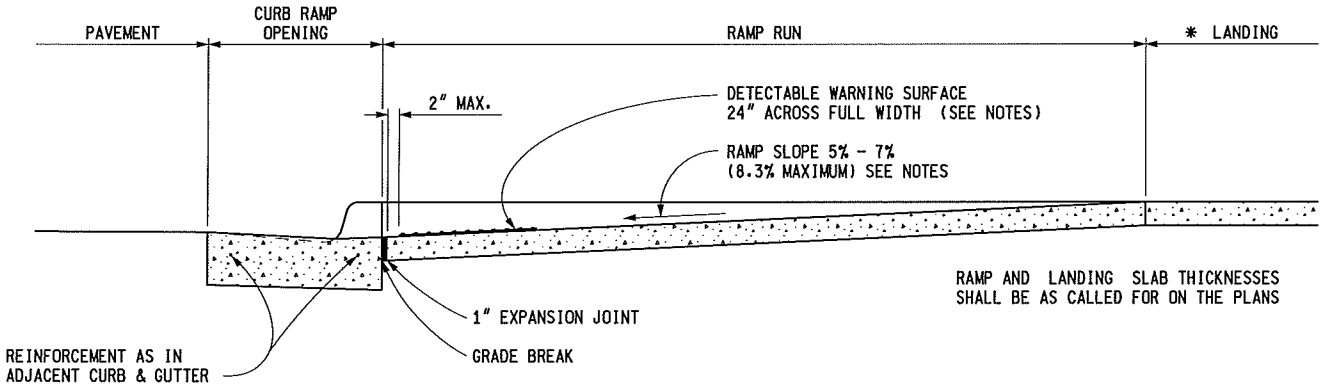
* MAXIMUM LANDING SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. LANDING MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%. RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



SIDEWALK RAMP TYPE RF

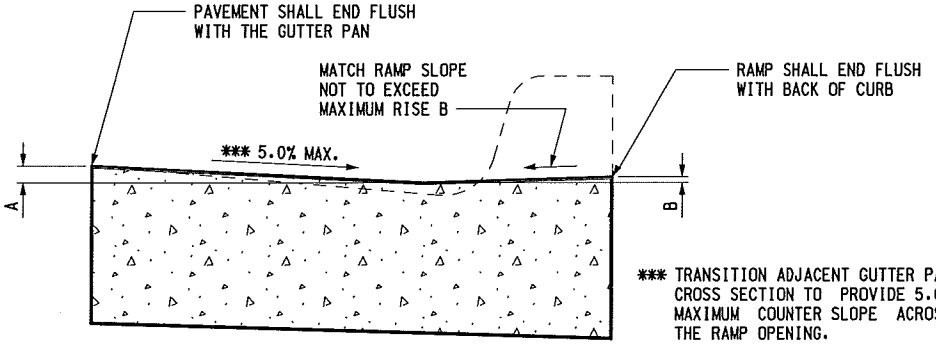
(ROLLED / FLARED SIDES)



CURB TYPE	MAXIMUM RISE (INCHES)	
	A	B
B1	3/4	1
B2	3/4	1
B3	3/4	1
D1	3/4	1
D2	3/4	1
D3	3/4	1
C1	1/2	1/2
C2	1/2	1/2
C3	3/4	1/2
C4	3/4	1/2
C5	1	1/2
C6	1	1/2
F1	1/2	1/2
F2	1/2	1/2
F3	3/4	1/2
F4	3/4	1/2
F5	1	1/2
F6	1	1/2

FOR CURB TYPES SEE STANDARD PLAN R-30-SERIES

SECTION A-A



*** TRANSITION ADJACENT GUTTER PAN CROSS SECTION TO PROVIDE 5.0% MAXIMUM COUNTER SLOPE ACROSS THE RAMP OPENING.

SECTION THROUGH CURB RAMP OPENING

(TYPICAL ALL RAMP TYPES)

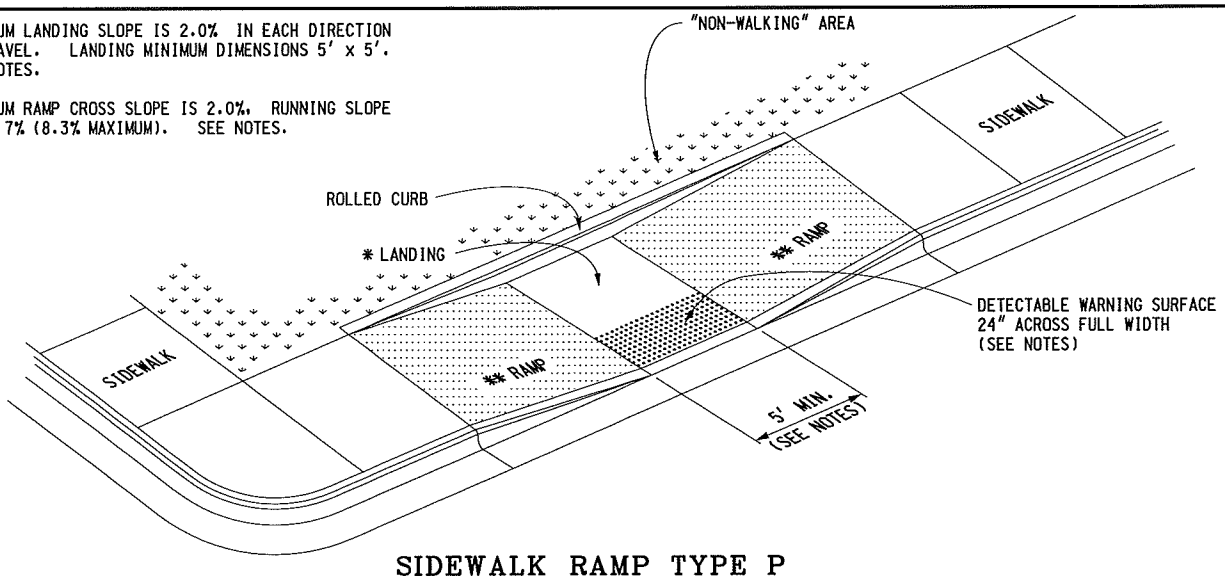
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

F.H.W.A. APPROVAL	12-11-2017 PLAN DATE	R-28-J	SHEET 2 OF 7

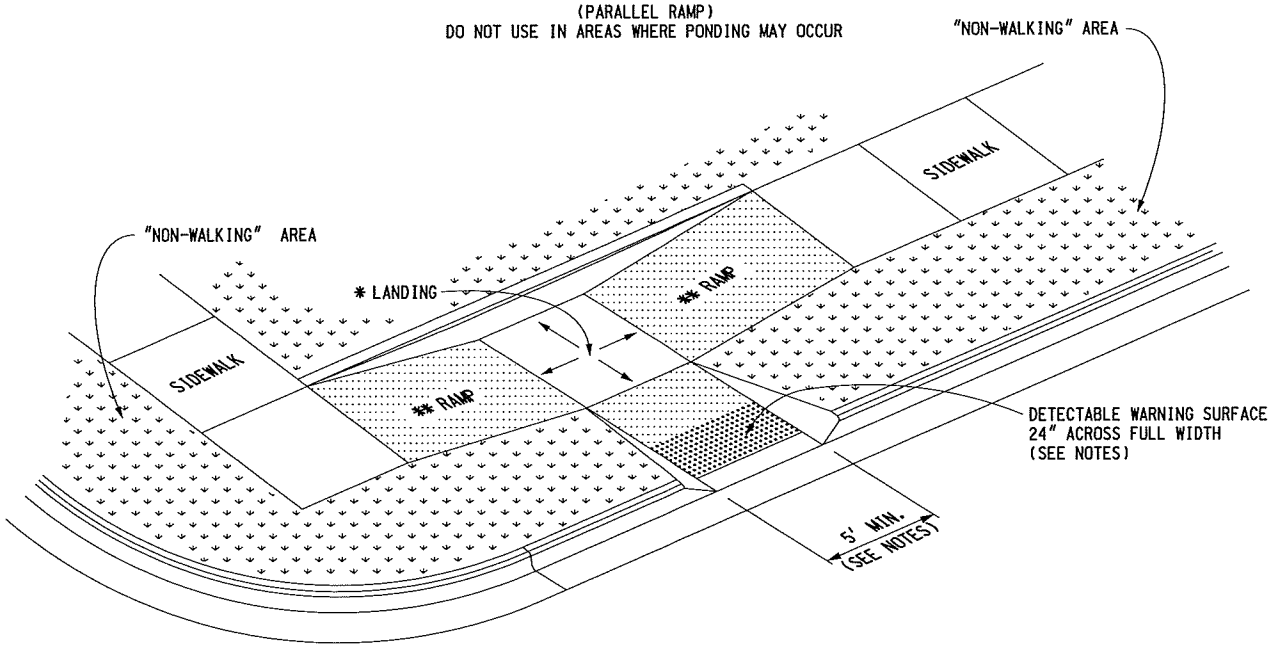
* MAXIMUM LANDING SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. LANDING MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



SIDEWALK RAMP TYPE P

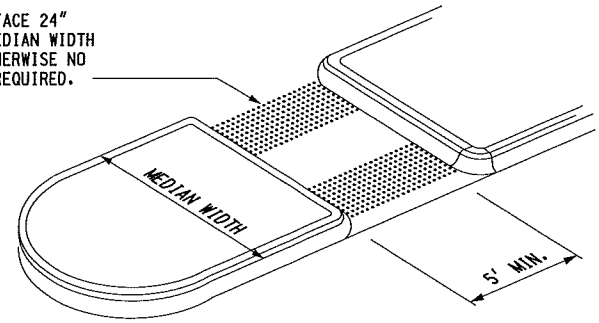
(PARALLEL RAMP)
DO NOT USE IN AREAS WHERE PONDING MAY OCCUR



SIDEWALK RAMP TYPE C

(COMBINATION RAMP)

DETECTABLE WARNING SURFACE 24" ACROSS FULL WIDTH IF MEDIAN WIDTH IS AT LEAST 6'-0". OTHERWISE NO DETECTABLE WARNING IS REQUIRED.



SIDEWALK RAMP TYPE M

(MEDIAN ISLAND)

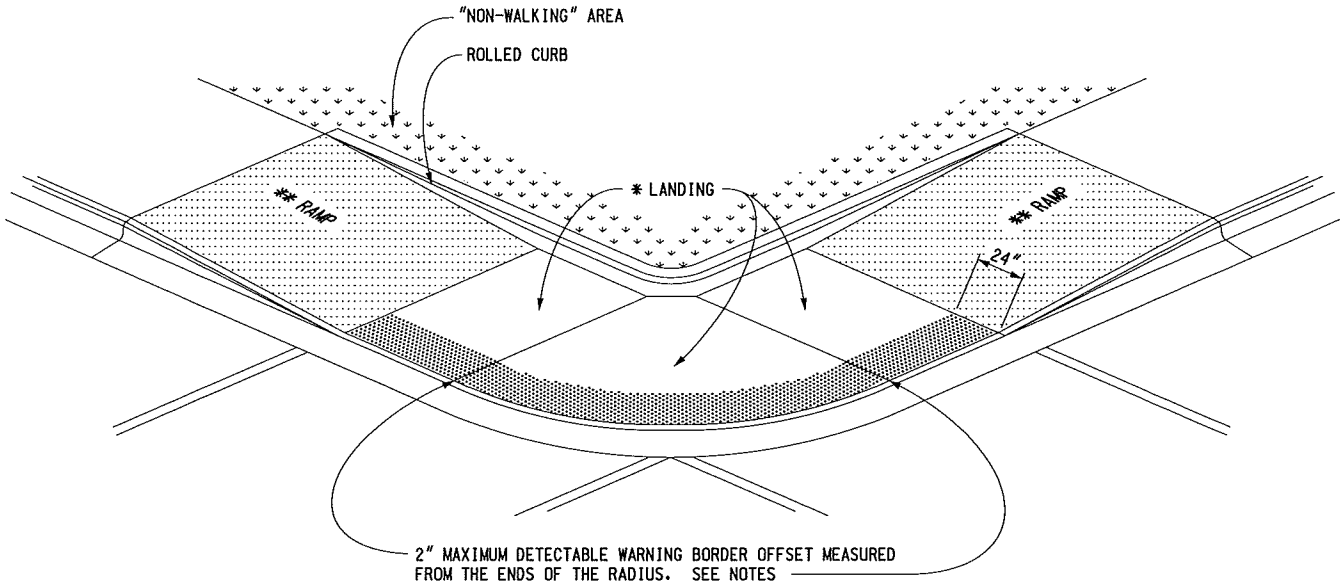
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

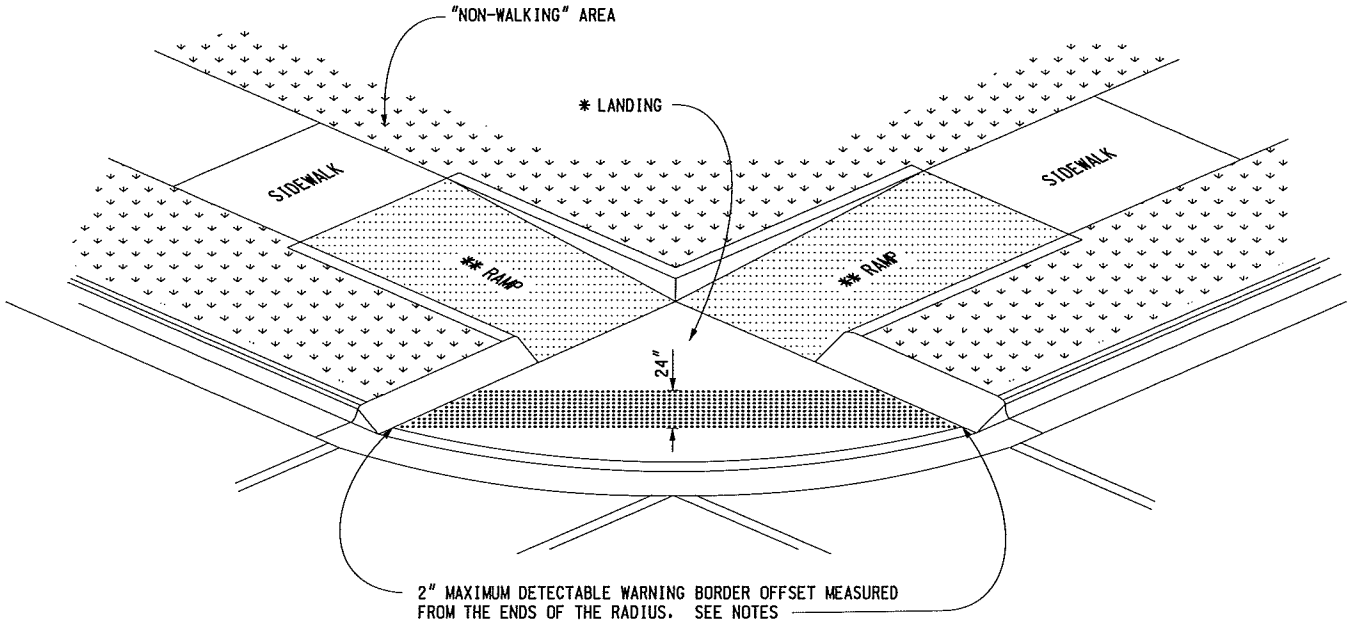
F.H.W.A. APPROVAL	12-11-2017 PLAN DATE	R-28-J	SHEET 3 OF 7

* MAXIMUM LANDING SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. LANDING MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



(RADIAL DETECTABLE WARNING SHOWN)



(TANGENT DETECTABLE WARNING SHOWN)

SIDEWALK RAMP TYPE D

(DEPRESSED CORNER)

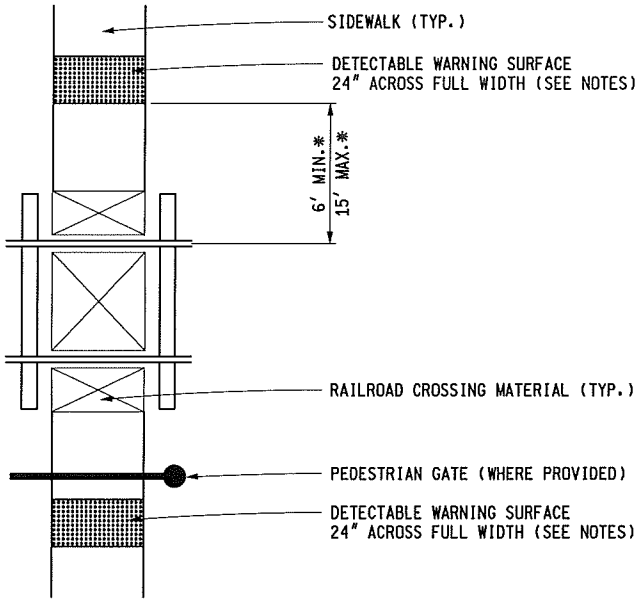
USE ONLY WHEN INDEPENDENT DIRECTIONAL RAMPS CAN NOT BE CONSTRUCTED FOR EACH CROSSING DIRECTION

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

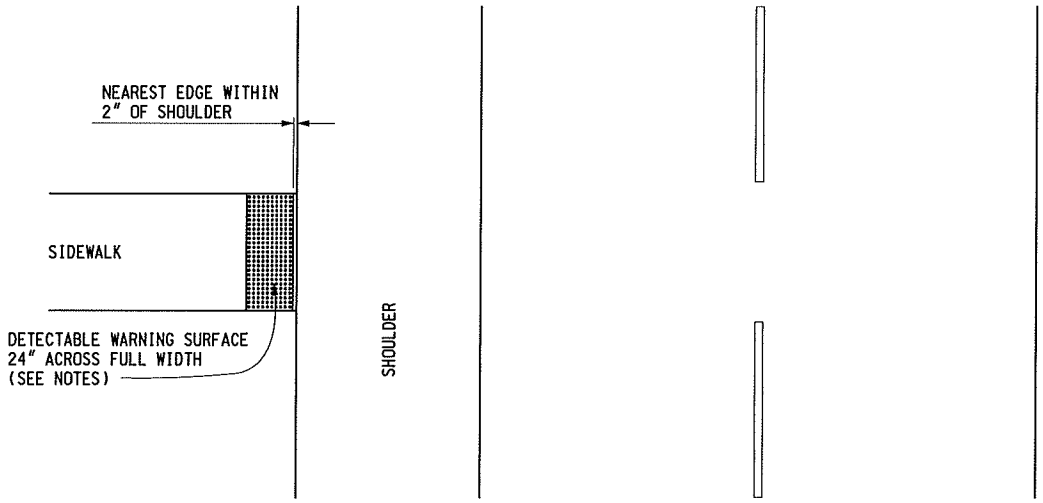
SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

F.H.W.A. APPROVAL	12-11-2017 PLAN DATE	R-28-J	SHEET 4 OF 7

* THE DETECTABLE WARNING SURFACE SHALL BE LOCATED SO THAT THE EDGE NEAREST THE RAIL CROSSING IS 6′ MINIMUM AND 15′ MAXIMUM FROM THE CENTERLINE OF THE NEAREST RAIL. DO NOT PLACE DETECTABLE WARNING ON RAILROAD CROSSING MATERIAL.



DETECTABLE WARNING AT RAILROAD CROSSING

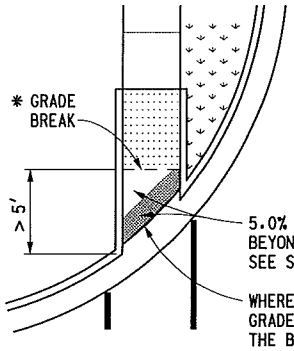


DETECTABLE WARNING AT FLUSH SHOULDER OR ROADWAY

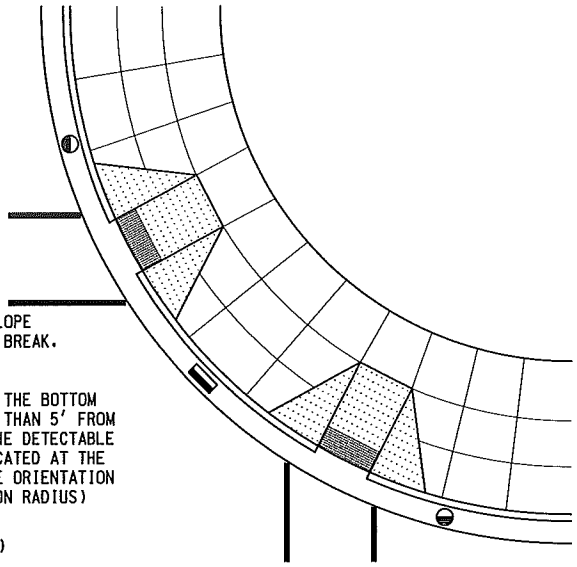
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

F.H.W.A. APPROVAL	12-11-2017 PLAN DATE	R-28-J	SHEET 5 OF 7

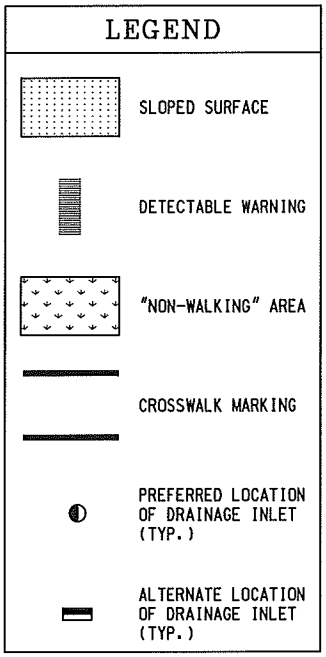


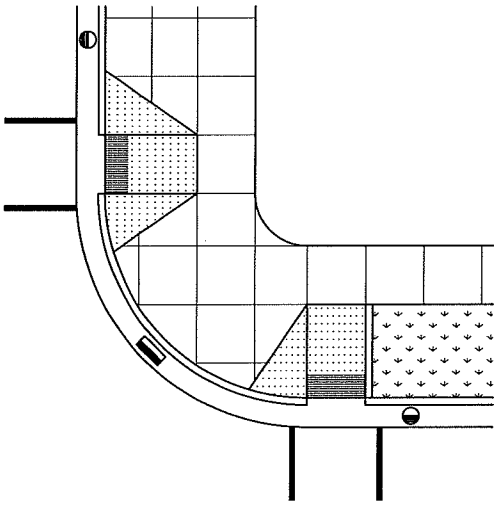
SIDEWALK RAMP LOCATED IN RADIUS (TYPE R SHOWN)
(GRADE BREAK OFFSET GREATER THAN 5')



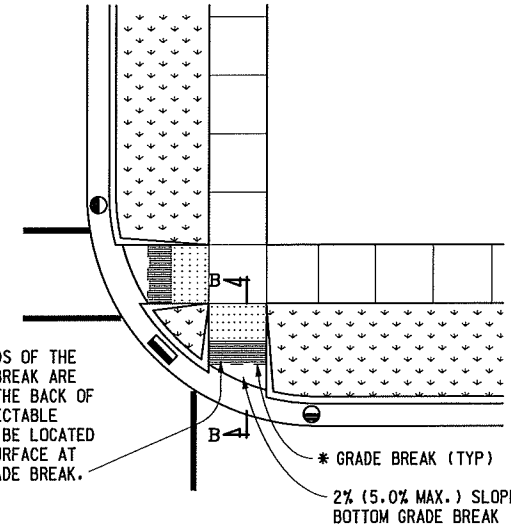
SIDEWALK RAMP PERPENDICULAR TO RADIAL CURB (TYPE F SHOWN)

(USE WITH RADIAL CURB WHEN THE CROSSWALK AND SIDEWALK RAMP ARE NOT ALIGNED)

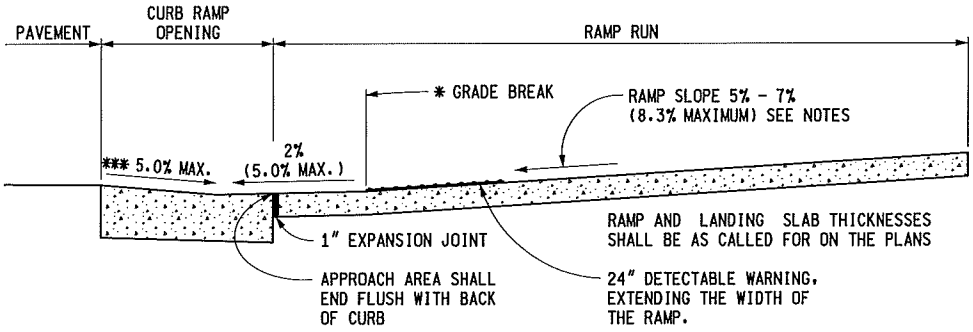




SIDEWALK RAMP PERPENDICULAR TO TANGENT CURB
(TYPE F AND TYPE RF SHOWN)



SIDEWALK RAMP LOCATED IN RADIUS (TYPE R SHOWN)
(GRADE BREAK OFFSET LESS THAN 5')



* GRADE BREAKS AT THE TOP AND BOTTOM OF CURB RAMPS SHALL BE PERPENDICULAR TO THE DIRECTION OF TRAVEL.

*** TRANSITION ADJACENT GUTTER PAN CROSS SECTION TO PROVIDE 5.0% MAXIMUM COUNTER SLOPE ACROSS THE RAMP OPENING.

SEE SHEET 2 FOR CURB RAMP OPENING DETAILS.

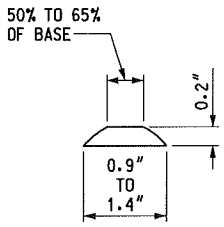
SECTION B-B

SIDEWALK RAMP ORIENTATION

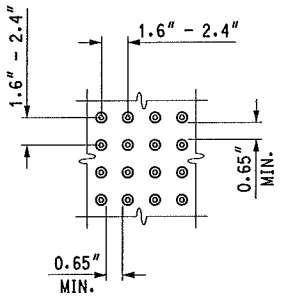
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

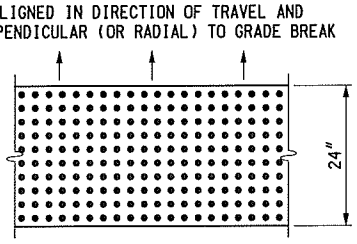
F.H.W.A. APPROVAL	12-11-2017 PLAN DATE	R-28-J	SHEET 6 OF 7



DOME SECTION



DOME SPACING



DOME ALIGNMENT

DETECTABLE WARNING DETAILS

NOTES:

DETAILS SPECIFIED ON THIS PLAN APPLY TO ALL CONSTRUCTION, RECONSTRUCTION, OR ALTERATION OF STREETS, CURBS, OR SIDEWALKS IN THE PUBLIC RIGHT OF WAY.

SIDEWALK RAMPS ARE TO BE LOCATED AS SPECIFIED ON THE PLANS OR AS DIRECTED BY THE ENGINEER.

RAMPS SHALL BE PROVIDED AT ALL CORNERS OF AN INTERSECTION WHERE THERE IS EXISTING OR PROPOSED SIDEWALK AND CURB. RAMPS SHALL ALSO BE PROVIDED AT MARKED AND/OR SIGNALIZED MID-BLOCK CROSSINGS.

SURFACE TEXTURE OF THE RAMP SHALL BE THAT OBTAINED BY A COARSE BROOMING, TRANSVERSE TO THE RUNNING SLOPE.

SIDEWALK SHALL BE RAMPED WHERE THE DRIVEWAY CURB IS EXTENDED ACROSS THE WALK.

CARE SHALL BE TAKEN TO ASSURE A UNIFORM GRADE ON THE RAMP. WHERE CONDITIONS PERMIT, IT IS DESIRABLE THAT THE SLOPE OF THE RAMP BE IN ONLY ONE DIRECTION, PARALLEL TO THE DIRECTION OF TRAVEL.

RAMP WIDTH SHALL BE INCREASED, IF NECESSARY, TO ACCOMMODATE SIDEWALK SNOW REMOVAL EQUIPMENT NORMALLY USED BY THE MUNICIPALITY.

WHEN 5' MINIMUM WIDTHS ARE NOT PRACTICABLE, RAMP WIDTH MAY BE REDUCED TO NOT LESS THAN 4' AND LANDINGS TO NOT LESS THAN 4' x 4'.

CURB RAMPS WITH A RUNNING SLOPE ≤5% DO NOT REQUIRE A TOP LANDING. HOWEVER, ANY CONTINUOUS SIDEWALK OR PEDESTRIAN ROUTE CROSSING THROUGH OR INTERSECTING THE CURB RAMP MUST INDEPENDENTLY MAINTAIN A CROSS SLOPE NOT GREATER THAN 2% PERPENDICULAR TO ITS OWN DIRECTION(S) OF TRAVEL.

DETECTABLE WARNING SURFACE COVERAGE IS 24" MINIMUM IN THE DIRECTION OF RAMP/PATH TRAVEL AND THE FULL WIDTH OF THE RAMP/PATH OPENING EXCLUDING CURBED OR FLARED CURB TRANSITION AREAS. A BORDER OFFSET NOT GREATER THAN 2" MEASURED ALONG THE EDGES OF THE DETECTABLE WARNING IS ALLOWABLE. FOR RADIAL CURB THE OFFSET IS MEASURED FROM THE ENDS OF THE RADIUS.

FOR NEW ROADWAY CONSTRUCTION, THE RAMP CROSS SLOPE MAY NOT EXCEED 2.0%. FOR ALTERATIONS TO EXISTING ROADWAYS, THE CROSS SLOPE MAY BE TRANSITIONED TO MEET AN EXISTING ROADWAY GRADE. THE CROSS SLOPE TRANSITION SHALL BE APPLIED UNIFORMLY OVER THE FULL LENGTH OF THE RAMP.

THE MAXIMUM RUNNING SLOPE OF 8.3% IS RELATIVE TO A FLAT (0%) REFERENCE. HOWEVER, IT SHALL NOT REQUIRE ANY RAMP OR SERIES OF RAMPS TO EXCEED 15 FEET IN LENGTH NOT INCLUDING LANDINGS OR TRANSITIONS.

DRAINAGE STRUCTURES SHOULD NOT BE PLACED IN LINE WITH RAMPS. THE LOCATION OF THE RAMP SHOULD TAKE PRECEDENCE OVER THE LOCATION OF THE DRAINAGE STRUCTURE. WHERE EXISTING DRAINAGE STRUCTURES ARE LOCATED IN THE RAMP PATH OF TRAVEL, USE A MANUFACTURER'S ADA COMPLIANT GRATE. OPENINGS SHALL NOT BE GREATER THAN $\frac{1}{2}$". ELONGATED OPENINGS SHALL BE PLACED SO THAT THE LONG DIMENSION IS PERPENDICULAR TO THE DOMINANT DIRECTION OF TRAVEL.

THE TOP OF THE JOINT FILLER FOR ALL RAMP TYPES SHALL BE FLUSH WITH THE ADJACENT CONCRETE.

CROSSWALK AND STOP LINE MARKINGS, IF USED, SHALL BE SO LOCATED AS TO STOP TRAFFIC SHORT OF RAMP CROSSINGS. SPECIFIC DETAILS FOR MARKING APPLICATIONS ARE GIVEN IN THE "MICHIGAN MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES".

FLARED SIDES WITH A SLOPE OF 10% MAXIMUM, MEASURED ALONG THE ROADSIDE CURB LINE, SHALL BE PROVIDED WHERE AN UNOBSTRUCTED CIRCULATION PATH LATERALLY CROSSES THE SIDEWALK RAMP. FLARED SIDES ARE NOT REQUIRED WHERE THE RAMP IS BORDERED BY LANDSCAPING, UNPAVED SURFACE OR PERMANENT FIXED OBJECTS. WHERE THEY ARE NOT REQUIRED, FLARED SIDES CAN BE CONSIDERED IN ORDER TO AVOID SHARP CURB RETURNS AT RAMP OPENINGS.

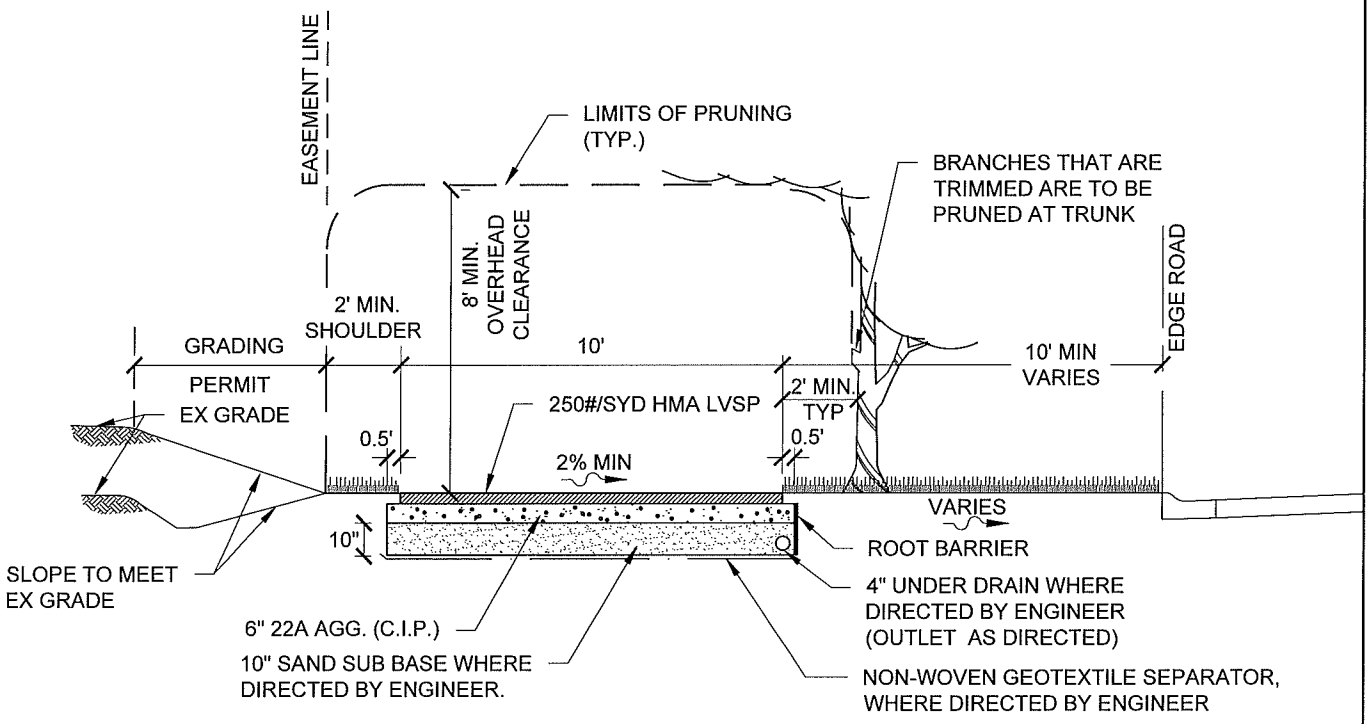
DETECTABLE WARNING PLATES MUST BE INSTALLED USING FABRICATED OR FIELD CUT UNITS CAST AND/OR ANCHORED IN THE PAVEMENT TO RESIST SHIFTING OR HEAVING.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

F.H.W.A. APPROVAL	12-11-2017 PLAN DATE	R-28-J	SHEET 7 OF 7

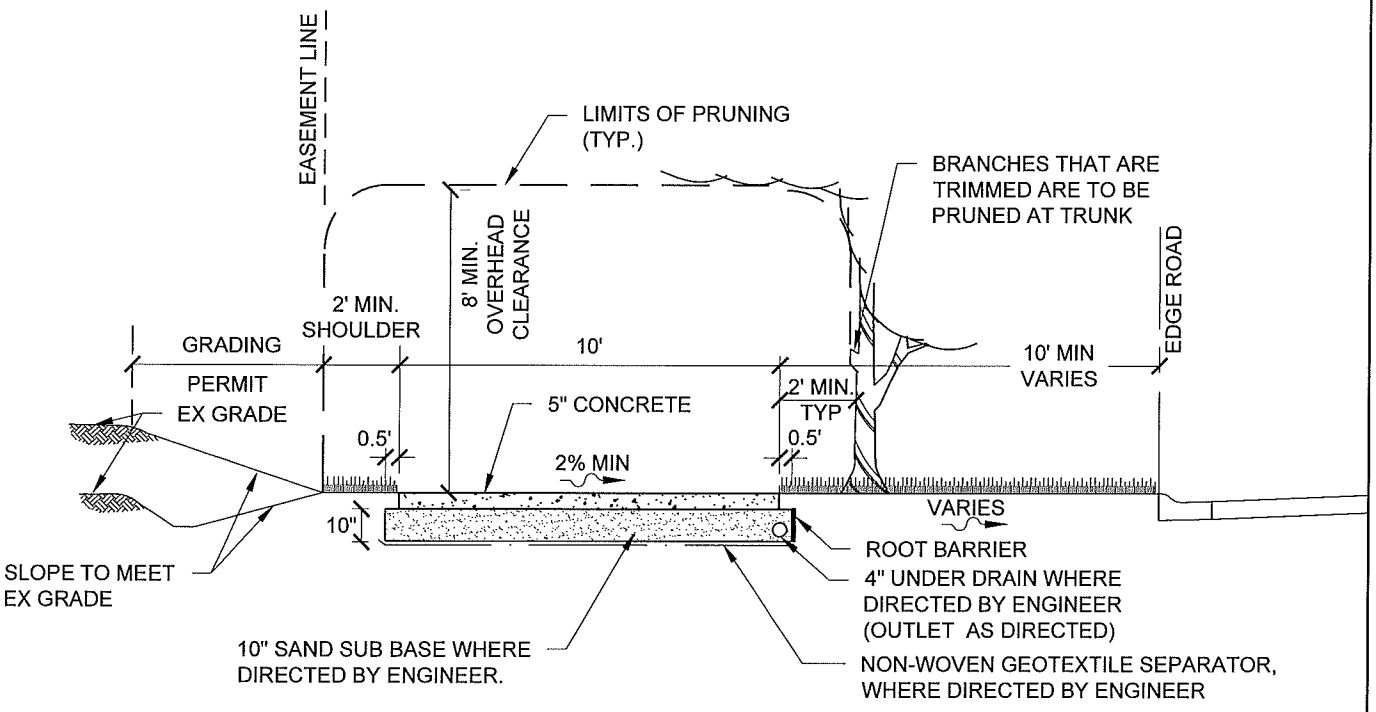
1071FIG_SHARED PATH/karim 010715



TYPICAL CROSS-SECTION
HMA SHARED USE PATH

SCALE: NOT TO SCALE

1071FIG_SHARED PATH/karim 010715



TYPICAL CROSS-SECTION
CONCRETE SHARED USE PATH

SCALE: NOT TO SCALE

SECTION 02660

WATER MAINS

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes the work required for water mains, structures and appurtenant work.

1.02 REFERENCES:

A. AWWA - American Waterworks Association, latest edition.

B. ANSI - American National Standards Institute, latest edition.

C. ASTM - American Society Testing Materials, latest edition.

D. Recommended Standards for Water Works – Ten State Standards, latest edition.

1.03 SUBMITTALS:

A. Submit the following for review by TOWNSHIP or TOWNSHIP'S ENGINEER:
   1. Product Data on Valves, Hydrant and service fittings.
   2. Details for each connection to existing water main.
   3. Proposed equipment and method for flushing, pressure testing, leakage testing and chlorination.
   4. Submittals must be approved by ACT Department of Public Utilities prior to construction.

B. Report witness measurements on valves, fittings and curb boxes.
   1. Provide measurements from two permanent fixtures such as building corners, power poles and trees 8-inch diameter and larger.

C. Provide certifications on pipe and fittings indicating conformance to specifications prior to installation.

D. Submittal of drawings of record plans to:
   1. Provide the Township Hall two (2) printed sets and one (1) electronic file
   2. Provide the Township Engineer (1) one electronic file with as-constructed dimensions and witnesses.
   3. Provide Township Utilities Superintendent (1) one electronic file

1.04 JOB CONDITIONS:

A. Interrupting Water Service:
   1. Scheduling: Obtain TOWNSHIP's approval prior to interruption of service.
   2. Provide notice of twenty-four (24) hours to affected occupants and twenty-four (24) hours to Fire Department of time and duration.
   3. Provide stand-by service as required; outage not to exceed four (4) hours.
   4. Existing valve operation shall be by TOWNSHIP employees or TOWNSHIP representative only. Valves improperly operated by Contractor resulting in resident

notifications, additional flushing or chlorination, shall have costs back charged to Contractor

5. Prevent contamination of existing water mains.

B. Install service lines after pressure and bacteriological testing is accepted.

C. Clean up promptly following pipe installation within maximum of 600 feet behind pipe laying operation. Clean up shall include backfill and rough grading.

D. Installation not allowed when air temperature is 25 degrees F or colder, or when determined too cold by Allendale Township field inspector.

E. Salvage all existing valve boxes, curb boxes and hydrants removed and deliver to the TOWNSHIP's yard. Hydrants shall be removed carefully without causing damage to the hydrant and fittings.

F. The Township Inspector or Township Engineer shall be provided notice and allowed three (3) work days to perform major inspections for water mains. Major inspections include the following;
   1. Substantial Completion
      a. Initial inspection and follow-up inspection will be at no charge. Any subsequent inspections will be charged to the developer.
   2. Completion
      a. Initial inspection and follow-up inspection will be at no charge. Any subsequent inspections will be charged to the developer.
   3. Fire Protection System Inspection

PART 2 - PRODUCTS

2.01 GENERAL:

A. Cement Lining: ANSI A21.4 standard thickness for ductile iron pipe and fittings.

B. Hydrant Leads: Ductile iron pipe with mechanical joints.
   1. Hydrant leads longer than 10 feet or tapped hydrant leads shall be minimum 8-inch diameter.

2.02 PIPE:

A. Ductile Iron: ANSI A21.50 and ANSI A21.51; Class 52.

B. Service Tubing:
   1. Copper: ASTM B88, Type K annealed and soft temper.
   2. Water services shall be 1-inch diameter for residential uses (i.e. single-family dwellings) and 1 ½ inch diameter or larger for commercial, industrial or multi-family uses.

2.03 JOINTS:

A. Ductile Iron Pipe and Fittings:
   1. Mechanical: ANSI A21.11. (i.e. – Iron Megalugs)
   2. Push-on: ANSI A21.11.
   3. Glands: ANSI A21.11 – (i.e. – Iron Megalugs)
   4. Rubber-Gasket: ANSI 21.11

5. Electrical Continuity: Provide bronze wedges (3 per joint) or thermite welded sockets and cables.

B. Service Tubing and Fittings:
   1. Copper: Match TOWNSHIP's standard. Provide electrically conductive fittings.
   2. Provide compression joints.

2.04 FITTINGS:

A. Ductile Iron: ANSI A21.10, or ANSI A21.53, Class 54, 250 psi working pressure through 12 inches and 150 psi above. Mechanical joint solid sleeves, Clow Corporation #F1012 or equal.

2.05 VALVES (OPEN RIGHT):

A. Gate: AWWA C515 Resilient seated, epoxy coated surfaces, rubber encapsulated gate, bronze non-rising stem with double o-ring seal. Provide full diameter unobstructed flow. End connections shall match pipe.
   1. Manufacturer(s): East Jordan, American Flow Control, US Pipe Metroseal 250 or American Darling.

B. Butterfly: AWWA C504, Class 150-B, cast iron short body, cast iron disc, mechanical joint, worm gear traveling nut operator for direct burial.

C. Boxes: Three (3) section cast iron with lid marked WATER: All sections must have threaded ends for screw on connection.
   1. Upper section: Screw on adjoining center section and full diameter throughout. Place geotextile fabric around threaded joint of risers, if used.
   2. Center section: Minimum 5 inch inside diameter.
   3. Base section: Fit over valve bonnet and shaped round for valves through 10 inch and oval for 12-inch and over. Place geotextile fabric around valve bonnet.

2.06 HYDRANTS (OPEN RIGHT):

A. Provide City of Grand Rapids standard to match TOWNSHIP's existing hydrants.
   1. Compression Type Fire Hydrants - Compression type fire hydrants shall be in strict conformity with the ANSI/AWWA C502 and the following specifications:
      a. Compression type fire hydrants shall be 5BR-250 by East Jordan.
      b. The hydrant shall be painted with a zinc chromate primer and finish coat of Rust Oleum #944 chrome yellow above grade after installation and after turning / height adjustment and with two coats of asphalt varnish below grade. Painting shall be in strict accordance with ANSI / AWWA C502.
      c. Barrel and stem extensions shall be made at or above the ground line and without digging.
      d. The hydrant shall be supplied with a tapped drain. The drain shall be plugged, if below water table.

B. Barrel length shall be properly sized, so the centerline of the pumper nozzle is 21" to 27" above grade at a minimum 5' depth of cover over the pipe.

C. Provide Hydrant Flag: 3/8-inch Ultimate Hydrant Marker, 48", ej#99840079

D. Hydrant Extension: 36-inch maximum, limited to 1 per hydrant.
   1. Install breakaway coupling in new extension.

E. A clear space of not less than ten feet (10') shall be provided in front of and around all fire hydrants. A clear space is required to be free of all obstructions such as parked cars, landscaping, utilities, service vehicles, construction work, snow and all other blockages.

2.07 SERVICE FITTINGS:

A. Corporation Stops:
1. Copper tubing: Inlet AWWA CC thread; outlet electrical conductivity fitting, Ford B 44-G series or A.Y. McDonald 74701-22 Series.

B. Curb Stops: Inlet electrical conductivity fitting, Ford F1000-G series or A.Y. McDonald 76100-22 Series.

C. Curb Stop Boxes: M&E Manufacturing, or approved equal, adjustable 50 inches to 68 inches with stationary rod to within 1 foot of surface grade. Provide 1 1/4-inch top, and arch and pattern base. Embed stationary rod into the cotter pin saddle. **NOTE – The stationary rod must be East Jordan.**

2.08 MISCELLANEOUS:

A. Service Clamps: Cast, or ductile iron strap, brass or bronze with stainless steel parts, AWWA C800 threads. Four corner fasteners

B. Plastic Seamless Encasement Tubing: Required in areas of corrosive soils.
1. Material: ASTM D-1248 Polyethylene, Type I, Class C, 8 mils thick. AWWA C105.
2. Closing Tape: 2-inch wide Poly Ken #900 0r Scotchwrap #50.

C. Mechanical Joint Restraint: Megalug Joint Restraints meeting Paragraphs 2.01, 2.02, 2.03 and 2.04 requirements.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Alignment and Grade:
1. Deviations: Notify OWNER's ENGINEER and obtain instructions to proceed where there is a grade discrepancy, or an obstruction not shown on plans.
a. Verify location and depth of existing utilities in advance of construction and provide adjustments in alignment and grade of water main.
2. Depth of pipe: Minimum cover over pipe below finished grade shall be 5 feet.
3. When the minimum clearance (18-inches) and cover (5-feet) can be obtained, the watermain is to be located above the sanitary sewer. Otherwise, any sanitary sewer joints within 10-feet of watermain shall be encased in concrete (Ref Section 02220, Paragraph 2.01.A.3)

B. Bedding:
1. Method: See Article 3.06 SCHEDULES.
2. Provide bedding area backfill in accordance with MDOT Standard Plan R-83C.
3. Provide continuous bearing supporting entire length of pipe barrel evenly.

C. Cleaning Pipe and Fittings:
1. General: Provide interior free of foreign material and joint surfaces free of lumps and blisters.

3.02 INSTALLATION:

A. General: Meet requirements of AWWA C600 and these specifications.

B. Laying Pipe:
1. Prevent entrance of foreign material and plug watertight when left unattended.
2. Provide pipe length and bedding as a unit in a frost free, dry trench.
3. Special supports and saddles: See Article 3.06 SCHEDULES.
4. Provide minimum vertical and horizontal separation between parallel water main and sanitary sewer or force main of 18 inches and 10 feet, respectively, unless otherwise approved.
5. TOWNSHIP's approval required for pipe lengths less than 6 feet.
6. Joint deflection shall not exceed the following values or as recommended by pipe manufacturer.

Maximum Joint Deflection

Nominal Pipe Size (inches)	Push-On Joint		Mechanical Joint	
	Deflection Angle (Deg-Min)	Maximum Offset (inches)*	Deflection Angle (Deg-Min)	Maximum Offset (inches)*
8	3° - 30'	14	4° - 00'	15
12	3° - 30'	14	4° - 00'	15
16	2° - 15'	8 ¼	2° - 40'	10
24	2° - 15'	8 ¼	1° - 45'	7

*Offsets are based upon 18-foot lengths of pipe

C. Cutting Pipe:
1. Ductile iron: Power saw.

D. Jointing:
1. Mechanical:
   a. Lubricate as recommended by manufacturer.
   b. Tighten bolts evenly per manufacturing recommendations.
2. Push-on:
   a. Lubricate as recommended by manufacturer.

E. Setting Valves, Fittings and Fire Hydrants:
1. General: See Article 3.06 SCHEDULES.
2. Valves: Set plumb.
3. Valve boxes:
   a. Base section: Center and plumb over operating nut and 2 inches above bonnet.
   b. Upper section: Set cover ¼-inch below finished grade.
   c. Witnesses: Provide 2 measurements to permanent surface features. Provide GPS measurement – coordinates.
4. Hydrants:
   a. Connection: With ductile iron pipe and auxiliary valve.
   b. Positioning: Plumb with pumper nozzle facing curb or street and nozzle centerline 21 to 27 inches above finished grade. Finished grade shall be as dictated by street construction or as directed by Township.

c. Provide necessary length of 6-inch pipe for hydrant leads.
d. Locate at 8 feet from right-of-way line within road right-of-way, unless otherwise directed by TOWNSHIP or TOWNSHIP ENGINEER.
e. Provide access to all hydrants by providing Hydrant Berm, if needed.

5. Provide joint restraint using Megalug retainer glands (Paragraph 2.03.A.3) in accordance with the pipe restraint table referenced in Paragraph 3.02.H.1 and Schedule 3.06. A.4. Locking rubber gaskets will not be allowed.

F. Connections:
1. Existing water mains:
a. Provide temporary support during cut-in.
b. Disinfect by swabbing pipe, valves and fittings with four percent (4%) chlorine solution.
c. Pressure off: Install mechanical joint solid sleeve.
d. Pressure on: Install tapping sleeve, valve and box.
2. Service lines:
a. Watermain must be situated along the lot's road frontage for service to be provided. All service lines must be located in 10' utility easement (if available) or within road right of way. Easements will not be allowed to obtain service to a residence.
b. Align at right angles to street or easement line. Maintain minimum 5 feet separation from sewer laterals. Locate 10 feet from left property line (facing lot) unless otherwise directed by TOWNSHIP or TOWNSHIP ENGINEER.
c. Minimum depth shall be same as pipe. Minimum size shall be 1-inch in diameter for residential uses and 1 ½-inch or larger for all other usage (multi-family and commercial) based on REU's.
d. Install after acceptable pressure test, chlorination of water main and acceptable bacteriological testing.
e. Curb stop boxes: Set plumb and provide 2 measurements to surface features with GPS coordinates.
(1) Locate at easement line within easement or at road right-of-way line within road right-of-way, unless otherwise directed by TOWNSHIP.
(2) Cover with 4' long section of 4-1/2" I.D. PVC pipe buried 1'.
(3) Set cover ¼-inch below finished grade.
f. Tapping shall be at 45° above center and shall provide horizontal loop at corporation stop.
g. Maximum tap sizes shall be as follows:

Type of Pipe	Pipe Size								
	6"	8"	10"	12"	14"	16"	18"	20"	24"
	Maximum Direct Tap Size								
Ductile:	1"	1½"	2"	2"	2"	2"	2"	2"	2"

G. Dead-end water main stubs longer than 20 feet:
1. Install standpipe with shutoff at dead-ends to aid in chlorinating, testing and flushing. Remove standpipe upon approval of water main.

H. Pipe Joint Restraint:
1. Provide mechanical joint restraint for the minimum lengths shown in joint restraint detail (i.e. Schedule 3.06.A.4).

* The length of restrained pipe required shown in joint restraint detail is based on trench backfill being compacted to 95% of the maximum density according to the Modified Proctor Method. The joint restraint detail does not consider polyethylene wrapped pipe. If the pipe is wrapped with polyethylene, a greater length of restrained pipe will be required. Unless otherwise specified, a multiplier of 1.5 shall be used to determine the required length when the pipe is wrapped with polyethylene.

** If straight run of pipe on small side of reducer exceeds this value, then no restrained joints are necessary.

a. Tees: Pipe restraint length shown in the joint restraint detail shall be provided in the branch direction. Also, the minimum length of pipe restraint in the straight through (run) direction shall be 10 feet on both sides of the tee.
b. Bends: Pipe restraint length shown in the joint restraint detail shall be provided on both sides of the bend.
c. Dead End: Pipe restraint length shown in the joint restraint detail shall be provided back from the dead-end plug.
d. All joints shall be restrained for pipe within casings.
e. All joints between bends on water main offsets shall be restrained.
f. See Joint Restraint Requirements detail for restrained joint pipe details.

I. Reaction Backing (Only allowed when approved by the Township ENGINEER):

J. Polyethylene Encasement:
1. In corrosive soils: install over ductile iron pipe and tape seams in accordance with AWWA C105.

K. Water Meters:
1. General: Water service line must have twelve (12) inches of clearance above finished floor and twelve (12) inches away from any adjacent wall, partition or foundation. If not provided, Contractor is responsible to rectify.

3.03 FIELD QUALITY CONTROL:

A. Testing and Inspection:
1. General:
a. **Observation:** By TOWNSHIP or TOWNSHIP's ENGINEER – measurements by contractor.
b. Notification: Pretest and arrange for observation of test – 24 hours required for observation – 48 hours required for testing.
c. Notification: The Township Inspector or Township Engineer shall be provided notice and allowed three (3) work days to perform major inspections for water main.
d. Equipment and assistance: Provide.
e. Required water: By TOWNSHIP where available from municipal system.
(1) Provide backflow prevention device on connection to existing water system.
f. Opening of valve to existing water main: After passing pressure / leakage and chlorination tests.
g. Meet requirements of AWWA C600 and these specifications.
2. Electrical continuity: Test ductile iron pipe for continuity and repair breaks.
3. Pressure/Leakage Test:
a. Conditions: Air or air-water methods of applying pressure prohibited.
b. Sequence: After flushing, prior to Chlorination.

c. Procedure: Fill system slowly, expel air through corporation stop at high points and apply pressure.
d. Pressure: Maintain water pressure of 150 psi.
e. Duration: Two (2) hours.
f. Make-up water: From measurable source.
g. Leakage: Quantity of water supplied to maintain test pressure.
h. Allowable: Less than:

$$L = \frac{SD \times \text{square root of } P}{148{,}000}$$

where,
L = leakage (gallons per hour).
S = length of pipe (feet).
D = nominal pipe diameter (inches).
P = average test pressure (pounds per square inch gauge).

i. Correction: Repair defects and repeat test until acceptable.
j. Maximum length of pipe to be tested shall be 2000 feet.

4. Dead-end water main stubs longer than 20 feet:
   a. Install standpipe with shutoff at dead-ends to aid in chlorinating, testing and flushing. Remove standpipe upon approval of water main.
5. Testing valves only: Maintain pressure on main and check all valves as follows:
   a. Need to maintain an air pressure of 120 psi for 5 minutes on tapping valve.
   b. Need to maintain a water pressure of 150 psi.
   c. Correction: Repair defects and repeat test until acceptable.

3.04 FLUSHING:

A. Flushing: Shall be performed in accordance with ANSI/AWWA C651-14
   1. Observation: By TOWNSHIP or TOWNSHIP's ENGINEER.
   2. Sequence: Prior to pressure testing and chlorination.
   3. Maximum intervals: 2,000 feet.
   4. Required water: By TOWNSHIP where and when available from municipal system. Maintain 20 psi residual pressure in existing water system.
   5. Minimum velocity: 3.0 feet per second at pipe wall. See table below for size and number of Taps required to achieve minimum velocity:

Required flow and openings to flush pipelines (with 40 psi residual pressure in water main)

Pipe Diameter *inches*	Flow Required to Produce 3.0 ft/s Velocity in Main *gpm*	Number of 2 ½-in. Hydrant Outlets	Number of 4 ½" Hydrant Outlets
4	120	1	1
6	260	1	1
8	470	1	1
10	730	1	1
12	1060	2	1
16	1880	2	1

- The internal scouring velocity must be a minimum of 3.0 feet per second throughout the entire length of water main being flushed. This velocity of water, flowing through an eight-inch pipe will yield 470 gallons per minute.
- During the procedure, the residual water pressure must not be less than 20 pounds per square inch.

- No more than 2,000 lineal feet of water main can be flushed at any one time.
- Discharged water shall be directed into the nearest storm drain system.
- Flushing must be observed by Township DPW staff or by the Township Engineer/Inspector.
- Discharge hoses shall not be used.

3.05 DISINFECTION:

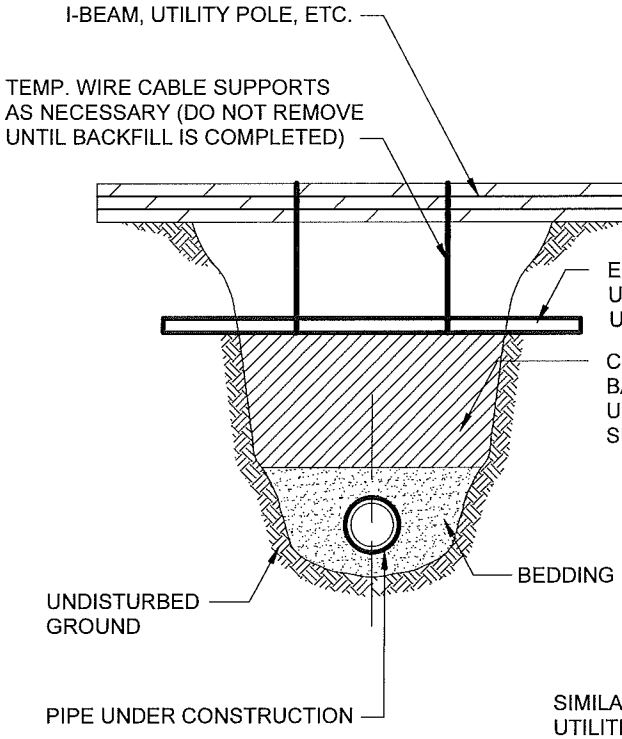
A. Chlorination:
1. Meet the requirements of ANSI/AWWA C651-92 (AWWA Standard for Disinfecting Water mains), continuous-feed method.
2. Observation: By TOWNSHIP or TOWNSHIP's ENGINEER.
3. Required water: By TOWNSHIP where available from municipal system.
4. Equipment and Assistance: Provide.
5. Chlorine gas: Not permitted on job-site.
6. Sequence: Following pressure tests and flushing and prior to connection to existing water main.
7. Retention time: Twenty-four (24) hours.
8. Procedure: Inject chlorine solution at constant rate to produce residual-free chlorine concentration of not less than 25 mg/l or more than 100 mg/l in all portions of the main at the end of the 24-hour retention period. Operate valves and clear line of residual chlorine after retention period.
9. Sampling: By TOWNSHIP, a minimum of two (2) samples shall be taken fifteen (15) minutes apart.
10. Correction: Re-chlorinate sections not meeting MDEQ bacteriological requirements.
    a. Retesting shall be paid by CONTRACTOR.
11. Disposing of heavily chlorinated water directly to open drains: Discharge water through de-chlorinated tablets in mesh sack.

3.06 SCHEDULES:

A. Standard Details:
1. Special supports for underground utilities / pipe saddles
2. Methods of bedding pipe
3. Water main offset / relocation detail
4. Joint restraint requirements
5. Hydrant assembly
6. Hydrant berm
7. Fire hydrant detail
8. Copper service lead connection / sample point.
9. Joint adapter detail
10. Underground utilities detail
11. H.D.P.E. to D.I.P. connection

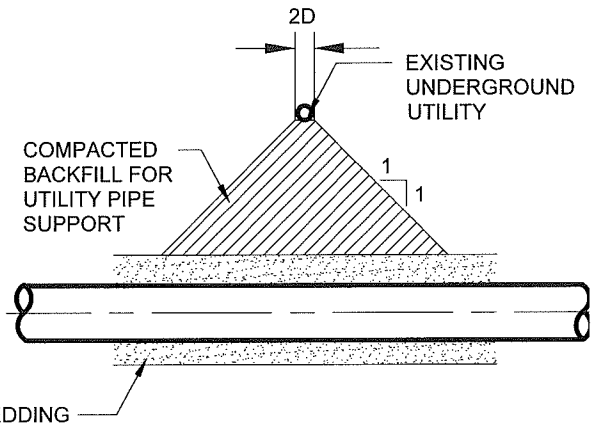
B. Water / Sewer Leakage & Pressure Testing Report Form.

END OF SECTION



SECTION

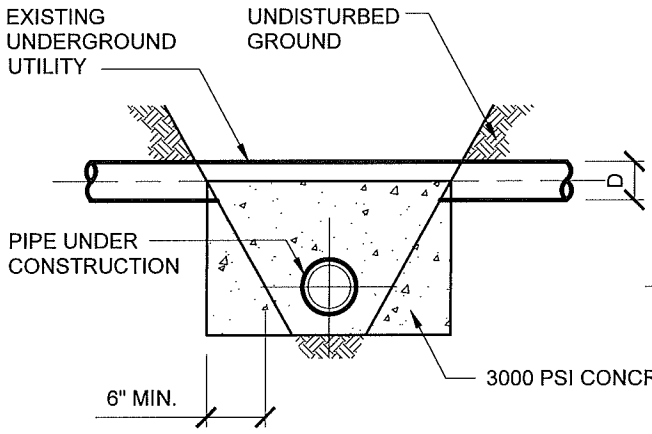
NOTE: MAINTAIN EXISTING COATING ON UTILITY

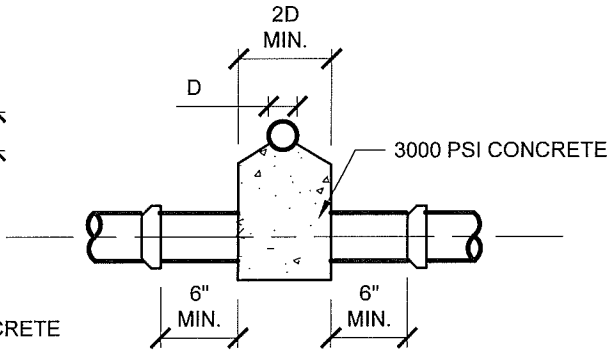


ELEVATION

SIMILAR SUPPORT METHODS APPLY TO UTILITIES PARALLELING AND ABOVE THE PIPE UNDER CONSTRUCTION

SPECIAL SUPPORTS FOR UNDERGROUND UTILITIES





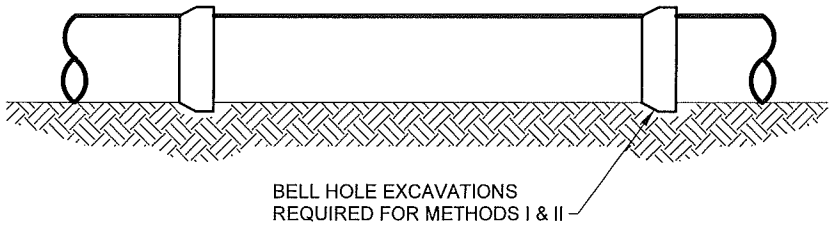
NOTE:

1. PIPE SADDLE IS NOT REQUIRED FOR PLASTIC, STEEL, LEAD OR COPPER PIPE 2" OR SMALLER.

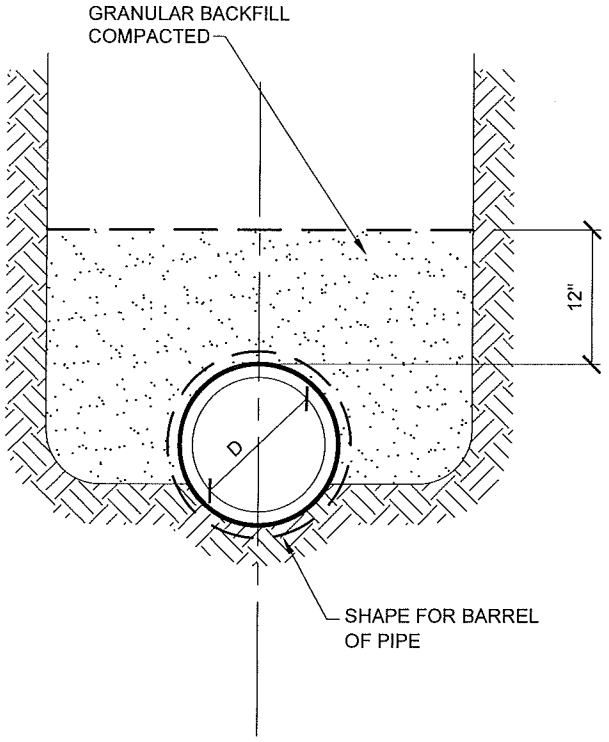
SECTION

ELEVATION

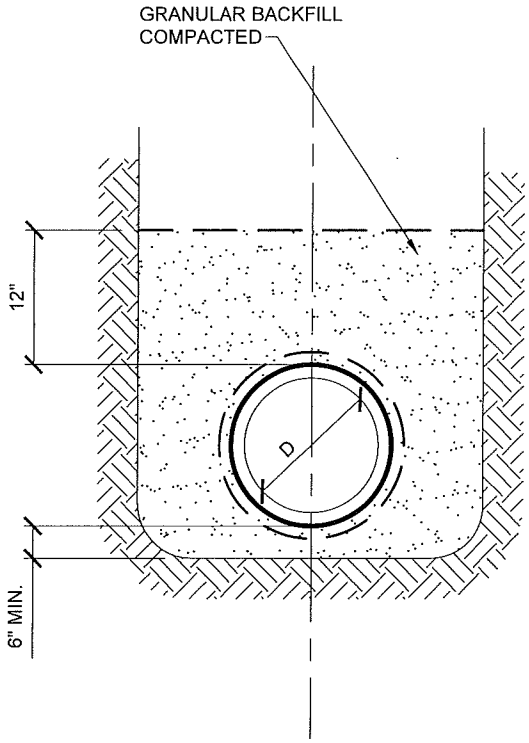
PIPE SADDLES



EXCAVATION FOR BELLS



METHOD I

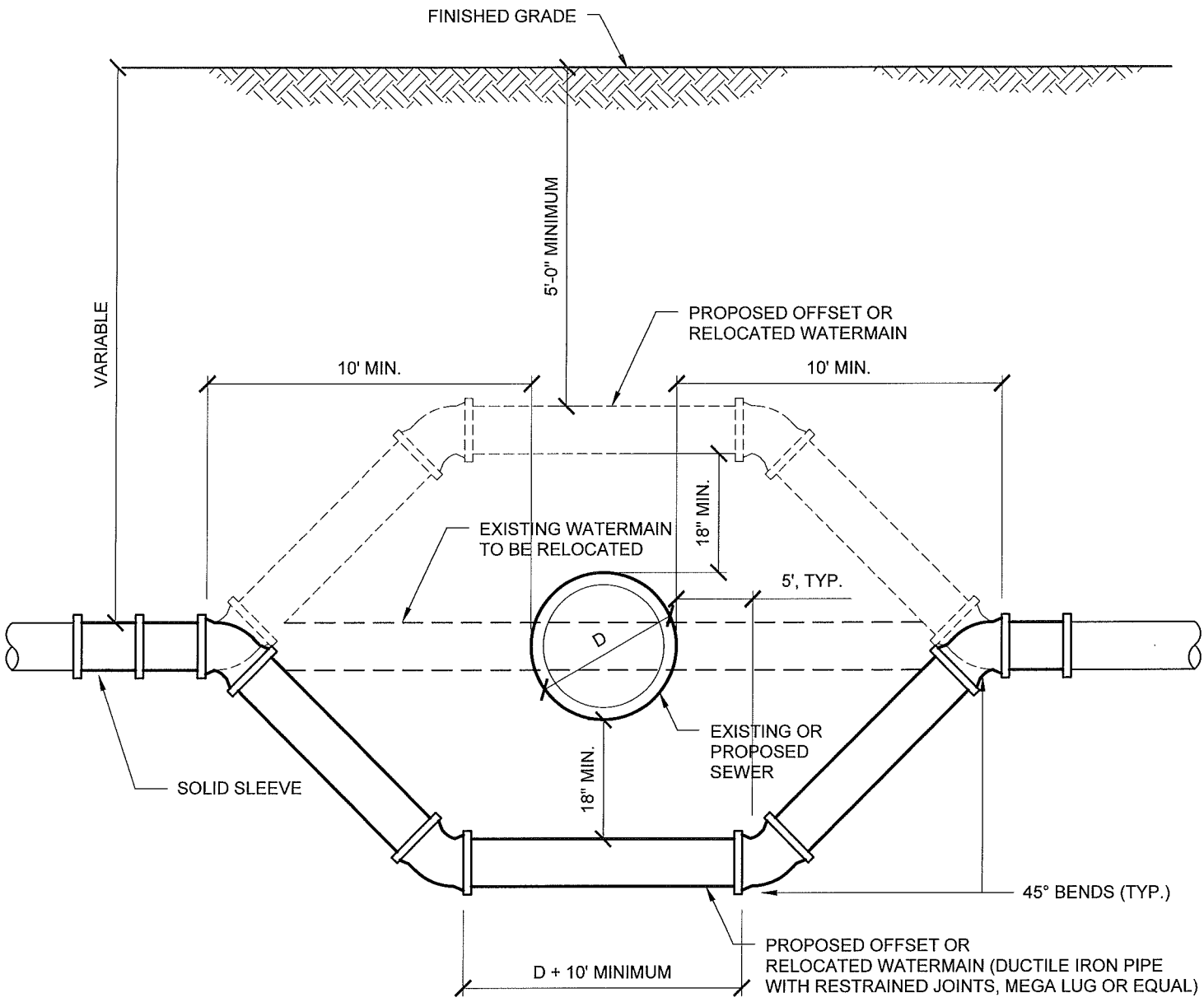


METHOD II

NOTES:

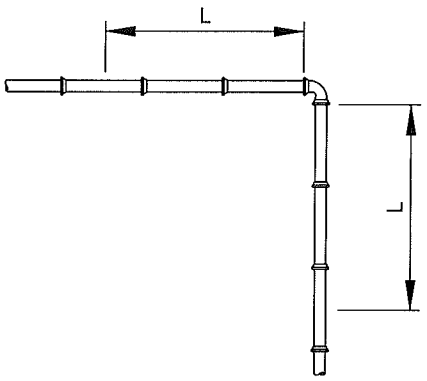
1. METHOD I. IN AREAS OF UNCONSOLIDATED SOILS (SAND, GRAVEL, ETC.)
2. METHOD II: IN AREAS OF CONSOLIDATED SOILS (CLAY, HARDPAN, ROCK, ETC.)

METHODS OF BEDDING PIPE

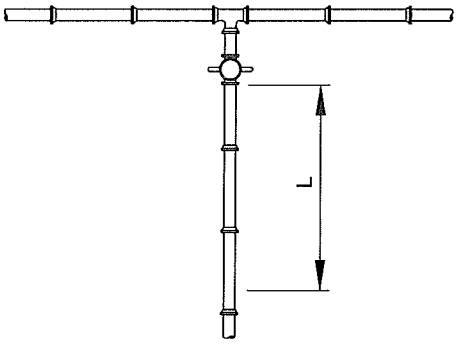


NOTE: WHEN THE MINIMUM CLEARANCE AND COVER CAN BE OBTAINED, THE WATERMAIN IS TO BE RELOCATED ABOVE THE SEWER. OTHERWISE, ANY SANITARY SEWER JOINTS WITHIN 10 FEET OF WATERMAIN SHALL BE ENCASED IN CONCRETE (REF. SECTION 02220, PARAGRAPH 2.01.A.3.

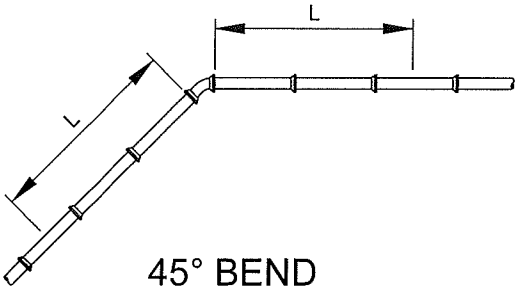
WATERMAIN OFFSET / RELOCATION DETAIL



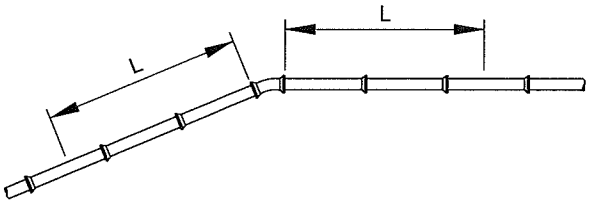
90° BEND



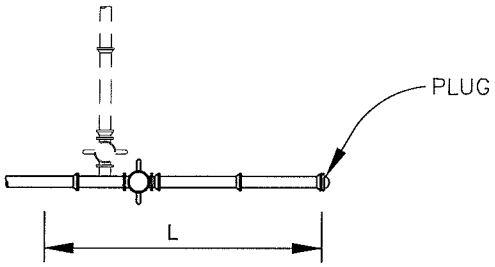
TEE



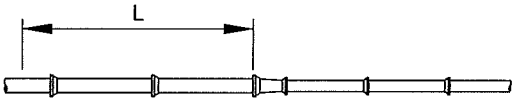
45° BEND



22 1/2° BEND OR LESS



DEAD END



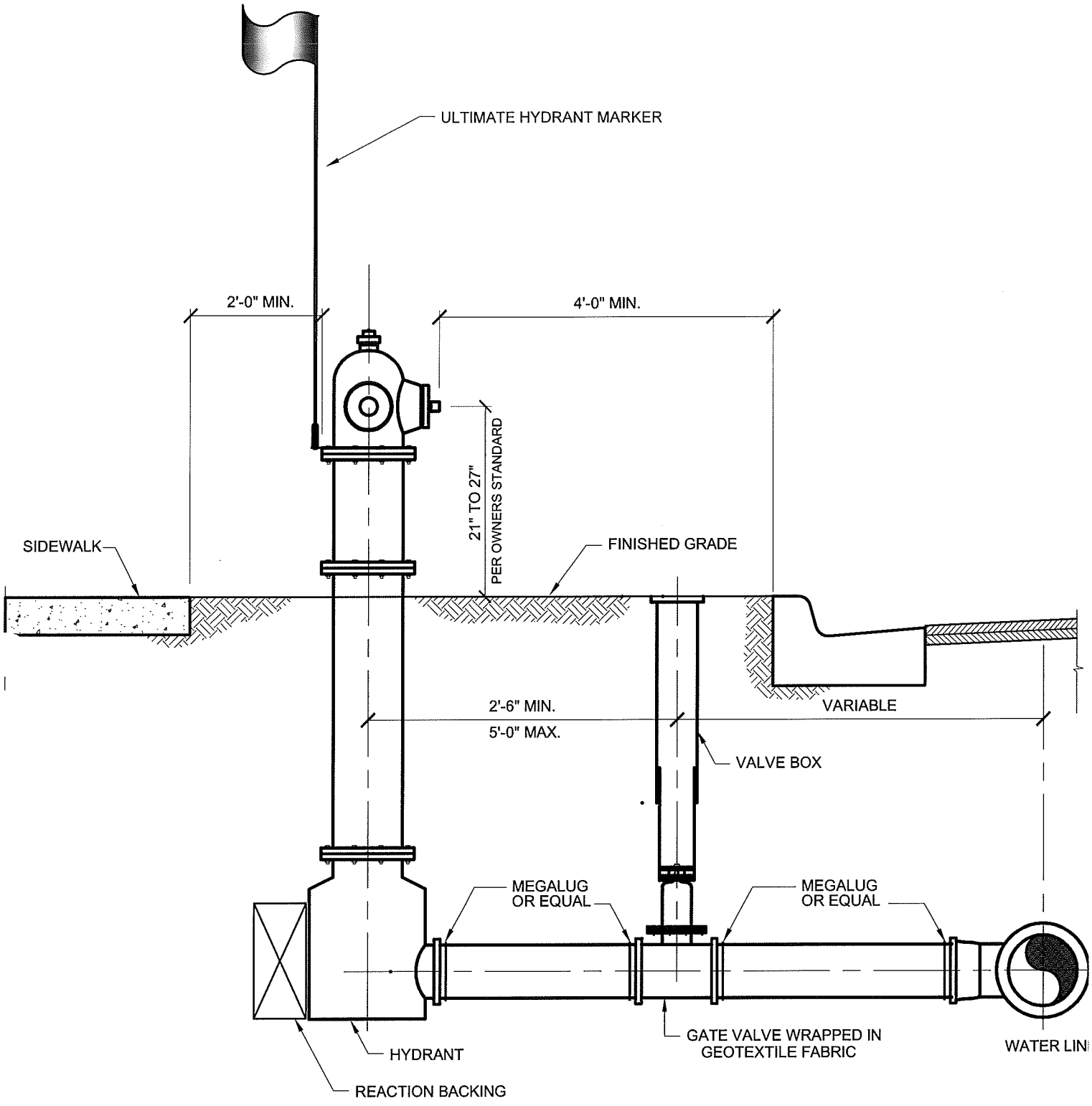
REDUCERS

"L" = MINIMUM LENGTH OF MECHANICAL JOINT RESTRAINT SHOWN IN TABLE

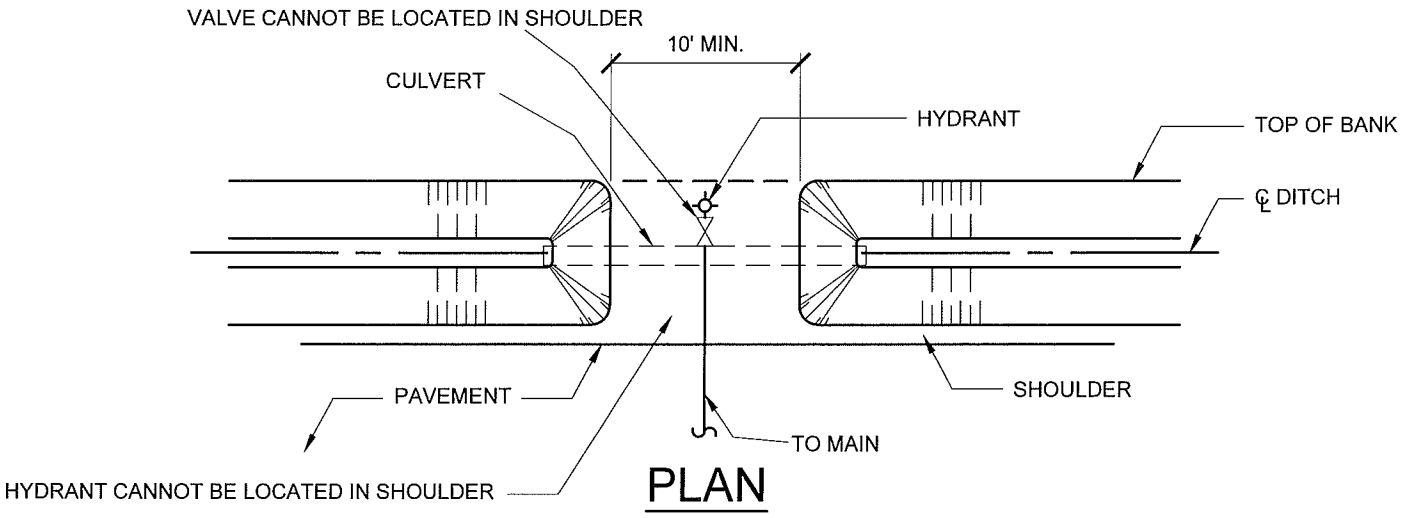
PIPE RESTRAINT LENGTH (L) REQUIRED, FEET*							
Pipe Dia.	Tees, 90° Bends	45° Bends	22-1/2° Bends	11-1/4° Bends	Dead Ends	Reducers (one size)	**
4"	23	9	5	2	57		
6"	32	13	6	3	82	43	63
8"	41	17	8	4	104	43	55
12"	58	24	12	6	149	80	120
16"	74	31	15	7	192	82	110

* AND ** - SEE PARAGRAPH 3.02H OF SPECIFICATION SECTION 02660
***VERTICAL BENDS REQUIRE 50% OF ADDITIONAL RESTRAINT.

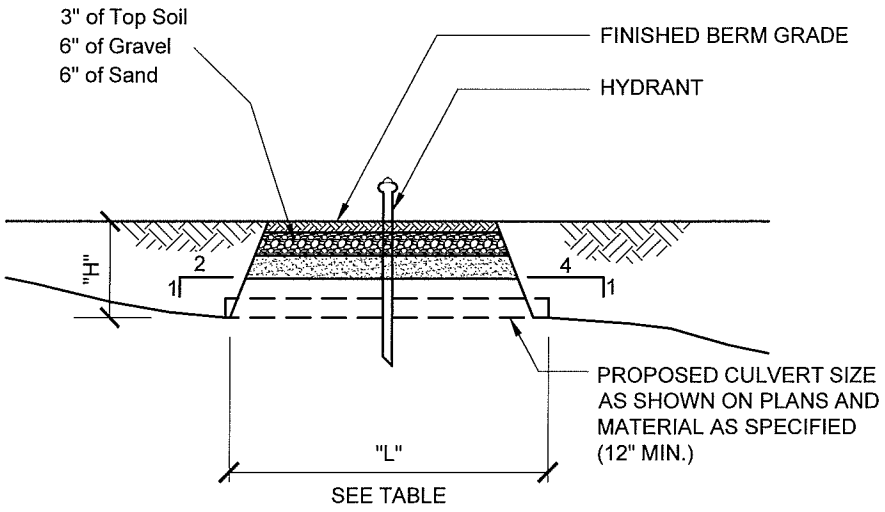
JOINT RESTRAINT REQUIREMENTS



HYDRANT ASSEMBLY



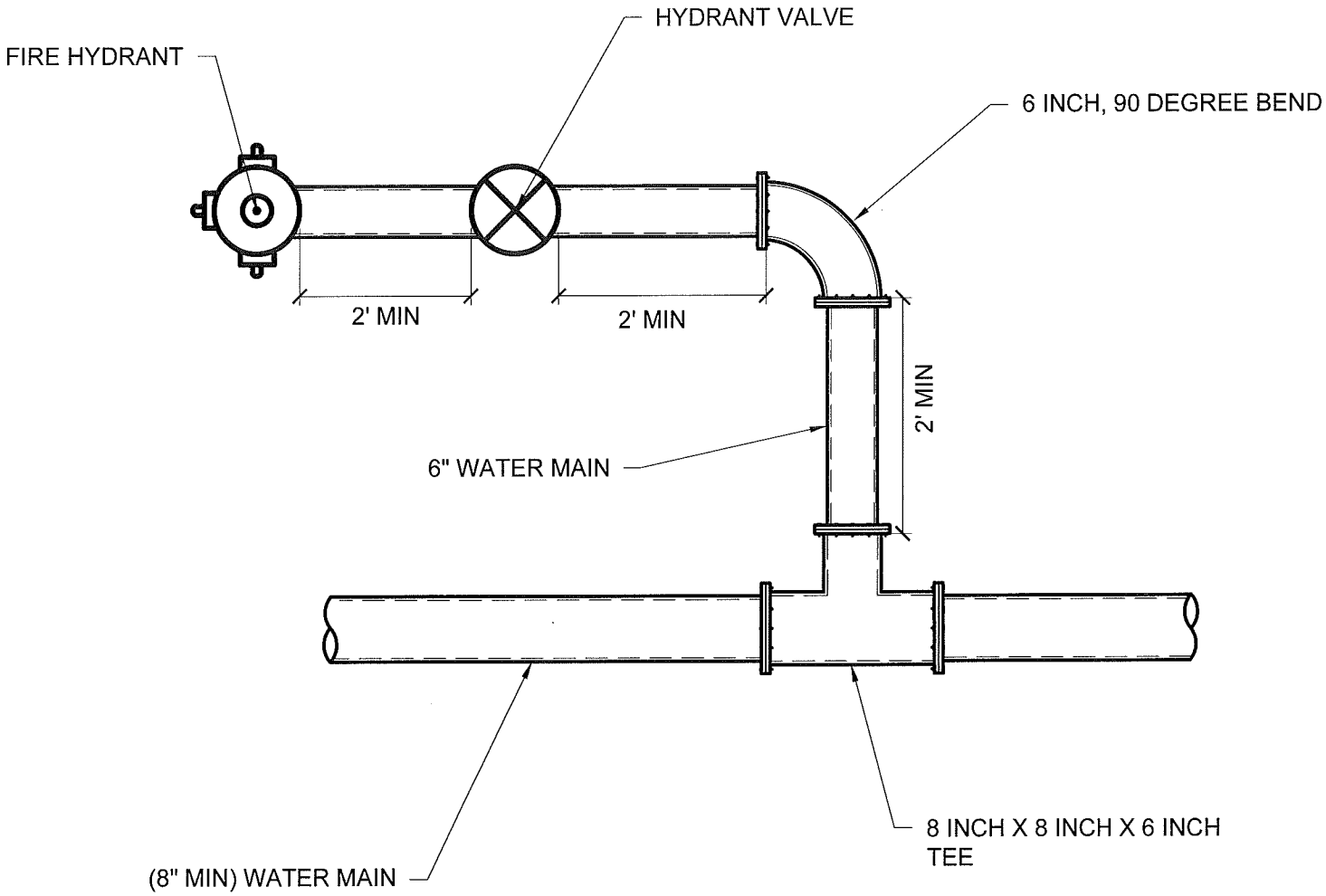
PLAN



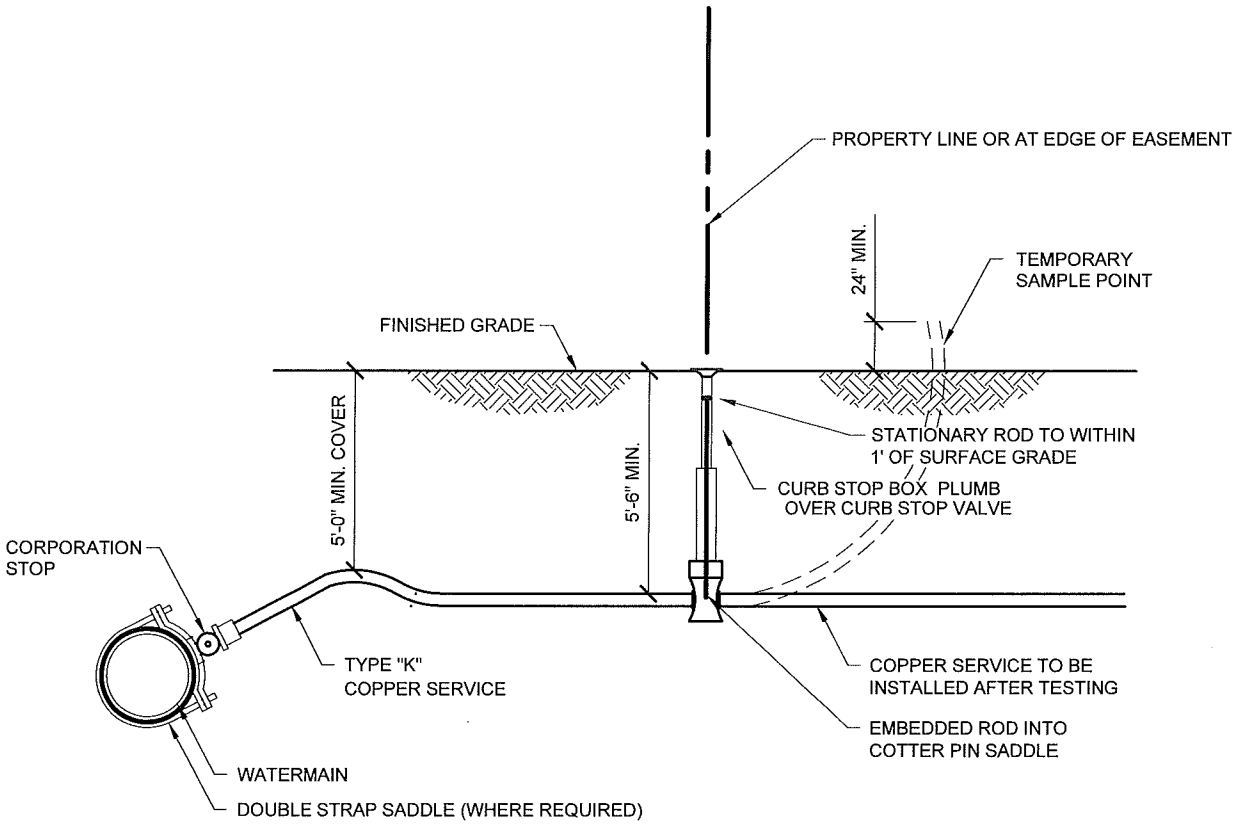
ELEVATION

	1:2 SIDE SLOPE	1:4 SIDE SLOPE
	SODDED	SEEDED
"H"	"L" (MIN.)	"L" (MIN.)
2'	18'	26'
3'	22'	34'
4'	26'	42'
5'	30'	50'
6'	34'	58'

HYDRANT BERM



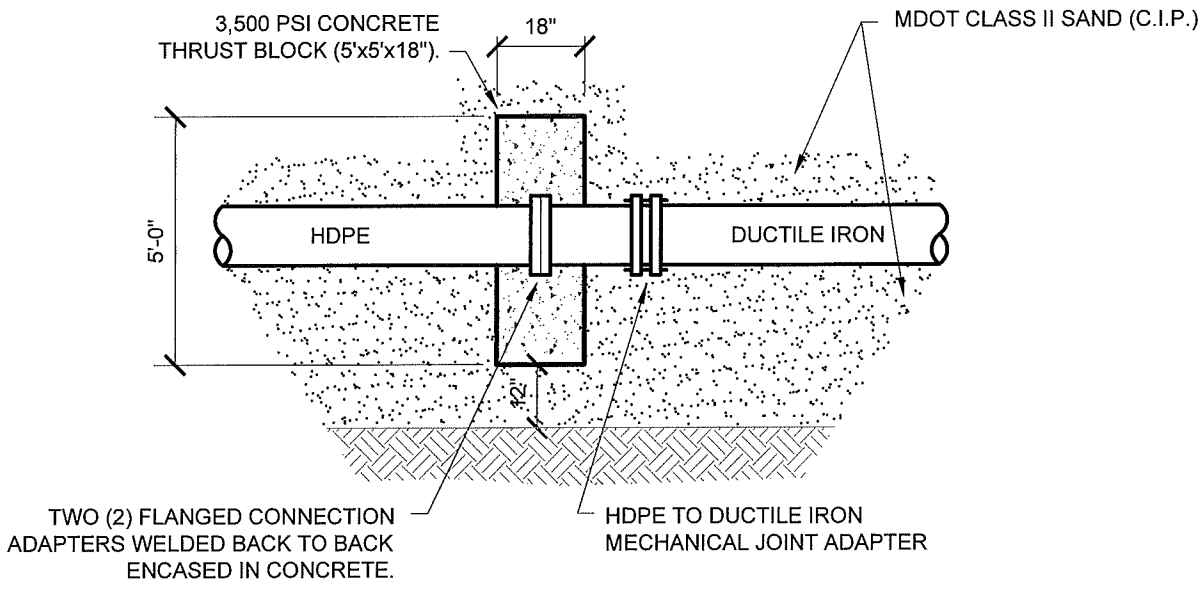
FIRE HYDRANT DETAIL



NOTES:

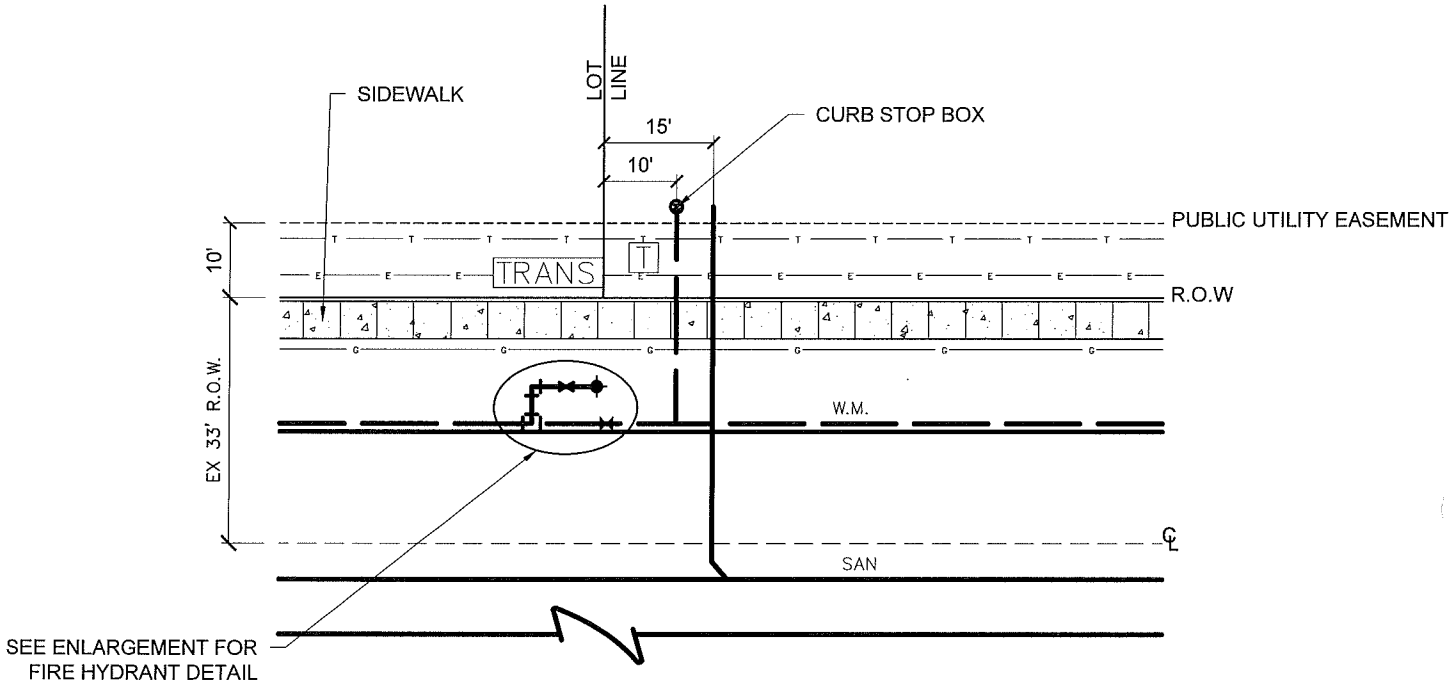
1. SAMPLE POINT TO BE USED FOR FUTURE SERVICE LEAD.
2. NO TAP SHALL BE MADE CLOSER THAN 18" TO ANY COUPLING OR JOINT IN THE PIPE.

COPPER SERVICE LEAD CONNECTION/SAMPLE POINT



HDPE TO DUCTILE IRON MECHANICAL JOINT ADAPTER DETAIL

NOT TO SCALE



UNDERGROUND UTILITIES

DRAWING TO SCALE

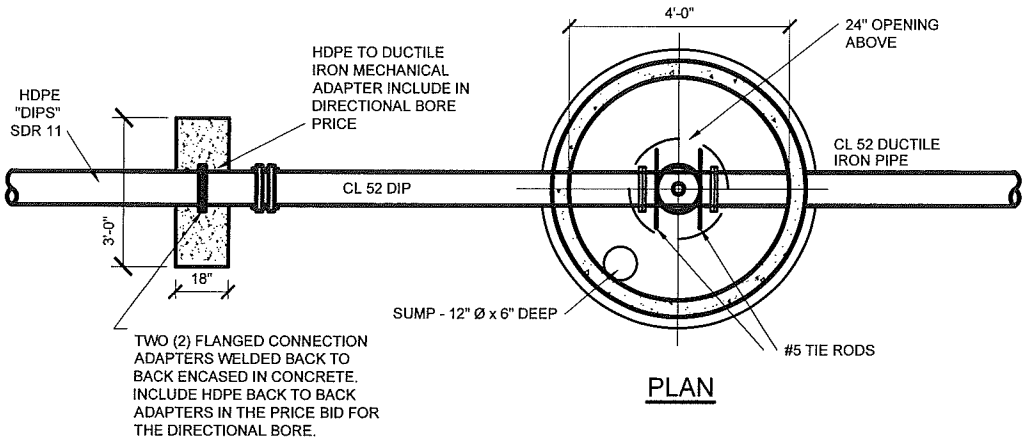
0 20 40

SCALE IN FEET

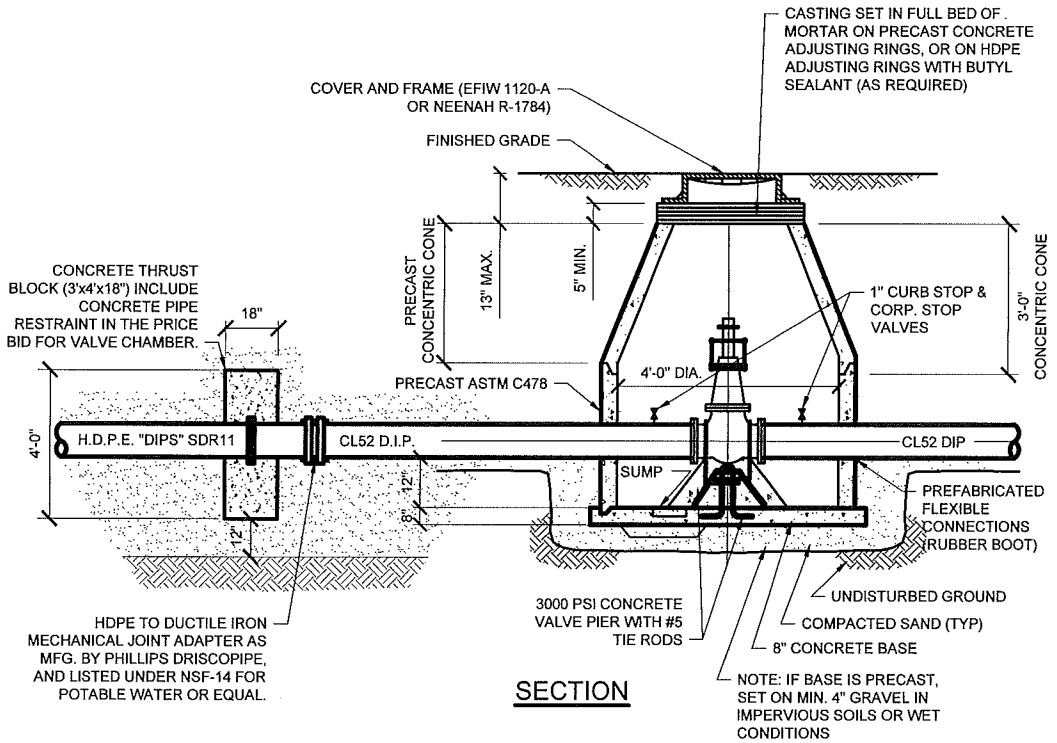
LEGEND

- E E Electrical
- T T Telephone
- G Gas
- T Telephone Pedestal
- TRANS Transformer

1071_Underground Utilities



PLAN



SECTION

HDPE TO DIP CONNECTION

WATER/SEWER LEAKAGE & PRESSURE TESTING REPORT

PROJECT: DATE:

PROJECT NO.: INSPECTOR:

LOCATION: REPORT NO.:

LOCATION	TEST NO.	PIPE SIZE (IN.)	LENGTH OF PIPE (LFT.)	PRESSURE AT START OF TEST (PSI)	PRESSURE AT COMPLETION OF TEST (PSI)	ALLOWABLE LOSS (GAL/HR)	ACTUAL LOSS (GAL/HR)	TIME REQUIRED FOR TEST	ACTUAL TIME OF TEST	APPROVED	REJECTED	REMARKS

WATERMAINS:

1. PRESSURE TEST: DURATION = 1 HR.
   140 TO 150 PSI @ LOWEST POINT
2. LEAKAGE TEST: DURATION OF TEST = 2 HRS.
   ALLOWABLE LOSS:

$$L = \frac{SD \times \text{square root } (P)}{148{,}000}$$

   L = LEAKAGE (GALLONS PER HOUR)
   S = LENGTH OF PIPE (FEET)
   D = NORMAL PIPE DIAMETER (INCHES)
   P = AVERAGE TEST PRESSURE (PSI GAUGE)
3. VALVES: ALLOWABLE LEAKAGE = LESS THAN 10 PSI IN 5 MINUTES W/PUMP OFF
   (120 psi air, 150 psi water)

SEWERS:

1. EXFILTRATION AIR TEST: DURATION = (SEE CHART ON BACK)
   3.5 PSI AFTER STABILIZATION OF PRESSURE
   PRESSURE LOSS FROM 3.5 TP 2.5 PSI MUST NOT EXCEED TIME LIMITS
   TIME FOR 2 OR MORE SIZES IN SAME RUN SHALL BE COMPUTED AND
   ADDED TOGETHER

SECTION 2661

REMOVAL/ABANDONMENT OF WATER SERVICES

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes the work required for the removal of one or more water service(s) from the water main to the curb stop valve and box and appurtenant work.
B. This Section includes the work required for the abandonment of one or more water service(s) from the water main to the curb stop valve and box and appurtenant work.

1.02 REFERENCES:

A. AWWA - American Waterworks Association, latest edition.

B. ANSI - American National Standards Institute, latest edition.

C. ASTM - American Society Testing Materials, latest edition.

D. Recommended Standards for Water Works – Ten State Standards, latest edition

1.03 SUBMITTALS:

A. Submit the following for review by TOWNSHIP DPU or TOWNSHIP'S ENGINEER:
   1. Product Data on material used to plug/seal at the corporation stop at the Water Main and/or at the Curb Stop Valve and Box.
   2. Proposed equipment and method for flushing, pressure testing, leakage testing and chlorination as needed to ascertain Water Main meets TOWNSHIP Standards for potability.
   3. Submittals must be approved prior to construction.

B. Report witness measurements on valves, fittings and curb boxes that are exposed and left in place (in-situ) during removal/abandonment.
   1. Provide measurements from two permanent fixtures such as building corners, power poles and trees 8-inch diameter and larger.

C. Provide certifications on material used to plug/seal Water Main, Corp Stop and/or Curb Stop indicating conformance to specifications prior to installation.

D. Submittal of drawings of record plans to:
   1. Provide the Township Hall two (2) printed sets and one (1) electronic file
   2. Provide the Township Engineer (1) one electronic file with as-constructed dimensions and witnesses.
   3. Provide Township Utilities Superintendent (1) one electronic file

1.04 JOB CONDITIONS:

A. Interrupting Water Service(s):
   1. REF SECTION 02660 – WATER MAINS 1.04
   2. Where removal of the water service to the water main is required, the existing water main shall be sealed in such a manner as to prohibit dirt and foreign material from

entering. Materials used shall be approved by the TOWNSHIP. The plug/seal shall be provided and installed by the Contractor, as directed by the TOWNSHIP.

3. Prevent contamination of existing water mains.

B. Clean up promptly upon completion or safely secure site if work not completed in one (1) work day. Clean up shall include backfill, rough grading and restoration of grounds. REF SECTION 02220 – EXCAVATING, BACKFILLING AND COMPACTING.

C. Contractor is solely responsible for confirming actual soil conditions and depth of water table.

D. Pavement, sidewalk, curbs or gutters removed or destroyed in connection with performance of the work shall be saw cut as directed by the TOWNSHIP and shall be replaced with pavement, sidewalks, curbs, gutters of the same kind, or better by the Contractor in accordance with TOWNSHIP Standards.

E. Granular Subbase and Aggregate Base shall be placed beneath the restored pavement to TOWNSHIP Standards.

F. All materials, salvaged or furnished by Contractor, shall meet TOWNSHIP Standards.

G. Areas of work shall be restored to conditions prior to water service removal or better.

H. No water services are to be abandoned in place unless directed by the TOWNSHIP or TOWNSHIP Engineer.

I. Removal/Abandonment not allowed when air temperature is 25 degrees F or colder or when determined too cold by TOWNSHIP.

J. Salvage all existing water meter, transponder, if applicable, and meter valves {inlet & outlet} (either side of water meter) and curb boxes removed and deliver to the TOWNSHIP's yard.

K. Demolition Permit
   1. Contractor to have at least $500,000 personal injury and property damage insurance.

L. Ownership of debris
   1. TOWNSHIP has first right to surplus materials.
   2. The Contractor is directly and solely responsible for disposal of surplus and unsuitable material.

PART 2 - PRODUCTS

2.01 GENERAL:

A. REFER TO SECTION 02660 – WATER MAINS

B. REFER TO SECTION 02220 – EXCAVATING, BACKFILLING AND COMPACTING

C. All materials must conform to TOWNSHIP, OTTAWA County Health Department and the Michigan Department of Environmental Quality (MDEQ).

PART 3 - EXECUTION

3.01 PREPARATION:

A. Contractor shall make proper provisions for the maintenance and continuation of utility services to surrounding properties as directed by the TOWNSHIP or TOWNSHIP Engineer, unless otherwise specified.

B. Properties may have more than one water service. Determine their locations prior to excavation.

C. Alignment:
   1. Notify TOWNSHIP DPU or TOWNSHIP's ENGINEER and to obtain instructions to proceed where there is a discrepancy, or an obstruction not shown on plans.
   2. Verify location and depth of existing utilities in advance of removal/abandonment. Provide the Township with GPS coordinates to all abandoned corporation stops.

D. Bedding:
   1. Method: See Article 3.06 SCHEDULES.
   2. Provide bedding area backfill in accordance with MDOT Standard Plan R-83C.
   3. Provide continuous bearing supporting entire length of exposed water main evenly, when exposed.

E. Cleaning Pipe and Fittings:
   1. Provide interior free of foreign material and joint surfaces free of lumps and blisters.

3.02 REMOVAL/ABANDONMENT:

A. General: Meet requirements of AWWA C600 and these specifications.

B. Determine status of property:
   1. Occupied – contact TOWNSHIP to report status and receive instructions on how to proceed.
   2. Unoccupied – proceed with removal/abandonment.

C. REF SECTION 02660 – WATER MAINS

D. Provide and place traffic and pedestrian traffic barriers, as necessary.

E. For water service removal from water main to curb stop box:
   1. Remove existing water service and leave corporation stop in place.
   2. Use a Ford or equivalent Tube Nut, Copper Gasket and Brass Corp Stop Plug. Prior to backfilling the abandoned corporation, the Township must inspect and give approval. Should the corp leak, the corp must be removed and the water main should be plugged using a plug/seal approved by the Township.
   3. If the corp is located within a saddle on the water main and requires removal, a Smith-Blair (or equivalent) repair clamp must be furnished by the contractor and installed.
   4. If shutting down the water main is necessary to complete the disconnect, the Township and residents must be notified at least 24 hours in advance.
   5. Excavate and remove water service and Curb Valve Stop and Box to five (5) feet outside of the ROW.
   6. Witness location of plugged service tap.

7. Backfill in accordance with MDOT Standard Plan R-83C prior to starting water service removal/abandonment on private property.
8. Salvage water meter, transponder, if applicable, and meter valves {inlet & outlet} (either side of water meter). Return to TOWNSHIP.
9. Backfill and grade in accordance with MDOT Standard Plan R-83C and SECTION 02220 – EXCAVATING, BACKFILLING AND COMPACTING

F. Remove and dispose of abandoned pipe, valves and boxes, or other appurtenances, as necessary for the removal/abandonment of the water service at no cost to the TOWNSHIP.

3.03 FIELD QUALITY CONTROL: REF SECTION 02660 – WATER MAINS 3.03

A. Contractor performing the work shall give the Township 48 hours' notice of water service abandonment/removal for inspection.

3.04 FLUSHING: REF SECTION 02660 – WATER MAINS 3.04

3.05 DISINFECTION: REF SECTION 02660 – WATER MAINS 3.05

3.06 SCHEDULES:

A. Standard Details:
1. Methods of bedding pipe
2. Copper service lead connection / sample point
3. Underground utilities detail

B. Water/Sewer Leakage & Pressure Testing Report Form.

The unit price includes the cost of structure repairs to remove water service, sawing, removal and disposal; providing, placing and compacting backfill and providing and placing replacement soil or base material(s) as determined by the TOWNSHIP.

END OF SECTION

SECTION 02720

STORM SEWERS

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes work required for storm sewer pipe, culverts, structures, drain excavation/cleanout and related work.

1.02 REFERENCES:

A. MDOT - Michigan Department of Transportation, *"Standard Specifications for Construction", Current Edition.*

B. ASTM - American Society Testing Materials, latest edition.

1.03 SUBMITTALS:

A. Submit the following for review by TOWNSHIP or TOWNSHIP's ENGINEER:
   1. Shop Drawings on radius pipe.

B. Notify TOWNSHIP on presence of wastewater.

C. Line and grade control method other than Laser Beam shall be approved by TOWNSHIP or TOWNSHIP's ENGINEER.

D. Report witness measurements and "as-built" elevation on end of footing drains.
   1. Provide measurements from two permanent fixtures such as building corners, power poles and trees 8-inch diameter and larger.

1.04 JOB CONDITIONS:

A. Maintain existing storm sewer operational.

B. Install service lines, catch basins and inlet leads as pipe laying progresses and within maximum of 600 feet of mainline sewer installation.

C. Clean up promptly following pipe installation and within maximum of 400 feet behind pipe laying operation. Cleanup shall include backfill and rough grading.

PART 2 - PRODUCTS

2.01 PIPE:

A. Concrete Pipe Classification Table:

Type & Size	Design Depth (feet) 3' - 19'	Over 19'
Reinforced Concrete 12" - 54"	ASTM C-76 Class III	ASTM C-76 Class IV
Reinforced Concrete 60" - 90"	ASTM C-76 Class III	ASTM C-76 Class IV

1. Concrete Pipe shall be circular.

B. Corrugated Steel: MDOT 909.05.

C. Polyethylene (PE):
1. ADS N-12 corrugated exterior, smooth interior: ASTM F-405
2. Hi-Q.

D. Footing Drains:
1. Footing and sump pump drain laterals shall not be connected directly to storm sewer, sanitary sewer or under drain within existing or proposed public roadways. Connections shall only be allowed to rear and/or side yard drainage systems outside of public roadways.

2.02 PREMIUM JOINTS:

A. Concrete: ASTM C443, modified to include "O" rings on grooved pipe ends.

B. Corrugated Metal:
1. Coupling bands: Same as standard joints.
2. Waterproofing materials: $^3/_8$-inch Neoprene, solid.
3. Neoprene width: 7 inch for 12 inch bands and 12 inch for 24 inch bands.

C. Plastic: Rubber O-Rings.

2.03 MANHOLES, CATCH BASINS AND INLETS:

A. Precast Units: ASTM C478 and ASTM C76 Class III.
1. Joints: Cement mortar, preformed bituminous rope or "O" ring gaskets.
2. Pipe openings: Pipe diameter plus 6 inches, maximum.

B. Concrete: 3500 psi 28 day, 4-inch maximum slump.

C. Concrete Radial Units: ASTM C139. For repair of existing units only.

D. Grade Rings: ASTM C478.

E. Manhole Steps shall be one of the following:
   1. Cast iron: 10 inches deep by 10 inches wide, 5-inch tread depth, 1 inch by 1 inch tread section, with 2-inch rail height.
   2. Plastic: Reinforced with $^3/_8$-inch steel rod and dimensioned as cast iron.

F. Manhole Castings: East Jordan 1120, B cover, Neenah 1764 perforated cover.

G. Catch Basin and Inlet Castings: MDOT C, E OR K as follows:
   1. Concrete rolled curb and gutter: Cover C.
   2. Bituminous valley gutter: Cover C.
   3. Ditch centerline: Cover E.
   4. Concrete standard curb and gutter: Cover K. Cover KK where called for on plans. Cover KK shall be East Jordan Iron Works #7030 T1 or T3, Neenah Grate r-3246 or equal.
   5. Catch basin backs / grates shall be marked with lettering "Dump No Waste, Drains to Waterways".

2.04 RIP RAP:

A. Rip Rap: MDOT 916.01.

B. Geotextile Fabric: Mirafi 600X.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Alignment and Grade:
   1. Deviations: Notify OWNER's ENGINEER and obtain instructions to proceed where there is a grade discrepancy or an obstruction not shown on the drawings.
   2. Expose existing utilities at crossings of proposed storm sewer in advance of laying pipe to verify existing depth. Advise OWNER's ENGINEER of conflicts in grade and provide adjustments in grade of storm sewer.

B. Laser Beam Control:
   1. Check grade at set-up point, 25 foot, 50 foot, 100 foot and 200 foot points thereafter to the next set-up point.
   2. Projector advancement: Reset at each manhole.

C. Bedding:
   1. Provide minimum 3 inches granular material bedding in areas of consolidated soils (i.e. clay, hardpan, bedrock, etc.).
   2. Provide bedding area backfill in accordance with SECTION 02220 EXCAVATING, BACKFILLING AND COMPACTING.
   3. Provide continuous bearing by supporting entire length of pipe barrel evenly. Excavate for bells of pipe joints.

3.02 INSTALLATION:

A. Laying pipe:
   1. Direction shall be upstream with spigot or tongue end downstream and bell end upstream.
   2. Joints shall be smooth and clean.
   3. Place pipe length and bedding as a unit in a frost free, dry trench.

4. Special supports and saddles: See Article 3.05 SCHEDULES.

B. Jointing:
   1. Premium:
      a. Solvents, adhesives and lubricants shall be furnished by Manufacturer.
      b. Seating: Fully.
      c. Gasket position: Check.
   2. All pipe 24-inches in diameter or larger shall have joints wrapped with geotextile fabric.

C. Manhole, Catch Basins and Inlets:
   1. General: See Article 3.05 SCHEDULES.
   2. Base bedding: Provide 4-inch pea stone with full and even bearing in impervious or wet conditions. Otherwise provide on undisturbed frost-free dry subgrade.
   3. Precast: Fill joint space completely and trowel.
   4. Block: Set in full bed of mortar with key slots filled, joints maximum ½ inch at inside face and wipe joints. Plaster coat complete interior of structure with ½ inch coat of cement mortar.
   5. Provide manhole casting grade setting as follows:
      a. Existing pavement: Finish grade.
      b. Gravel road surface: 6 inches below.
      c. Unpaved lawn areas: Finished grade.
   6. Provide catch basin casting grade setting as follows:
      a. Gutter grade: ½ inch below nearest asphalt or concrete
      b. Unpaved areas: 6 inches below finished grade.

D. Connections:
   1. Existing storm sewer:
      a. Structures: Relay and repoint loose blocks and bricks.
   2. Future Storm Sewer:
      a. Plug: Pipe 4 inch through 21 inch with standard disc.
      b. Bulkhead: Pipe 24 inch and larger with brick and mortar, ½ inch plaster outside.
         (1) 24 inch - 36 inch: 4 inch thick.
         (2) 42 inch - 60 inch: 8 inch thick.
         (3) 60 inch and larger: 12 inch thick.

E. Drain Excavation/Cleanout:
   1. Section: 4-foot flat bottom with 1 on 2 maximum side slopes.
   2. Remove trees and brush as required, unless otherwise indicated.
   3. Excess excavated material:
      a. Drain excavation of 2 feet or less: Spread, level and grade to drain along top of banks.
      b. Drain excavation in excess of 2 feet: Remove from site and place in an upland disposal site.

3.03 TESTING AND INSPECTION:

A. General:
   1. Observation: By TOWNSHIP OR TOWNSHIP'S ENGINEER.
   2. Testing: All polyethylene pipe shall have a mandrell pulled through to confirm no deformation of circular pipe.
   3. Completion: Before connecting to active system.
   4. Notification: Clean and arrange for inspection.

B. Line and Grade: Allowable drift between structures from proposed alignment will be as follows:
   1. Line:
      a. Through 36 inch: 0.40 foot.
      b. Over 36 inch: 0.80 foot.
   2. Grade:
      a. Through 36 inch: 0.05 foot.
      b. Over 36 inch: 0.10 foot.

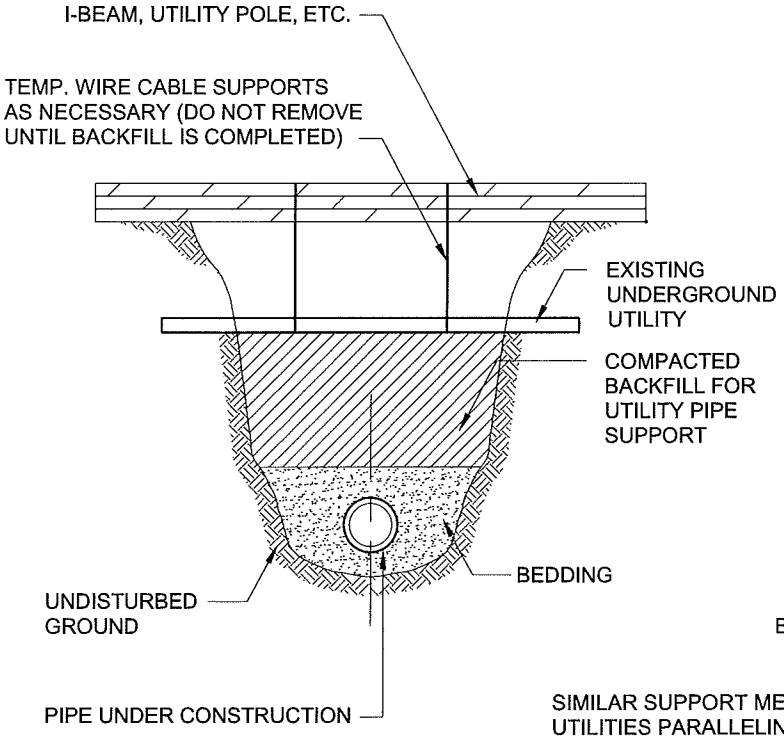
3.04 ADJUST AND CLEAN:

A. General:
   1. Structures to be checked at project completion per Ottawa County Water Resources Commission Standards.

3.05 SCHEDULES:

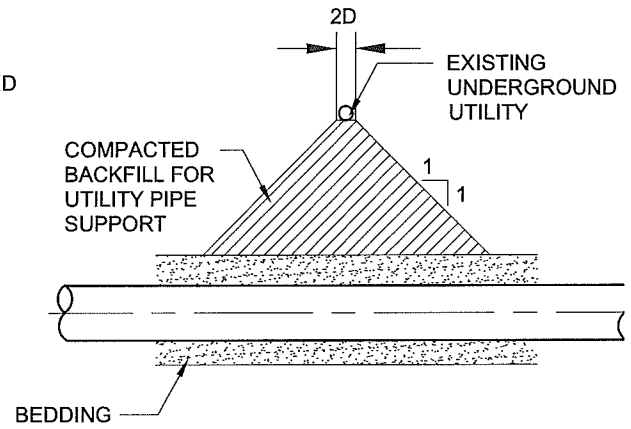
A. Standard Details:
   1. Special supports for underground utilities / pipe saddles.
   2. Methods of bedding pipe.
   3. Standard storm manhole.
   4. Standard storm tee manhole.
   5. Standard catch basin.
   6. Standard inlets.
   7. Special curb / yard inlet.

END OF SECTION



SECTION

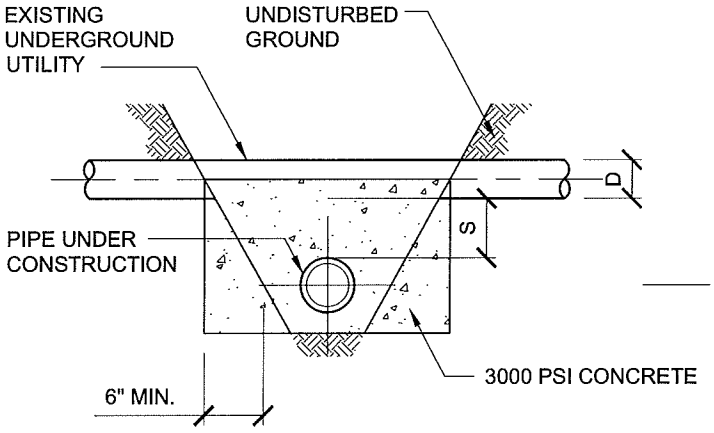
NOTE: MAINTAIN EXISTING COATING ON UTILITY

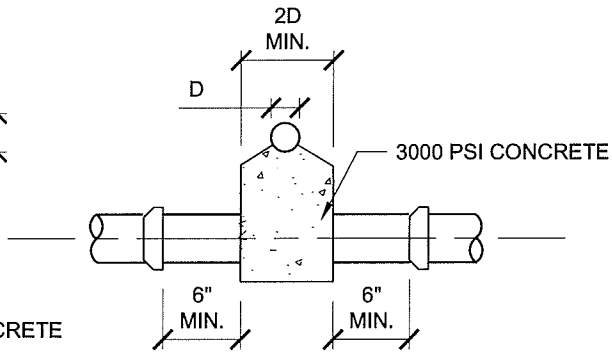


SIMILAR SUPPORT METHODS APPLY TO UTILITIES PARALLELING AND ABOVE THE PIPE UNDER CONSTRUCTION

ELEVATION

SPECIAL SUPPORTS FOR UNDERGROUND UTILITIES





NOTES:

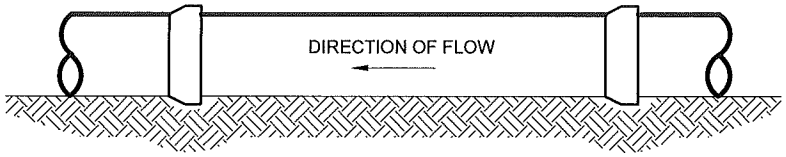
1. PIPE SADDLE REQUIRED WHEN SEPARATION (S) IS 12 INCHES OR LESS UNLESS OTHWERWISE DIRECTED OR SHOWN ON PLANS

2. PIPE SADDLE IS NOT REQUIRED FOR PLASTIC, STEEL, LEAD OR COPPER PIPE 2" OR SMALLER.

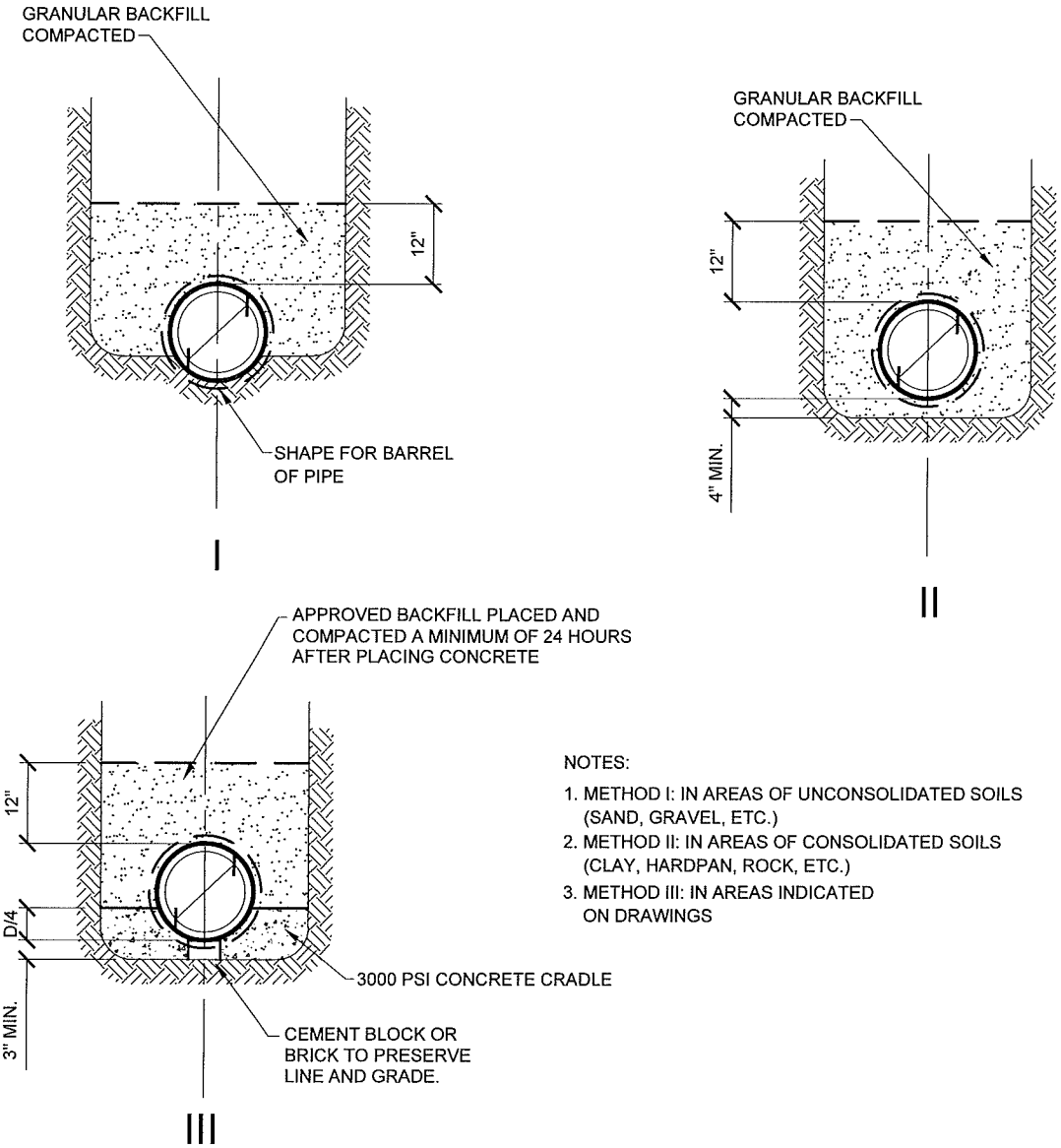
SECTION

ELEVATION

PIPE SADDLES



EXCAVATION FOR BELLS



NOTES:

1. METHOD I: IN AREAS OF UNCONSOLIDATED SOILS (SAND, GRAVEL, ETC.)
2. METHOD II: IN AREAS OF CONSOLIDATED SOILS (CLAY, HARDPAN, ROCK, ETC.)
3. METHOD III: IN AREAS INDICATED ON DRAWINGS

METHODS OF BEDDING PIPE

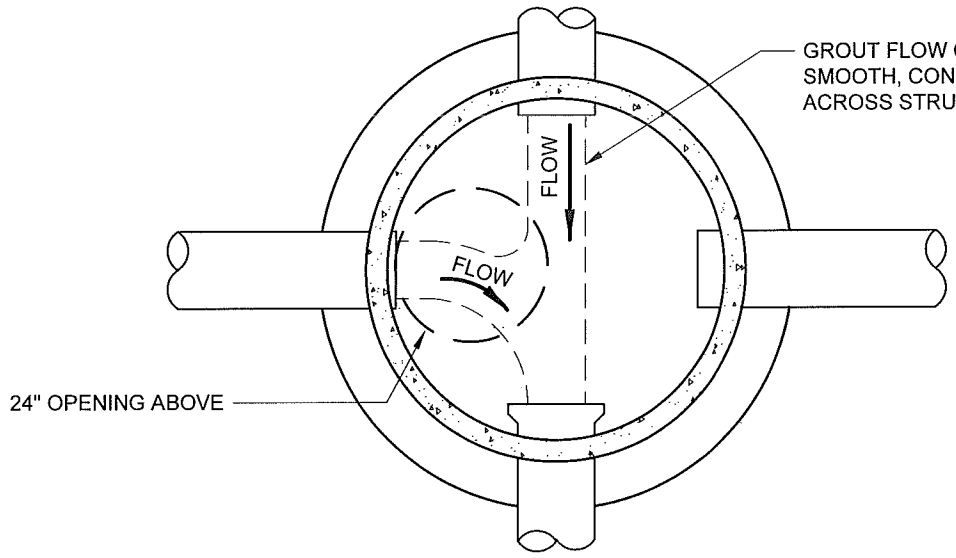
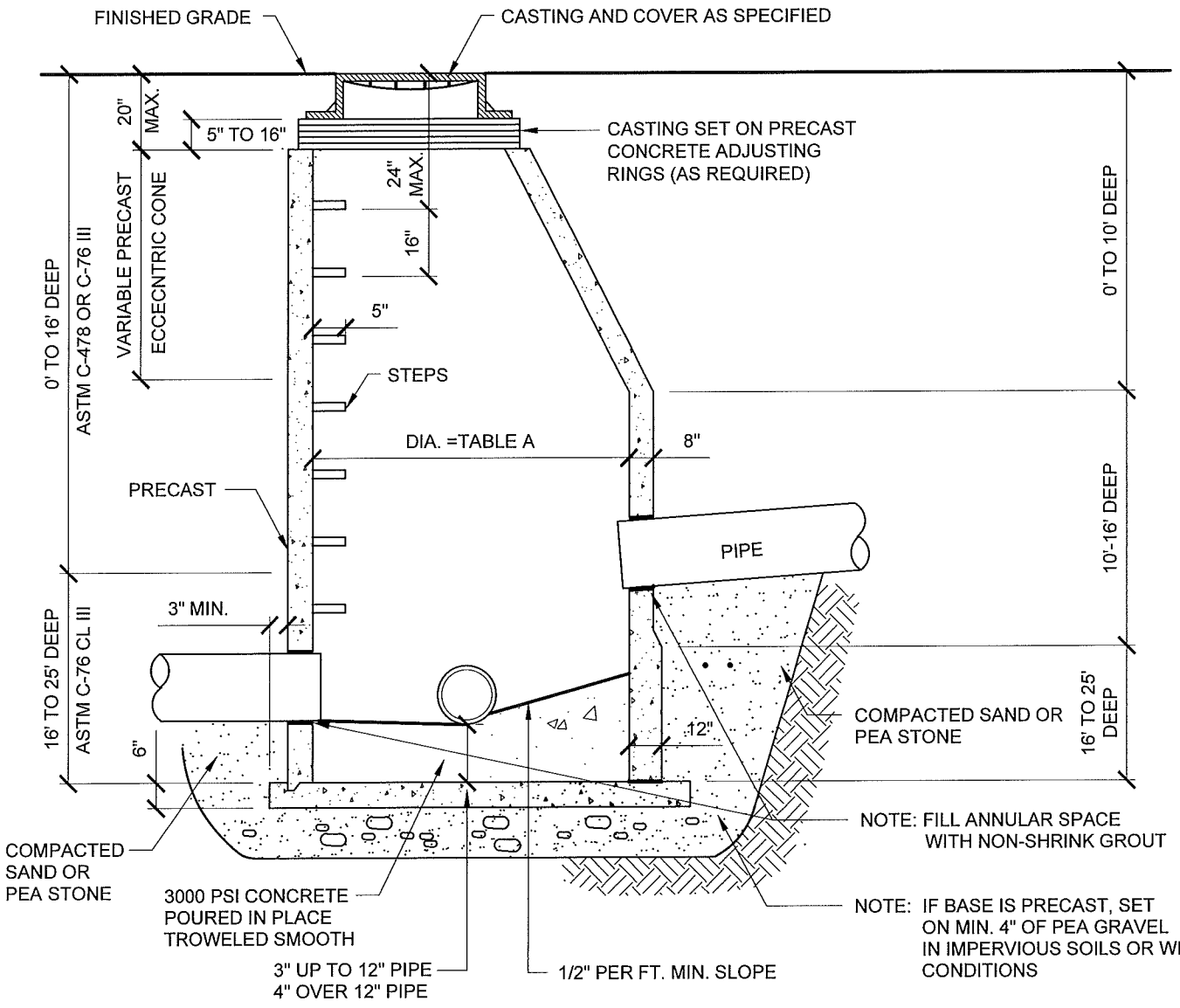


TABLE A

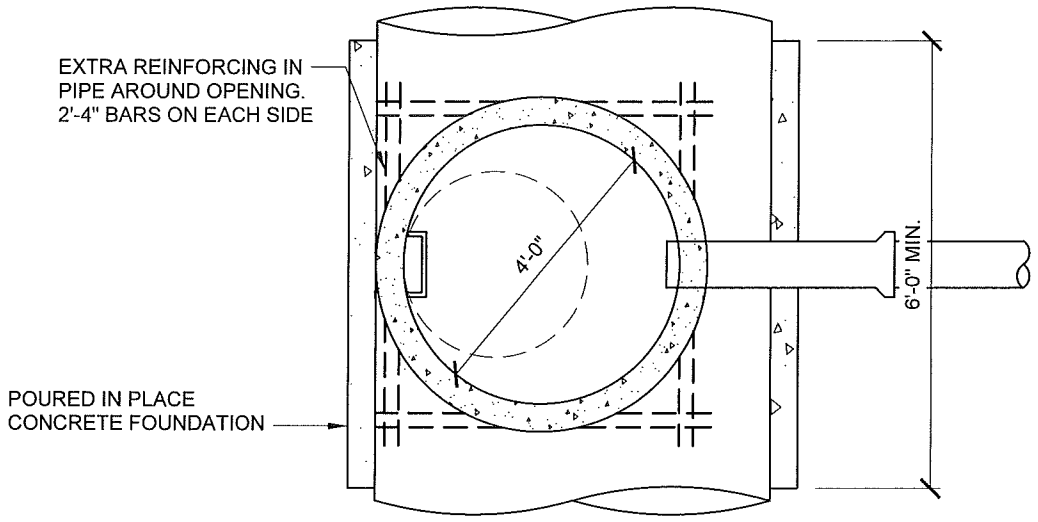
PIPE SIZE	DIAMETER
8" TO 24"	4'-0"
27" TO 33"	5'-0"
36" TO 42"	6'-0"

PLAN

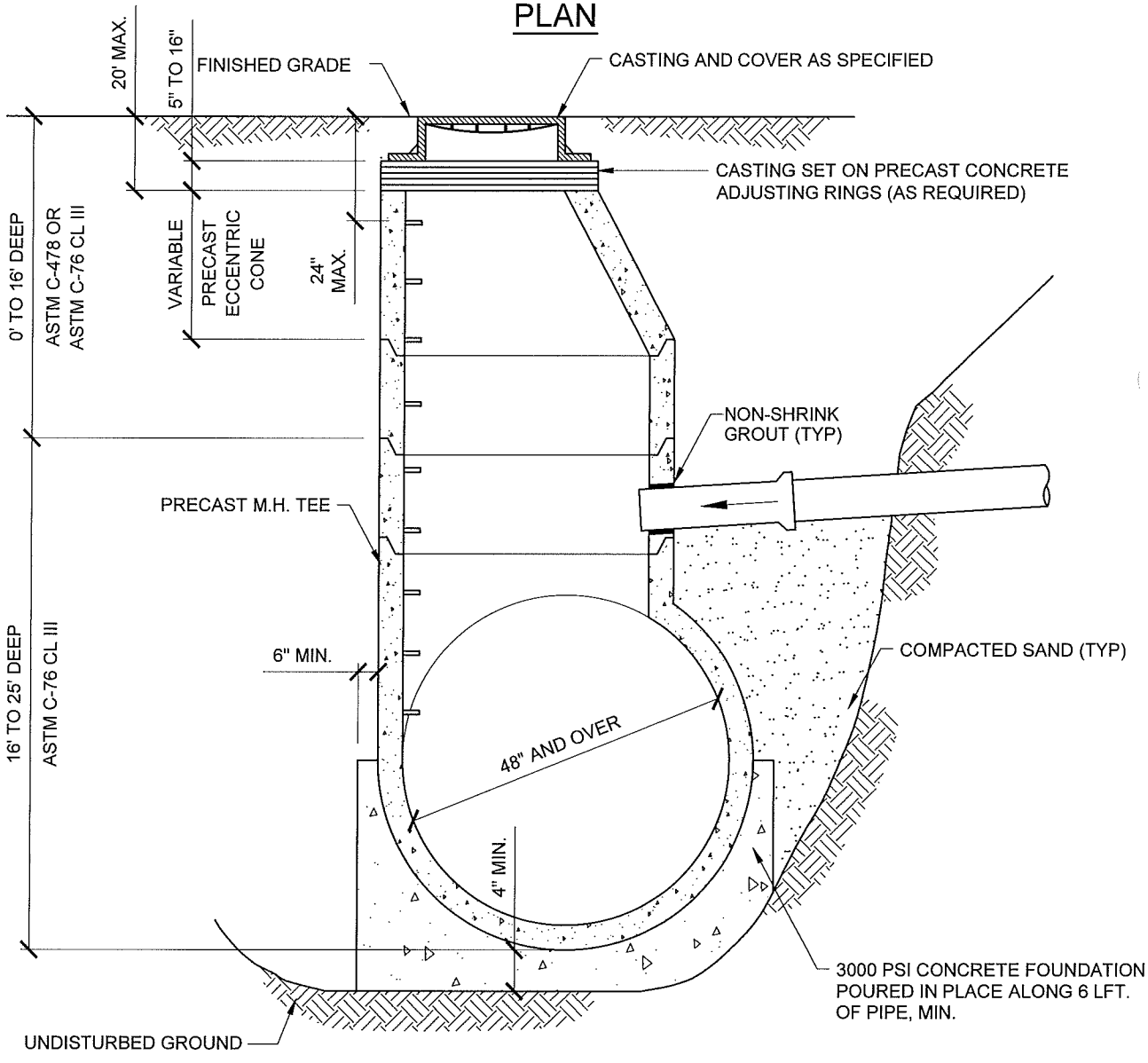


SECTION

STANDARD STORM MANHOLE



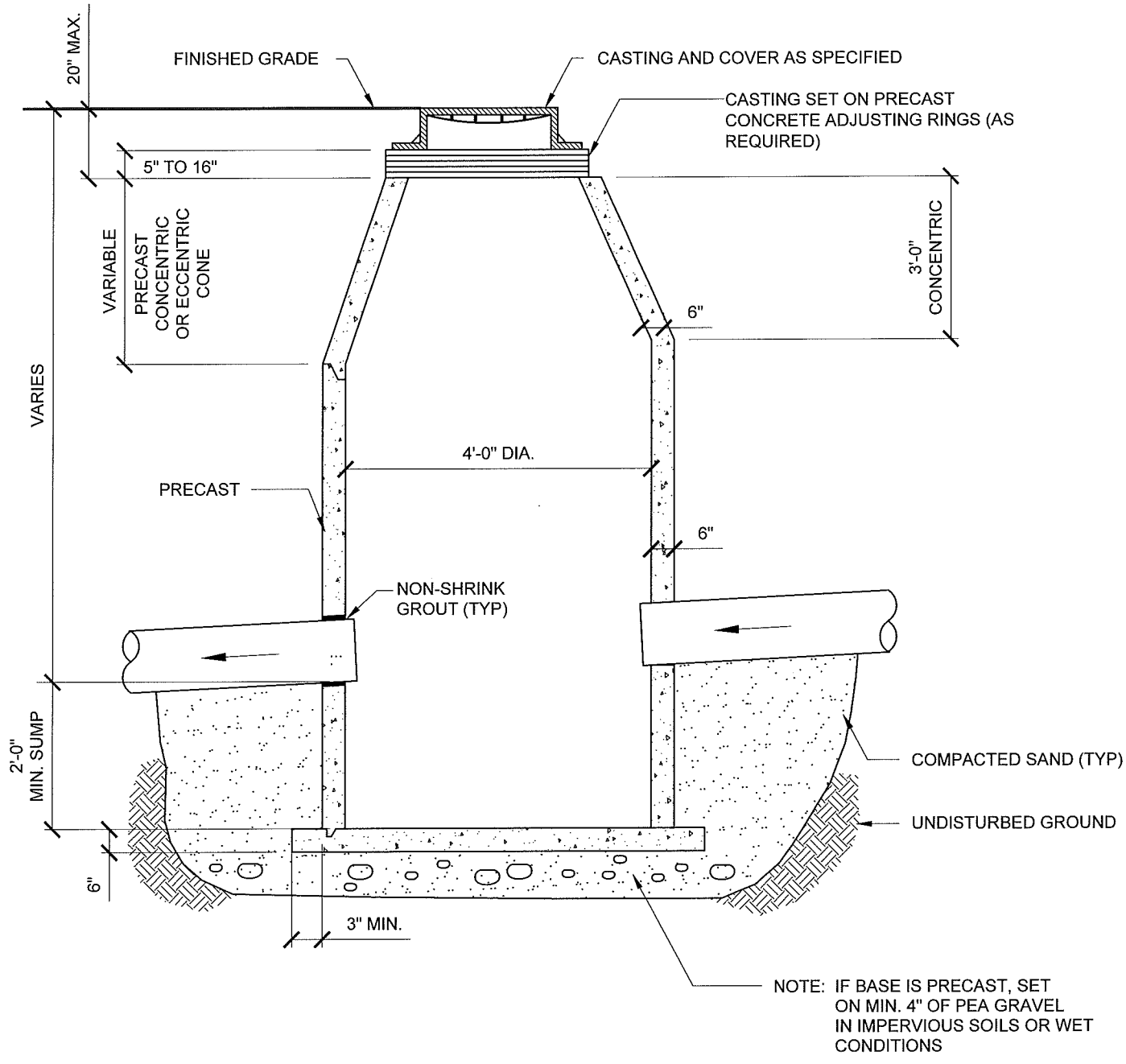
PLAN



SECTION

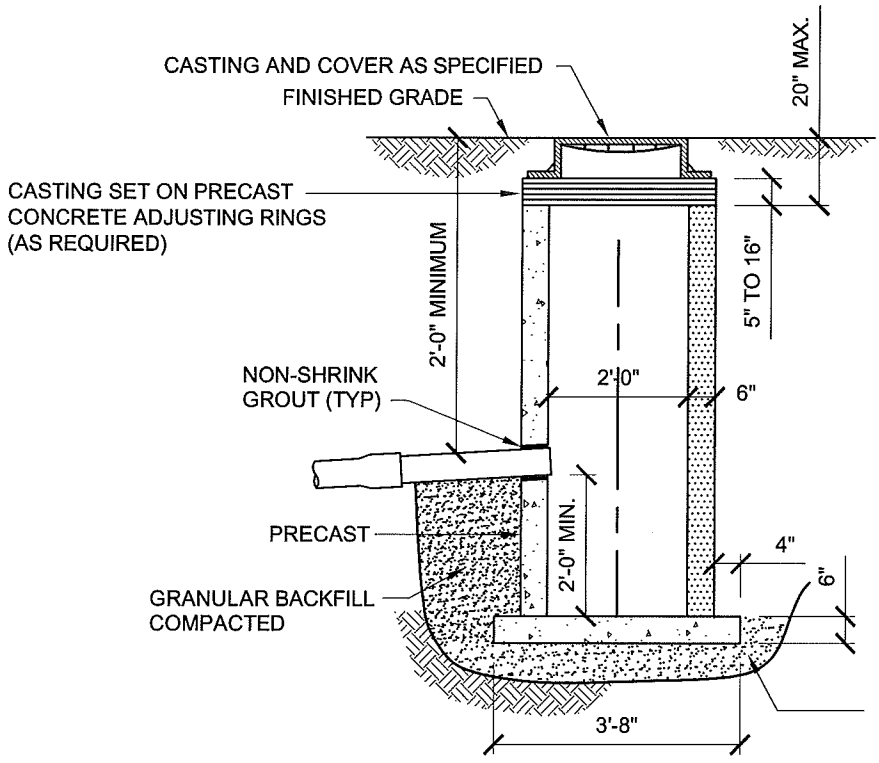
STANDARD STORM TEE MANHOLE

02720_TEEMAN
8/02

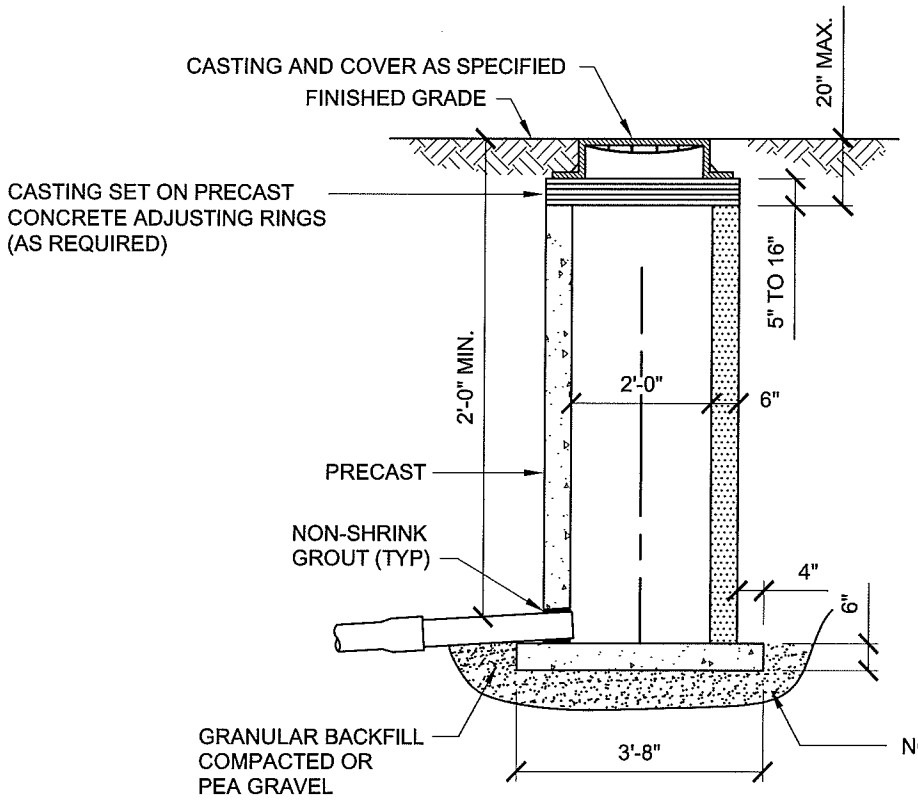


STANDARD CATCH BASIN

02720_CB
8/02

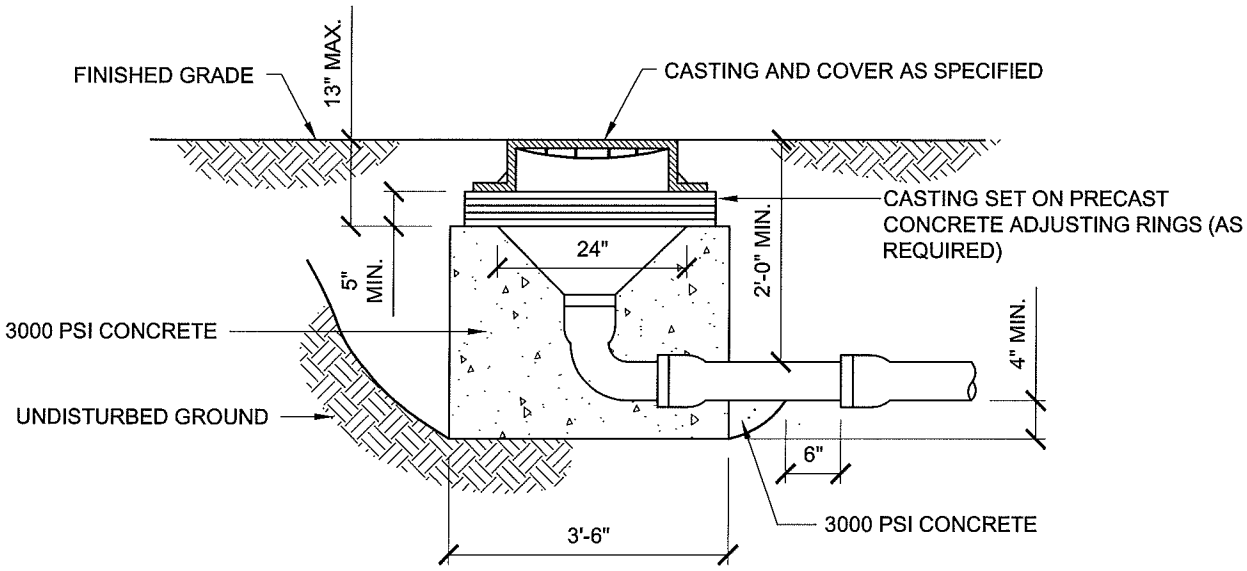


2' DIA. INLET WITH SUMP



2' DIA. INLET

STANDARD INLETS



SPECIAL CURB / YARD INLET

SECTION 02730

SANITARY SEWERS

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes work required for sanitary sewer pipe, structures and appurtenant work.

1.02 REFERENCES:

A. ASTM - American Society Testing Materials, latest edition

B. NCPI - National Clay Pipe Institute.

1.03 SUBMITTALS:

A. Submit the following for review by TOWNSHIP or TOWNSHIP's ENGINEER:
   1. Manufacturer's certifications for all pipe and fittings.
   2. Plan of proposed equipment and method for leakage testing.
   3. Details of connection to sanitary sewer system.
   4. Submittals must be approved by ACT DPU prior to construction.

B. Report witness measurements and "as-built" elevation on end of service lines.
   1. Provide measurements from two permanent fixtures such as building corners, power poles and trees 8-inch diameter and larger.
   2. Provide invert measurements at all manholes.

C. Report presence of underground utilities and drains.

D. Line and grade control method other than Laser Beam shall be approved by TOWNSHIP or TOWNSHIP's ENGINEER.

E. Submittal of drawings of record plans:
   1. Provide the Township Hall two (2) printed sets and one (1) electronic file.
   2. Provide the Township Engineer (1) one electronic file with as-constructed dimensions and witnesses.
   3. Provide Township Utilities Superintendent (1) one electronic file.

1.04 JOB CONDITIONS:

A. Existing sanitary sewer system shall remain operational. Contractor is required to provide bypass pumping as needed for construction.

B. Do not bypass wastewater to ground or surface waters.

C. Clean up promptly following pipe installation and within maximum of 400 feet behind pipe laying operation. Cleanup includes backfill and rough grading.

D. The Township Inspector or Township Engineer shall be provided notice and allowed three (3) work days to perform major inspections for sanitary sewer. Major inspections include the following;

1. Substantial Completion
   a. Initial inspection and follow-up inspection will be at no charge. Any subsequent inspections will be charged to the developer.
2. Completion
   a. Initial inspection and follow-up inspection will be at no charge. Any subsequent inspections will be charged to the developer.

PART 2 - PRODUCTS

2.01 PIPE:

A. Sanitary sewer pipe 8" – 15" shall be plastic truss (PVC), ASTM D2680 or plastic (PVC), ASTM D3034-SDR35 for depths up to 19 feet and SDR26 for depths over 19 feet unless otherwise approved by TOWNSHIP and TOWNSHIP's ENGINEER. Pipes larger than 15" shall be plastic (PVC) solid wall, ASTM F679 or Vylon closed profile, ASTM D1784.

B. Service Pipe: Provide minimum 6-inch, same classification as mainline pipe.
   1. ASTM D3034-SDR35 or 26, or ASTM D2680.

C. Plastic Pipe: Provide seating marks where couplings are used for jointing.
   1. Joints: Provide rubber "O" ring.

D. Joint Repair or Connecting to Existing Sewer Pipe of Different Material:
   1. Provide gasketed slip coupling or ROMAC XR-501. Flexible couplings shall not be used.

E. Provide Joint Materials as Indicated for the following Pipes:
   1. Plastic (PVC): ASTM D3034.
   2. Plastic (PVC) truss pipe: ASTM D2680.
   3. Plastic (PVC) solid wall pipe: ASTM F679.
   4. Vylon closed profile pipe: ASTM D3212.
      a. Lateral connections shall be made with InsertaTee at top of pipe.

F. Use hydraulic cement for flow channel work.

2.02 MANHOLES:

A. Manholes shall be precast units or cast-in-place concrete – no brick allowed.

B. Maintain uniform diameter from manhole base to cone section.

C. Precast Units: ASTM C76 Class III or ASTM C478 with circular reinforcement, modified for "O" ring gaskets.
   1. Pipe Openings: Provide flexible, watertight rubber boot using mechanically compressed flexible joint re-seal, link-seal, Pressure Wedge, Kor-N-Seal or equal. Conform to ASTM C923.

D. Concrete: 4000 psi 28 day, 4-inch maximum slump.

E. Concrete Brick: ASTM C55, Grade N-1 (repair of brick manholes ONLY)

F. Grade Rings: ASTM C478 with mastic rope seal or mortar for adhesion.

G. Mortar (For grade ring adjustments only): ASTM C270: 1-part Portland cement, 1-part lime and 3 parts sand by volume.

H. Manhole Steps:
   1. Plastic with $^3/_8$-inch steel rod reinforcement conforming to ASTM D4101, Type II.
   2. Dimensions: 10-inch deep by 10-inch wide, 5-inch tread depth.
   3. Comply with applicable Occupational Safety and Health Administration Standards (OSHA).

I. Standard Manhole Castings: East Jordan 1040 A cover or – two (2) hole cover with the words "ALLENDALE AREA SANITARY SEWER" & East Jordan 1045 Z1 frame.

J. Bituminous Waterproofing: ASTM D449.

K. Cement Waterproofing: Masonry filler.

2.03 FLOWABLE FILL:

A. Flowable fill shall be low strength, lean mix, flowable mortar meeting the specifications in Article 3.05 SCHEDULES.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Alignment and Grade:
   1. Deviations: Notify OWNER's ENGINEER and obtain instructions to proceed where there is a grade discrepancy, or an obstruction not shown on the plans.
   2. Laser Beam Control: Provide.
   3. Check grade: At set-up point, 25-foot, 50-foot, 100-foot and 200-foot points thereafter to the next set-up point. Pipe invert elevation is to be measured prior to setting manhole cone for as-built drawings.
   4. Projector advancement: Reset at each manhole.

B. Bedding:
   1. Method: See Article 3.05 SCHEDULES.
   2. Provide bedding area backfill in accordance with MDOT Standard Plan No. R-83B.
   3. Provide continuous bearing by supporting entire length of pipe barrel evenly.

3.02 INSTALLATION:

A. Laying pipe:
   1. Direction shall be upstream with spigot or tongue end downstream and bell end upstream.
   2. Joints shall be smooth and clean.
   3. Place pipe length and bedding as a unit in a frost free, dry trench.
   4. Special supports and saddles: See Article 3.05 SCHEDULES.
   5. Sewer joints within 10-feet and above watermain offset, shall be encased in concrete (ref 02220-2.01. A.3)

6. Minimum grade for 8-inch pipe: 0.45%.

Pipe Size	Minimum Required Slope	Pipe Size	Minimum Required Slope
8"	0.45%	21"	0.12%
10"	0.32%	24"	0.10%
12"	0.26%	27"	0.08%
15"	0.20%	30"	0.06%
18"	0.16%		

B. Jointing:
   1. Provide solvents, adhesives and lubricants as furnished by Manufacturer.
   2. Gasket position: Confirm that the gasket is in place and that the joint is properly made.

C. Manholes:
   1. General: See Article 3.05 SCHEDULES:
   2. Base bedding: Provide 4-inch pea stone with full and even bearing in impervious soils or wet conditions. Otherwise provide on undisturbed, frost-free, dry subgrade.
   3. Fill joint space completely and trowel between sections of precast units.
   4. Provide casting grade setting as follows:
      a. Existing pavement: Finished grade.
      b. Gravel grade: 6 inches below in road R.O.W (only).
      c. Unpaved areas: Finished grade.
   5. Provide waterproofing on ASTM C478 units and cast-in-place manholes using one of the following methods:
      a. Bituminous: Apply 1 gallon per 100 sq.ft. to outside free of holidays and open pin holes
      b. Cement: Apply masonry filler to outside by brushing on two (2) coats, each minimum of 2 lbs. per sq. yd.
   6. Flow channels:
      a. Construct with concrete up to spring line of pipe unless otherwise directed by Township and slope towards center of manhole. Trowel smooth.
      b. Minimum elevation difference between pipe inverts: 0.1 feet.
   7. Casting adjustment: concrete ring between leveling and top course of bituminous.
   8. Drop connections, should be required for all installations without a flow channel, required for drop of 2 feet or more. The alternative drop connection should be used for drops greater than 0.1 feet and less than 2 feet: See ARTICLE 3.05 SCHEDULES.
   9. Place manhole at the end of an existing sewer stub if necessary to accommodate change in grade and / or alignment.
   10. Provide access to all manholes for sewer maintenance vehicles as directed by TOWNSHIP and TOWNSHIP ENGINEER.
   11. Manholes with precast flow channels will not be allowed unless the flow channels meet all requirements of these specifications.

D. Abandoning and filling existing sanitary sewer:
   1. Plug both ends of the sewer pipe to be abandoned and fill the existing pipe completely with flowable fill.

E. Connections:
   1. Expose existing sanitary sewer and structures to which the new work is to be connected to confirm condition, location and elevation.

2. Connect to existing sanitary manhole by coring an opening adequate to insert pipe and flexible water tight rubber boot and secure circumference of pipe with non-shrink cement mortar.
   a. Relay and repoint loose blocks and bricks on existing block and brick structures. Re-channel flow lines and benches with concrete.
3. Construct manhole over existing sanitary sewer by installing precast manhole doghouse over existing pipe onto precast concrete manhole base. Do not cut open the existing pipe until written approval has been obtained from the TOWNSHIP.
4. Future Sanitary Sewer: Provide the following:
   a. Plug: Pipe 6-inch through 21-inch with standard disc.
   b. Bulkhead: Pipe 24-inch and larger with brick and mortar and ½-inch plaster coat outside.
      (1) 24 inch - 36 inch: 4-inch thick.
      (2) 42 inch - 60 inch: 8-inch thick.
5. No inside drop connections shall be permitted.

F. Service Lines:
1. Sanitary sewer must be situated along lot's road frontage for service to be provided. All laterals must be located in 10' utility easement (if available) or within the road right of way. Easements will not be allowed to obtain service to a residence.
2. Align at right angles to street or easement line. Locate 15 feet from left property line (facing lot) unless otherwise directed by TOWNSHIP.
3. Grade: Provide at uniform rate from connection or main riser to the property or easement line, minimum 1/4 inch per foot for residential, 1/8 inch per foot for commercial uses.
4. Provide minimum depth at street right-of-way line, property line or easement line as follows:
   a. House with basement: 12 feet below first floor elevation or 3 feet below basement elevation, whichever is deeper.
   b. Commercial and industrial buildings, schools, churches: As determined by OWNER's ENGINEER.
   c. The above depths govern, except that the minimum depth at the right-of-way line or property line shall be 6 feet below street or easement centerline grade unless otherwise permitted.
   d. The above depths are based on homes located at minimum setback from street right-of-way line and with typical 8-foot high ceiling in basement. Depths required may increase based on setback and ceiling heights.
5. Connection fitting:
   a. Locate as shown on Plans or as directed by OWNER's ENGINEER in field.
   b. 45° or 60° Wyes: Provide on all pipe except concrete pipe.
   c. Tees: Allowed only on reinforced concrete pipe.
   d. No laterals shall be connected to manholes.
6. Main riser will be allowed where cover exceeds 13 feet at mainline.
7. Plugging: Provide standard caps securely blocked.
8. Markers: Place a wood marker (2" x 2" minimum) at end of lateral with sufficient length to extend from invert of lateral to ground surface. Install a steel re-rod 24-inches in length immediately next to the wood marker with the top of the re-rod 2" below grade. Cover 2' x 2' wood marker and steel rerod with 4' long 4-1/2" ID minimum pipe buried 1' foot.
9. Witnesses: Report the following to the Owner's Engineer for preparation of record drawings:
   a. Wyes and Tee: Measurements to nearest downstream manhole.
   b. Markers: Two (2) measurements to permanent surface features.
   c. Laterals: Provide lengths and invert elevations.

10. Property line Riser: Required on all laterals. See Article 3.05 SCHEDULES.

G. By-pass Pumping: Contractor to provide by-pass pumping of wastewater flow as required during construction or replacement of sanitary sewer.

H. Pipe insulation: Where noted on plans, place 2-inch thick Styrofoam insulation board 4 feet wide over pipe at top of bedding.

I. No excavation within 10-feet of sanitary sewer or other manner which could cause undermining of service after back fill which could impact its function as determined by Township DPU and /or Township Engineer.

3.03 TESTING AND INSPECTION:

A. General:
1. **Observation**: By TOWNSHIP or TOWNSHIP's ENGINEER.
2. Testing: Perform upon completion and before connecting to active system.
3. Leakage tests: Provide promptly following installation of sewer pipe including services and keep within maximum 1200 feet behind pipe laying operation.
4. Notification: Clean, pretest and arrange for final inspection and test.
5. Notification: The Township Inspector or Township Engineer shall be provided 48-hour notice and three (3) work days to complete major inspections (See Paragraph 1.04.D).
6. Provide necessary equipment, manpower and assistance.
7. Video televising: Provide prior to paving.

B. Line and Grade: Allowable drift between structures from proposed alignment will be as follows:
1. Line:
   a. Through 36-inch: 0.20 foot.
   b. Over 36-inch: 0.40 foot.
2. Grade:
   a. Allowable sag between pipe joints: 5% of pipe diameter with maximum of 1-inch.
3. Sags in excess of tolerance shall be repaired prior to acceptance by TOWNSHIP. Repaired sections shall be re-televised.

C. Plastic pipe deformation (required only if video televising indicates a problem):
1. Pipe deflection will be limited to five percent (5%) of diameter.
2. Correction: Repair defects and retest until acceptable.

D. Video Televising (see Section 02731 – Cleaning and Televising Sanitary Sewers):
1. CONTRACTOR to complete video televising of completed sewers. The sewer main, laterals and manholes shall be cleaned and completely free of debris prior to televising. Flush sewer with flow of water from upstream end immediately prior to televising. Minimum of five (5) gallons of water to be used.
2. Schedule: Televise after final backfill has been in place a minimum of thirty (30) days, and after shutdown of dewatering operation.
3. CONTRACTOR to provide 1 original (USB Drive) of video of sewers to the Township.
4. The first review will be performed at no charge. Should the inspection fail to meet Township requirements, a subsequent review of corrected items will be performed at no charge. Any subsequent reviews of the televising will be charged to the developer.
5. Repairs causing disturbance to the pipe bedding or backfill will require retesting and an additional mandatory 30-day waiting period for televising.

E. Leakage Testing:

1. CONTRACTOR to perform exfiltration (air) test.
2. Exfiltration air test will have a holding time not less than that listed in table. Refer to Article 3.05 - Schedules
3. Correction: Repair defects and repeat test until acceptable.
   a. Method of repairing defects shall be approved by TOWNSHIP or TOWNSHIP's ENGINEER.

F. Exfiltration (air): Perform in accordance with NCPI Publication, *"Low Pressure Air Test for Sanitary sewers"*, and in accordance with ASTM F 1417, *"Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air".*
   1. Condition: Clean, dry pipe
   2. Procedure:
      a. All pressure readings are above the average groundwater head.

3.04 ADJUST AND CLEAN:

A. General: Keep pipe and structures clean as work progresses.

3.05 SCHEDULES:

A. Exfiltration Air Test Table.

B. Water / Sewer Leakage & Pressure Testing Report Form.

C. Specification FF-1 for Flowable Fill.

D. Standard Details:
   1. Special supports for underground utilities / pipe saddles.
   2. Methods of bedding pipe.
   3. Standard sanitary manhole.
   4. Watertight manhole cover.
   5. Plastic pipe manhole junction.
   6. Sanitary sewer cleanout.
   7. Standard riser details.
   8. Underground utilities detail.

E. Manhole Final Inspection Punch List.

END OF SECTION

EXFILTRATION AIR TEST

TIME REQUIRED FOR LOSS OF PRESSURE FROM 3.5 PSIG TO 3.0 PSIG FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015 (CU. FT./MIN./SQ.FT. OF INTERNAL SURFACE AREA)

Pipe Diameter (in.)	Minimum time (min; sec.)	Length for Min. Time (ft.)	Time for Longer length (sec.)	Specification Time for Length (L) Shown (min:sec)										
				100ft	150ft	200ft	250ft	300ft	350ft	400ft	450ft	500ft	550ft	600ft
6	2:50	398	.427L	2:5050	2:50	2:50	2:50	2:50	2:50	2:51	3:12	3:34	3:55	4:16
8	3:47	298	.760	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	6:20	6:58	7:36
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	9:54	10:53	11:52
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:48	11:24	12:50	14:15	15:40	17:06
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	22:16	24:29	26:43
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	32:03	35:16	38:28
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	43:37	47:59	52:21
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	56:59	62:41	68:23
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	72:07	79:20	86:33
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	89:02	97:56	106:51
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57	107:44	118:31	129:17
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	128:13	141:02	153:51
39	18:25	61	18.054L	30:57	45:09	60:11	75:14	90:16	105:19	120:22	135:24	160:32	165:31	180:34
42	19:50	57	20.939L	34:54	52:21	69:48	87:15	104:42	122:09	139:36	157:03	174:31	191:58	209:25

Note: When 2 sizes of pipe are involved, the time shall be computed by the ratio of lengths involved.

Example: 400 feet of 10-inch pipe and 200 feet of 6-inch pipe

$$\text{Time} = \frac{\text{Length (1)} \times \text{Time (1)} + \text{Length (2)} \times \text{Time (2)}}{\text{Length (1)} + \text{Length (2)}} = \frac{400 \times 7{:}54 + 200 \times 2{:}50}{400 + 200}$$

$$= \frac{400 \times 474 + 200 \times 170}{400 + 200} = 373 \text{ seconds} = 6{:}13 \text{ (min:sec)}$$

SPECIFICATION FF-1
SPECIFICATION FOR FLOWABLE FILL

DESCRIPTION

Flowable Fill (FF) shall consist of a mixture of (a) Portland cement, fly ash, and water; (b) Portland cement, granular material, fly ash, and water; or (c) fly ash, granular material and water. All Materials will be as specified in the Standard Specifications or as stated. All flowable fill after setting is intended to be removable by conventional mechanical excavation methods.

MATERIALS

		Specific Gravities***
Portland Cement	MDOT Section 901	3.15
Fly ash	ASTM C 618(1)*	2.40
Granular material Class II **	MDOT Section 902	2.60
Water	MDOT Section 911	1.00

* Except there is no limit on the loss on ignition.
** Except that 100% shall pass 19mm sieve.
*** Specific gravity values used for mix proportions given. If material used differs from these values appropriate adjustments should be made.

OPTIONAL FLOWABLE FILL (FF) MIXTURES

FF Mix Number One*
Cement Stabilized Fly Ash Mixture (Class F Fly Ash)

Portland Cement		100 lb/ft3
Fly ash	(Class F)	2,000 lb/ft3
Water	Sufficient water to produce the desired flowability	(approx. 3 gal/ ft3)

FF Mix Number Two*
Controlled Density Fill Mixture (Class F Fly Ash)

Portland Cement		50 lb/ft3
Fly ash	(Class F)	500 lb/ft3
Granular material		2,850 lb/ft3
Water	Sufficient water to produce the desired flowability	(approx. 1 gal/ft3)

FF Mix Number Three*
Controlled Density Fill Mixture (Class C Fly Ash)

(due to the variability of type 'C' fly ash there is no suggested mix)

*NOTE: The ready-mixed concrete producer supplying the flowable fill shall have a 28-day test on the mix option to be used for the trench backfill showing that the compressive strength is less than 1034 kPa for the fly ash from the same source that will be used for the trench backfill.

TRANSPORTING AND CONSTRUCTION METHODS

The temperature of the flowable fill mix as manufactured and delivered shall be at least 50° F.

Mixtures shall be transported to the point of placement in a revolving drum mixer or agitator.

During placement operations around manholes and in utility trenches, care shall be used to avoid dislocating any pipes due to fluid pressure from the flowable fill by even placing of the material. Any pipes within the backfill area should be considered for securing to avoid buoyant effect of flowable fill.

When Flowable Fill (FF) is used in pavement cuts the fill shall be placed to the top of pavement. After setting, the flowable fill is to be removed to the bottom of a concrete pavement patch or to the top of bituminous base course.

SECTION 02730

SANITARY SEWERS

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes work required for sanitary sewer pipe, structures and appurtenant work.

1.02 REFERENCES:

A. ASTM - American Society Testing Materials, latest edition

B. NCPI - National Clay Pipe Institute.

1.03 SUBMITTALS:

A. Submit the following for review by TOWNSHIP or TOWNSHIP's ENGINEER:
   1. Manufacturer's certifications for all pipe and fittings.
   2. Plan of proposed equipment and method for leakage testing.
   3. Details of connection to sanitary sewer system.
   4. Submittals must be approved by ACT DPU prior to construction.

B. Report witness measurements and "as-built" elevation on end of service lines.
   1. Provide measurements from two permanent fixtures such as building corners, power poles and trees 8-inch diameter and larger.
   2. Provide invert measurements at all manholes.

C. Report presence of underground utilities and drains.

D. Line and grade control method other than Laser Beam shall be approved by TOWNSHIP or TOWNSHIP's ENGINEER.

E. Submittal of drawings of record plans:
   1. Provide the Township Hall two (2) printed sets and one (1) electronic file.
   2. Provide the Township Engineer (1) one electronic file with as-constructed dimensions and witnesses.
   3. Provide Township Utilities Superintendent (1) one electronic file.

1.04 JOB CONDITIONS:

A. Existing sanitary sewer system shall remain operational. Contractor is required to provide bypass pumping as needed for construction.

B. Do not bypass wastewater to ground or surface waters.

C. Clean up promptly following pipe installation and within maximum of 400 feet behind pipe laying operation. Cleanup includes backfill and rough grading.

D. The Township Inspector or Township Engineer shall be provided notice and allowed three (3) work days to perform major inspections for sanitary sewer. Major inspections include the following;

1. Substantial Completion
   a. Initial inspection and follow-up inspection will be at no charge. Any subsequent inspections will be charged to the developer.
2. Completion
   a. Initial inspection and follow-up inspection will be at no charge. Any subsequent inspections will be charged to the developer.

PART 2 - PRODUCTS

2.01 PIPE:

A. Sanitary sewer pipe 8" – 15" shall be plastic truss (PVC), ASTM D2680 or plastic (PVC), ASTM D3034-SDR35 for depths up to 19 feet and SDR26 for depths over 19 feet unless otherwise approved by TOWNSHIP and TOWNSHIP's ENGINEER. Pipes larger than 15" shall be plastic (PVC) solid wall, ASTM F679 or Vylon closed profile, ASTM D1784.

B. Service Pipe: Provide minimum 6-inch, same classification as mainline pipe.
   1. ASTM D3034-SDR35 or 26, or ASTM D2680.

C. Plastic Pipe: Provide seating marks where couplings are used for jointing.
   1. Joints: Provide rubber "O" ring.

D. Joint Repair or Connecting to Existing Sewer Pipe of Different Material:
   1. Provide gasketed slip coupling or ROMAC XR-501. Flexible couplings shall not be used.

E. Provide Joint Materials as Indicated for the following Pipes:
   1. Plastic (PVC): ASTM D3034.
   2. Plastic (PVC) truss pipe: ASTM D2680.
   3. Plastic (PVC) solid wall pipe: ASTM F679.
   4. Vylon closed profile pipe: ASTM D3212.
      a. Lateral connections shall be made with InsertaTee at top of pipe.

F. Use hydraulic cement for flow channel work.

2.02 MANHOLES:

A. Manholes shall be precast units or cast-in-place concrete – no brick allowed.

B. Maintain uniform diameter from manhole base to cone section.

C. Precast Units: ASTM C76 Class III or ASTM C478 with circular reinforcement, modified for "O" ring gaskets.
   1. Pipe Openings: Provide flexible, watertight rubber boot using mechanically compressed flexible joint re-seal, link-seal, Pressure Wedge, Kor-N-Seal or equal. Conform to ASTM C923.

D. Concrete: 4000 psi 28 day, 4-inch maximum slump.

E. Concrete Brick: ASTM C55, Grade N-1 (repair of brick manholes ONLY)

F. Grade Rings: ASTM C478 with mastic rope seal or mortar for adhesion.

G. Mortar (For grade ring adjustments only): ASTM C270: 1-part Portland cement, 1-part lime and 3 parts sand by volume.

H. Manhole Steps:
   1. Plastic with $^3/_8$-inch steel rod reinforcement conforming to ASTM D4101, Type II.
   2. Dimensions: 10-inch deep by 10-inch wide, 5-inch tread depth.
   3. Comply with applicable Occupational Safety and Health Administration Standards (OSHA).

I. Standard Manhole Castings: East Jordan 1040 A cover or – two (2) hole cover with the words "ALLENDALE AREA SANITARY SEWER" & East Jordan 1045 Z1 frame.

J. Bituminous Waterproofing: ASTM D449.

K. Cement Waterproofing: Masonry filler.

2.03 FLOWABLE FILL:

A. Flowable fill shall be low strength, lean mix, flowable mortar meeting the specifications in Article 3.05 SCHEDULES.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Alignment and Grade:
   1. Deviations: Notify OWNER's ENGINEER and obtain instructions to proceed where there is a grade discrepancy, or an obstruction not shown on the plans.
   2. Laser Beam Control: Provide.
   3. Check grade: At set-up point, 25-foot, 50-foot, 100-foot and 200-foot points thereafter to the next set-up point. Pipe invert elevation is to be measured prior to setting manhole cone for as-built drawings.
   4. Projector advancement: Reset at each manhole.

B. Bedding:
   1. Method: See Article 3.05 SCHEDULES.
   2. Provide bedding area backfill in accordance with MDOT Standard Plan No. R-83B.
   3. Provide continuous bearing by supporting entire length of pipe barrel evenly.

3.02 INSTALLATION:

A. Laying pipe:
   1. Direction shall be upstream with spigot or tongue end downstream and bell end upstream.
   2. Joints shall be smooth and clean.
   3. Place pipe length and bedding as a unit in a frost free, dry trench.
   4. Special supports and saddles: See Article 3.05 SCHEDULES.
   5. Sewer joints within 10-feet and above watermain offset, shall be encased in concrete (ref 02220-2.01. A.3)

6. Minimum grade for 8-inch pipe: 0.45%.

Pipe Size	Minimum Required Slope	Pipe Size	Minimum Required Slope
8"	0.45%	21"	0.12%
10"	0.32%	24"	0.10%
12"	0.26%	27"	0.08%
15"	0.20%	30"	0.06%
18"	0.16%		

B. Jointing:
   1. Provide solvents, adhesives and lubricants as furnished by Manufacturer.
   2. Gasket position: Confirm that the gasket is in place and that the joint is properly made.

C. Manholes:
   1. General: See Article 3.05 SCHEDULES:
   2. Base bedding: Provide 4-inch pea stone with full and even bearing in impervious soils or wet conditions. Otherwise provide on undisturbed, frost-free, dry subgrade.
   3. Fill joint space completely and trowel between sections of precast units.
   4. Provide casting grade setting as follows:
      a. Existing pavement: Finished grade.
      b. Gravel grade: 6 inches below in road R.O.W (only).
      c. Unpaved areas: Finished grade.
   5. Provide waterproofing on ASTM C478 units and cast-in-place manholes using one of the following methods:
      a. Bituminous: Apply 1 gallon per 100 sq.ft. to outside free of holidays and open pin holes
      b. Cement: Apply masonry filler to outside by brushing on two (2) coats, each minimum of 2 lbs. per sq. yd.
   6. Flow channels:
      a. Construct with concrete up to spring line of pipe unless otherwise directed by Township and slope towards center of manhole. Trowel smooth.
      b. Minimum elevation difference between pipe inverts: 0.1 feet.
   7. Casting adjustment: concrete ring between leveling and top course of bituminous.
   8. Drop connections, should be required for all installations without a flow channel, required for drop of 2 feet or more. The alternative drop connection should be used for drops greater than 0.1 feet and less than 2 feet: See ARTICLE 3.05 SCHEDULES.
   9. Place manhole at the end of an existing sewer stub if necessary to accommodate change in grade and / or alignment.
   10. Provide access to all manholes for sewer maintenance vehicles as directed by TOWNSHIP and TOWNSHIP ENGINEER.
   11. Manholes with precast flow channels will not be allowed unless the flow channels meet all requirements of these specifications.

D. Abandoning and filling existing sanitary sewer:
   1. Plug both ends of the sewer pipe to be abandoned and fill the existing pipe completely with flowable fill.

E. Connections:
   1. Expose existing sanitary sewer and structures to which the new work is to be connected to confirm condition, location and elevation.

2. Connect to existing sanitary manhole by coring an opening adequate to insert pipe and flexible water tight rubber boot and secure circumference of pipe with non-shrink cement mortar.
   a. Relay and repoint loose blocks and bricks on existing block and brick structures. Re-channel flow lines and benches with concrete.
3. Construct manhole over existing sanitary sewer by installing precast manhole doghouse over existing pipe onto precast concrete manhole base. Do not cut open the existing pipe until written approval has been obtained from the TOWNSHIP.
4. Future Sanitary Sewer: Provide the following:
   a. Plug: Pipe 6-inch through 21-inch with standard disc.
   b. Bulkhead: Pipe 24-inch and larger with brick and mortar and ½-inch plaster coat outside.
      (1) 24 inch - 36 inch: 4-inch thick.
      (2) 42 inch - 60 inch: 8-inch thick.
5. No inside drop connections shall be permitted.

F. Service Lines:
1. Sanitary sewer must be situated along lot's road frontage for service to be provided. All laterals must be located in 10' utility easement (if available) or within the road right of way. Easements will not be allowed to obtain service to a residence.
2. Align at right angles to street or easement line. Locate 15 feet from left property line (facing lot) unless otherwise directed by TOWNSHIP.
3. Grade: Provide at uniform rate from connection or main riser to the property or easement line, minimum 1/4 inch per foot for residential, 1/8 inch per foot for commercial uses.
4. Provide minimum depth at street right-of-way line, property line or easement line as follows:
   a. House with basement: 12 feet below first floor elevation or 3 feet below basement elevation, whichever is deeper.
   b. Commercial and industrial buildings, schools, churches: As determined by OWNER's ENGINEER.
   c. The above depths govern, except that the minimum depth at the right-of-way line or property line shall be 6 feet below street or easement centerline grade unless otherwise permitted.
   d. The above depths are based on homes located at minimum setback from street right-of-way line and with typical 8-foot high ceiling in basement. Depths required may increase based on setback and ceiling heights.
5. Connection fitting:
   a. Locate as shown on Plans or as directed by OWNER's ENGINEER in field.
   b. 45° or 60° Wyes: Provide on all pipe except concrete pipe.
   c. Tees: Allowed only on reinforced concrete pipe.
   d. No laterals shall be connected to manholes.
6. Main riser will be allowed where cover exceeds 13 feet at mainline.
7. Plugging: Provide standard caps securely blocked.
8. Markers: Place a wood marker (2" x 2" minimum) at end of lateral with sufficient length to extend from invert of lateral to ground surface. Install a steel re-rod 24-inches in length immediately next to the wood marker with the top of the re-rod 2" below grade. Cover 2' x 2' wood marker and steel rerod with 4' long 4-1/2" ID minimum pipe buried 1' foot.
9. Witnesses: Report the following to the Owner's Engineer for preparation of record drawings:
   a. Wyes and Tee: Measurements to nearest downstream manhole.
   b. Markers: Two (2) measurements to permanent surface features.
   c. Laterals: Provide lengths and invert elevations.

10. Property line Riser: Required on all laterals. See Article 3.05 SCHEDULES.

G. By-pass Pumping: Contractor to provide by-pass pumping of wastewater flow as required during construction or replacement of sanitary sewer.

H. Pipe insulation: Where noted on plans, place 2-inch thick Styrofoam insulation board 4 feet wide over pipe at top of bedding.

I. No excavation within 10-feet of sanitary sewer or other manner which could cause undermining of service after back fill which could impact its function as determined by Township DPU and /or Township Engineer.

3.03 TESTING AND INSPECTION:

A. General:
1. **Observation**: By TOWNSHIP or TOWNSHIP's ENGINEER.
2. Testing: Perform upon completion and before connecting to active system.
3. Leakage tests: Provide promptly following installation of sewer pipe including services and keep within maximum 1200 feet behind pipe laying operation.
4. Notification: Clean, pretest and arrange for final inspection and test.
5. Notification: The Township Inspector or Township Engineer shall be provided 48-hour notice and three (3) work days to complete major inspections (See Paragraph 1.04.D).
6. Provide necessary equipment, manpower and assistance.
7. Video televising: Provide prior to paving.

B. Line and Grade: Allowable drift between structures from proposed alignment will be as follows:
1. Line:
   a. Through 36-inch: 0.20 foot.
   b. Over 36-inch: 0.40 foot.
2. Grade:
   a. Allowable sag between pipe joints: 5% of pipe diameter with maximum of 1-inch.
3. Sags in excess of tolerance shall be repaired prior to acceptance by TOWNSHIP. Repaired sections shall be re-televised.

C. Plastic pipe deformation (required only if video televising indicates a problem):
1. Pipe deflection will be limited to five percent (5%) of diameter.
2. Correction: Repair defects and retest until acceptable.

D. Video Televising (see Section 02731 – Cleaning and Televising Sanitary Sewers):
1. CONTRACTOR to complete video televising of completed sewers. The sewer main, laterals and manholes shall be cleaned and completely free of debris prior to televising. Flush sewer with flow of water from upstream end immediately prior to televising. Minimum of five (5) gallons of water to be used.
2. Schedule: Televise after final backfill has been in place a minimum of thirty (30) days, and after shutdown of dewatering operation.
3. CONTRACTOR to provide 1 original (USB Drive) of video of sewers to the Township.
4. The first review will be performed at no charge. Should the inspection fail to meet Township requirements, a subsequent review of corrected items will be performed at no charge. Any subsequent reviews of the televising will be charged to the developer.
5. Repairs causing disturbance to the pipe bedding or backfill will require retesting and an additional mandatory 30-day waiting period for televising.

E. Leakage Testing:

1. CONTRACTOR to perform exfiltration (air) test.
2. Exfiltration air test will have a holding time not less than that listed in table. Refer to Article 3.05 - Schedules
3. Correction: Repair defects and repeat test until acceptable.
   a. Method of repairing defects shall be approved by TOWNSHIP or TOWNSHIP's ENGINEER.

F. Exfiltration (air): Perform in accordance with NCPI Publication, *"Low Pressure Air Test for Sanitary sewers"*, and in accordance with ASTM F 1417, *"Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air"*.
1. Condition: Clean, dry pipe
2. Procedure:
   a. All pressure readings are above the average groundwater head.

3.04 ADJUST AND CLEAN:

A. General: Keep pipe and structures clean as work progresses.

3.05 SCHEDULES:

A. Exfiltration Air Test Table.

B. Water / Sewer Leakage & Pressure Testing Report Form.

C. Specification FF-1 for Flowable Fill.

D. Standard Details:
1. Special supports for underground utilities / pipe saddles.
2. Methods of bedding pipe.
3. Standard sanitary manhole.
4. Watertight manhole cover.
5. Plastic pipe manhole junction.
6. Sanitary sewer cleanout.
7. Standard riser details.
8. Underground utilities detail.

E. Manhole Final Inspection Punch List.

END OF SECTION

EXFILTRATION AIR TEST

TIME REQUIRED FOR LOSS OF PRESSURE FROM 3.5 PSIG TO 3.0 PSIG FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015 (CU. FT./MIN./SQ.FT. OF INTERNAL SURFACE AREA)

Pipe Diameter (in.)	Minimum time (min; sec.)	Length for Min. Time (ft.)	Time for Longer length (sec.)	Specification Time for Length (L) Shown (min:sec)										
				100ft	150ft	200ft	250ft	300ft	350ft	400ft	450ft	500ft	550ft	600ft
6	2:50	398	.427L	2:5050	2:50	2:50	2:50	2:50	2:50	2:51	3:12	3:34	3:55	4:16
8	3:47	298	.760	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	6:20	6:58	7:36
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36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	128:13	141:02	153:51
39	18:25	61	18.054L	30:57	45:09	60:11	75:14	90:16	105:19	120:22	135:24	160:32	165:31	180:34
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Note: When 2 sizes of pipe are involved, the time shall be computed by the ratio of lengths involved.

Example: 400 feet of 10-inch pipe and 200 feet of 6-inch pipe

$$\text{Time} = \frac{\text{Length (1)} \times \text{Time (1)} + \text{Length (2)} \times \text{Time (2)}}{\text{Length (1)} + \text{Length (2)}} = \frac{400 \times 7{:}54 + 200 \times 2{:}50}{400 + 200}$$

$$= \frac{400 \times 474 + 200 \times 170}{400 + 200} = 373 \text{ seconds} = 6{:}13 \text{ (min:sec)}$$

SPECIFICATION FF-1
SPECIFICATION FOR FLOWABLE FILL

DESCRIPTION

Flowable Fill (FF) shall consist of a mixture of (a) Portland cement, fly ash, and water; (b) Portland cement, granular material, fly ash, and water; or (c) fly ash, granular material and water. All Materials will be as specified in the Standard Specifications or as stated. All flowable fill after setting is intended to be removable by conventional mechanical excavation methods.

MATERIALS

		Specific Gravities***
Portland Cement	MDOT Section 901	3.15
Fly ash	ASTM C 618(1)*	2.40
Granular material Class II **	MDOT Section 902	2.60
Water	MDOT Section 911	1.00

* Except there is no limit on the loss on ignition.
** Except that 100% shall pass 19mm sieve.
*** Specific gravity values used for mix proportions given. If material used differs from these values appropriate adjustments should be made.

OPTIONAL FLOWABLE FILL (FF) MIXTURES

FF Mix Number One*
Cement Stabilized Fly Ash Mixture (Class F Fly Ash)

Portland Cement		100 lb/ft3
Fly ash	(Class F)	2,000 lb/ft3
Water	Sufficient water to produce the desired flowability	(approx. 3 gal/ ft3)

FF Mix Number Two*
Controlled Density Fill Mixture (Class F Fly Ash)

Portland Cement		50 lb/ft3
Fly ash	(Class F)	500 lb/ft3
Granular material		2,850 lb/ft3
Water	Sufficient water to produce the desired flowability	(approx. 1 gal/ft3)

FF Mix Number Three*
Controlled Density Fill Mixture (Class C Fly Ash)

(due to the variability of type 'C' fly ash there is no suggested mix)

*NOTE: The ready-mixed concrete producer supplying the flowable fill shall have a 28-day test on the mix option to be used for the trench backfill showing that the compressive strength is less than 1034 kPa for the fly ash from the same source that will be used for the trench backfill.

TRANSPORTING AND CONSTRUCTION METHODS

The temperature of the flowable fill mix as manufactured and delivered shall be at least 50° F.

Mixtures shall be transported to the point of placement in a revolving drum mixer or agitator.

During placement operations around manholes and in utility trenches, care shall be used to avoid dislocating any pipes due to fluid pressure from the flowable fill by even placing of the material. Any pipes within the backfill area should be considered for securing to avoid buoyant effect of flowable fill.

When Flowable Fill (FF) is used in pavement cuts the fill shall be placed to the top of pavement. After setting, the flowable fill is to be removed to the bottom of a concrete pavement patch or to the top of bituminous base course.

WATER/SEWER LEAKAGE & PRESSURE TESTING REPORT

PROJECT:
PROJECT NO.:
LOCATION:

DATE:
INSPECTOR:
REPORT NO.:

LOCATION	TEST NO.	PIPE SIZE (IN.)	LENGTH OF PIPE (LFT.)	PRESSURE AT START OF TEST (PSI)	PRESSURE AT COMPLETION OF TEST (PSI)	ALLOWABLE LOSS (GAL/HR)	ACTUAL LOSS (GAL/HR)	TIME REQUIRED FOR TEST	ACTUAL TIME OF TEST	APPROVED	REJECTED	REMARKS

WATERMAINS:

1. PRESSURE TEST: DURATION = 1 HR.
   140 TO 150 PSI @ LOWEST POINT
2. LEAKAGE TEST: DURATION OF TEST = 2 HRS.
   ALLOWABLE LOSS:

$$L = \frac{SD \times \sqrt{P}}{148{,}000}$$

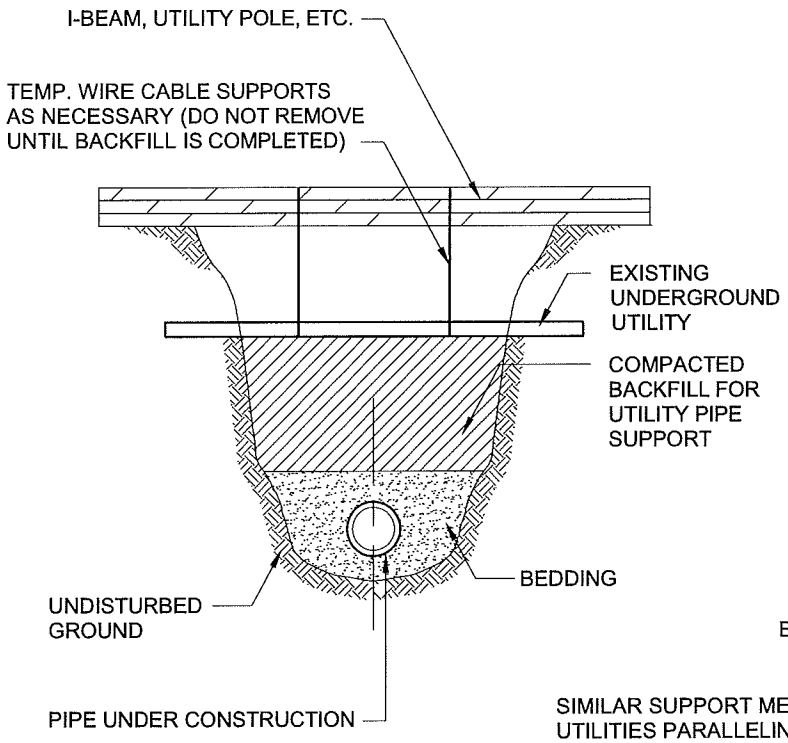
   L = LEAKAGE (GALLONS PER HOUR)
   S = LENGTH OF PIPE (FEET)
   D = NORMAL PIPE DIAMETER (INCHES)
   P = AVERAGE TEST PRESSURE (PSI GAUGE)
3. VALVES: ALLOWABLE LEAKAGE = LESS THAN 10 PSI IN 5 MINUTES W/PUMP OFF

(120 psi air, 150 psi water)

LEAKTST.XLS

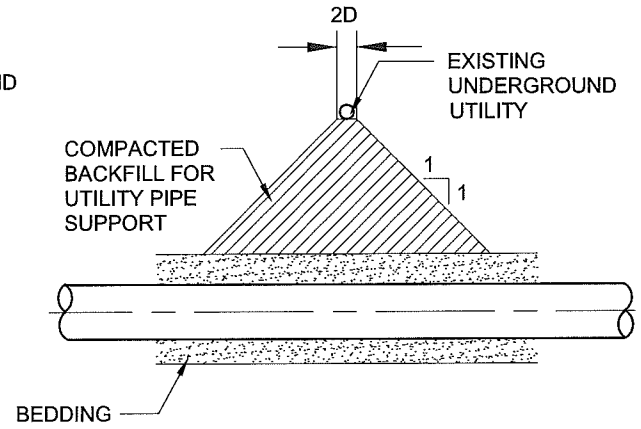
SEWERS:

1. EXFILTRATION AIR TEST: DURATION = (SEE CHART ON BACK)
   3.5 PSI AFTER STABILIZATION OF PRESSURE
   PRESSURE LOSS FROM 3.5 TP 2.5 PSI MUST NOT EXCEED TIME LIMITS
   TIME FOR 2 OR MORE SIZES IN SAME RUN SHALL BE COMPUTED AND ADDED TOGETHER



SECTION

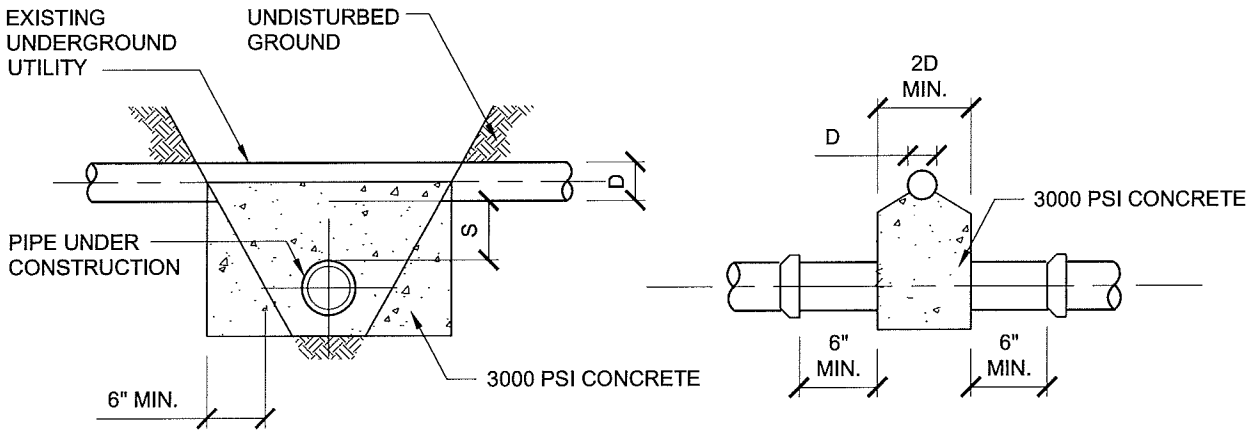
NOTE: MAINTAIN EXISTING COATING ON UTILITY



SIMILAR SUPPORT METHODS APPLY TO UTILITIES PARALLELING AND ABOVE THE PIPE UNDER CONSTRUCTION

ELEVATION

SPECIAL SUPPORTS FOR UNDERGROUND UTILITIES



NOTES:

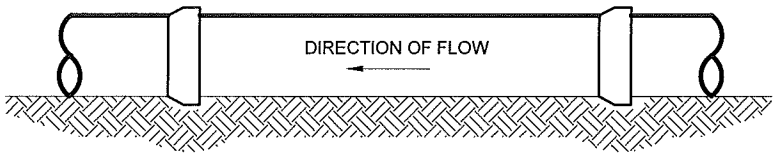
1. PIPE SADDLE REQUIRED WHEN SEPARATION (S) IS 12 INCHES OR LESS UNLESS OTHWERWISE DIRECTED OR SHOWN ON PLANS

2. PIPE SADDLE IS NOT REQUIRED FOR PLASTIC, STEEL, LEAD OR COPPER PIPE 2" OR SMALLER.

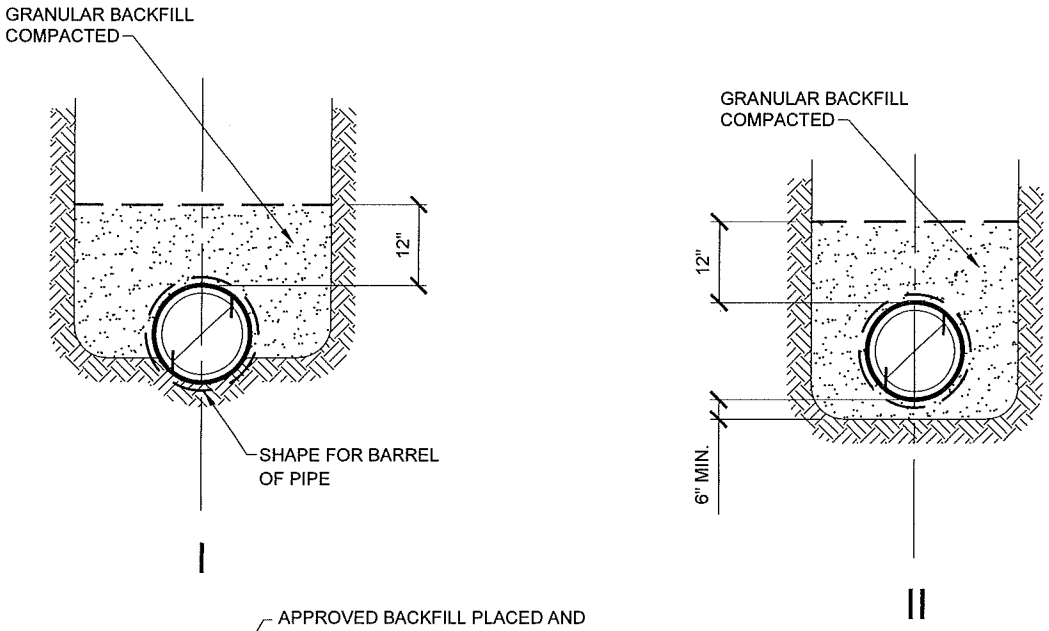
SECTION

ELEVATION

PIPE SADDLES



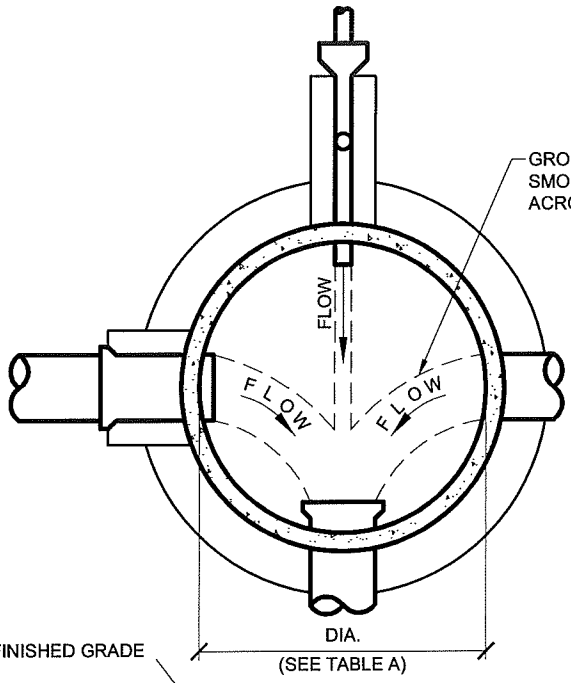
EXCAVATION FOR BELLS



NOTES:

1. METHOD I: IN AREAS OF UNCONSOLIDATED SOILS (SAND, GRAVEL, ETC.)
2. METHOD II: IN AREAS OF CONSOLIDATED SOILS (CLAY, HARDPAN, ROCK, ETC.)
3. METHOD III: IN AREAS INDICATED ON DRAWINGS

METHODS OF BEDDING PIPE



PLAN

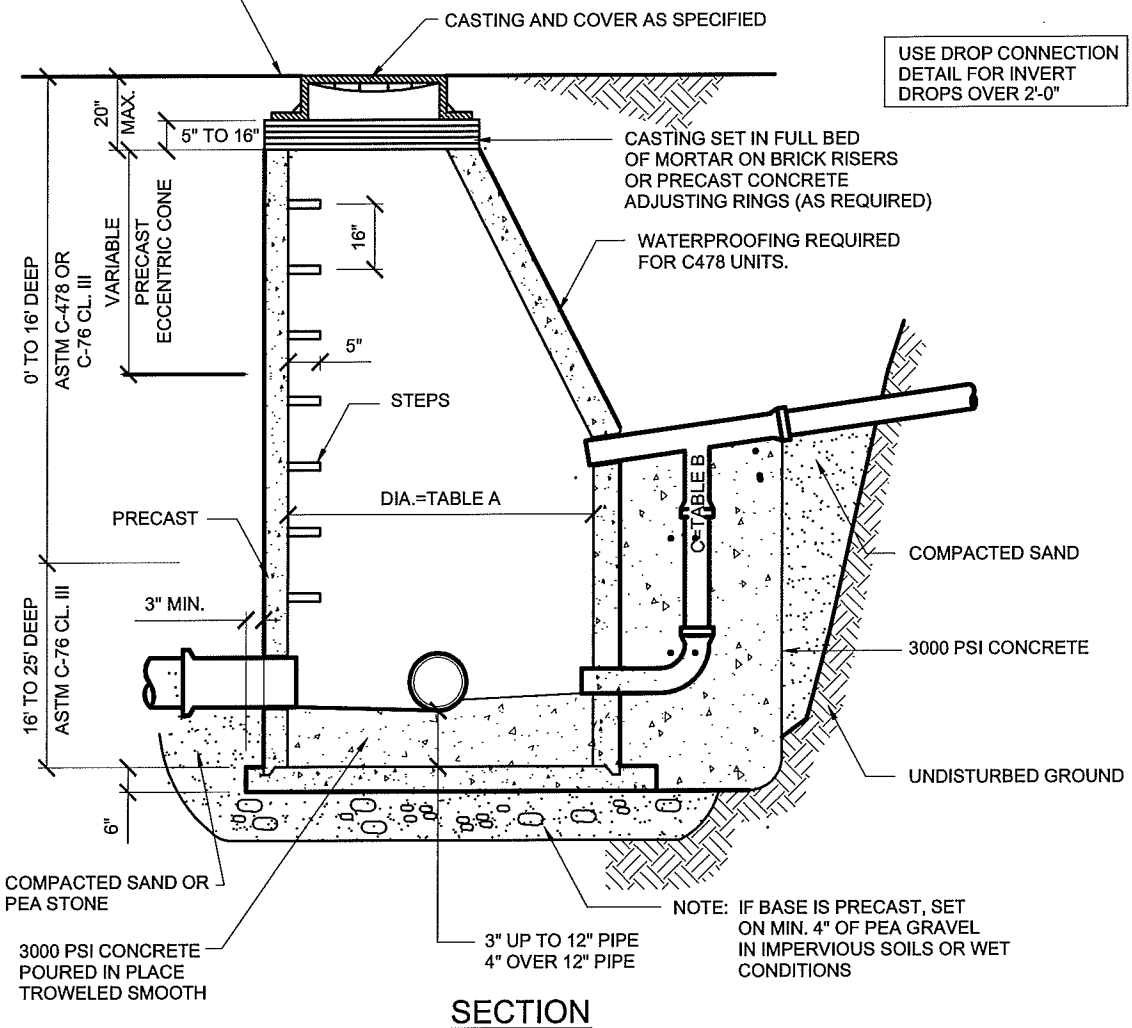
TABLE A

PIPE SIZE	DIA.
8" TO 24"	4'-0"
27" TO 33"	5'-0"
36" TO 42"	6'-0"

TABLE B

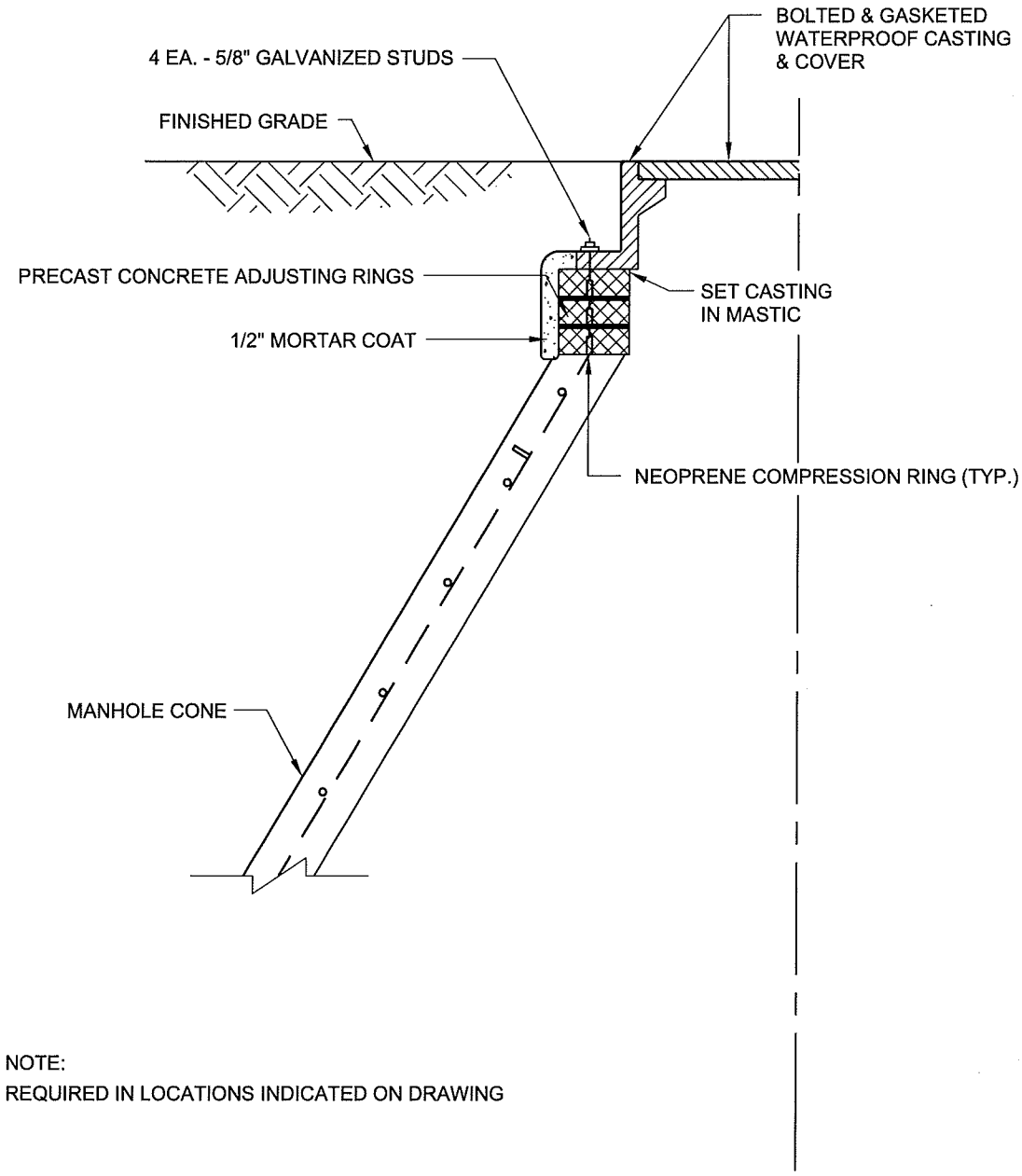
PIPE SIZE (INCOMING)	DROP SIZE C
8" THRU 12"	8"
15" THRU 18"	10"
21" THRU 27"	12"
30" THRU 36"	15"

USE DROP CONNECTION DETAIL FOR INVERT DROPS OVER 2'-0"



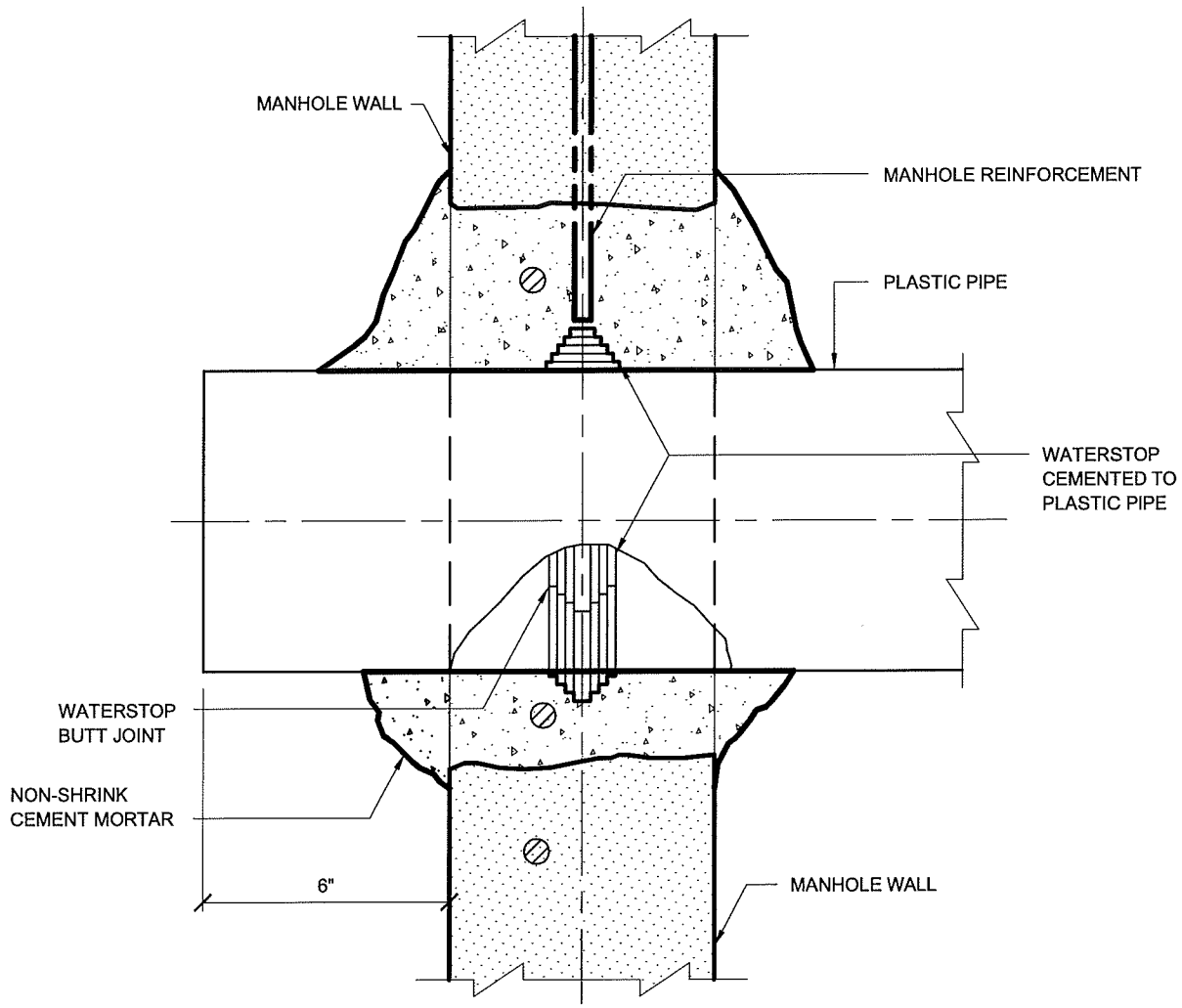
SECTION

STANDARD SANITARY MANHOLE



NOTE:
REQUIRED IN LOCATIONS INDICATED ON DRAWING

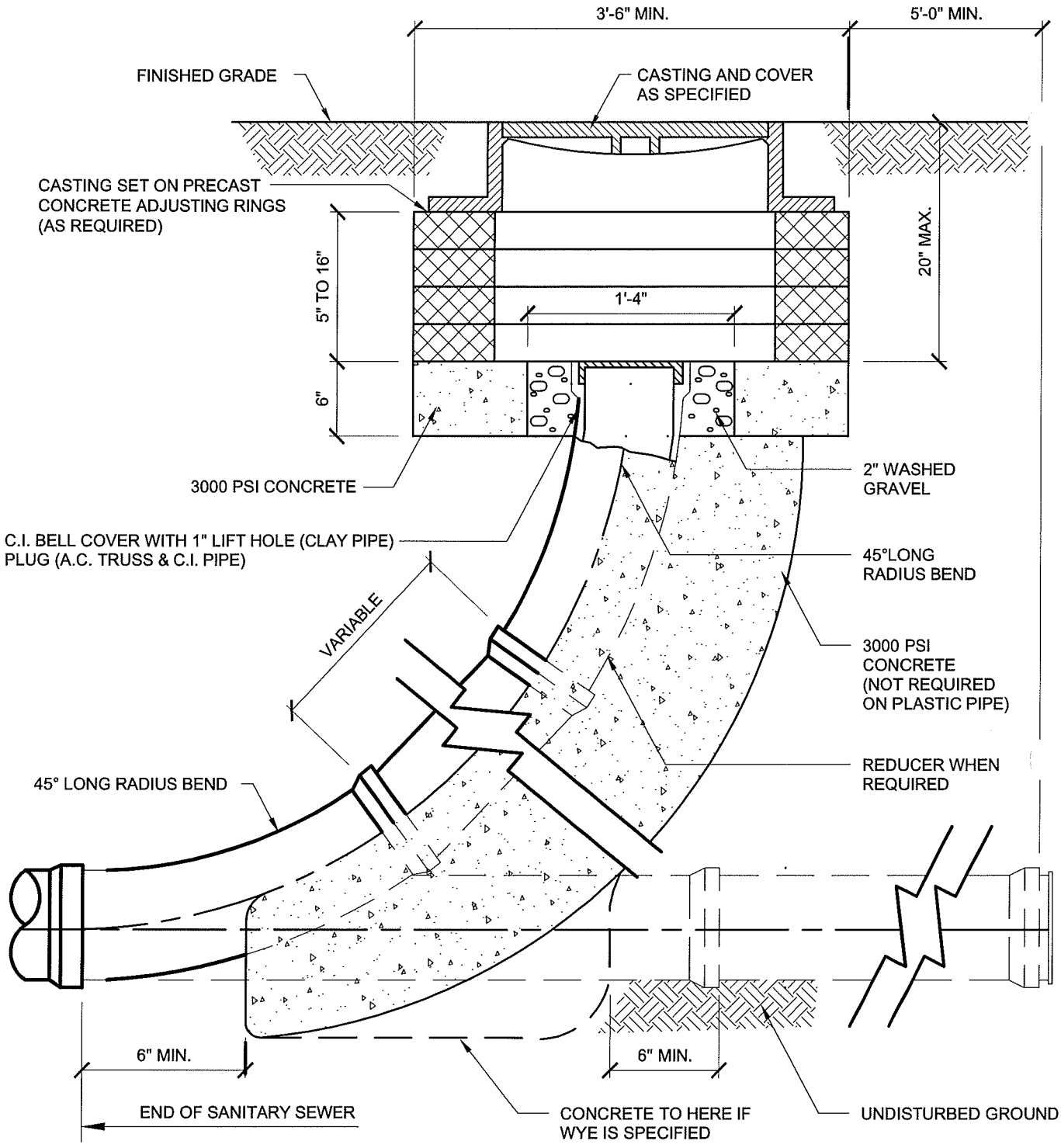
WATER TIGHT MANHOLE COVER



NOTE:

TO BE USED ONLY FOR CONNECTION TO EXISTING MANHOLE WHERE FLEXIBLE RUBBER BOOT CANNOT BE INSTALLED OR AS ALLOWED BY ENGINEER

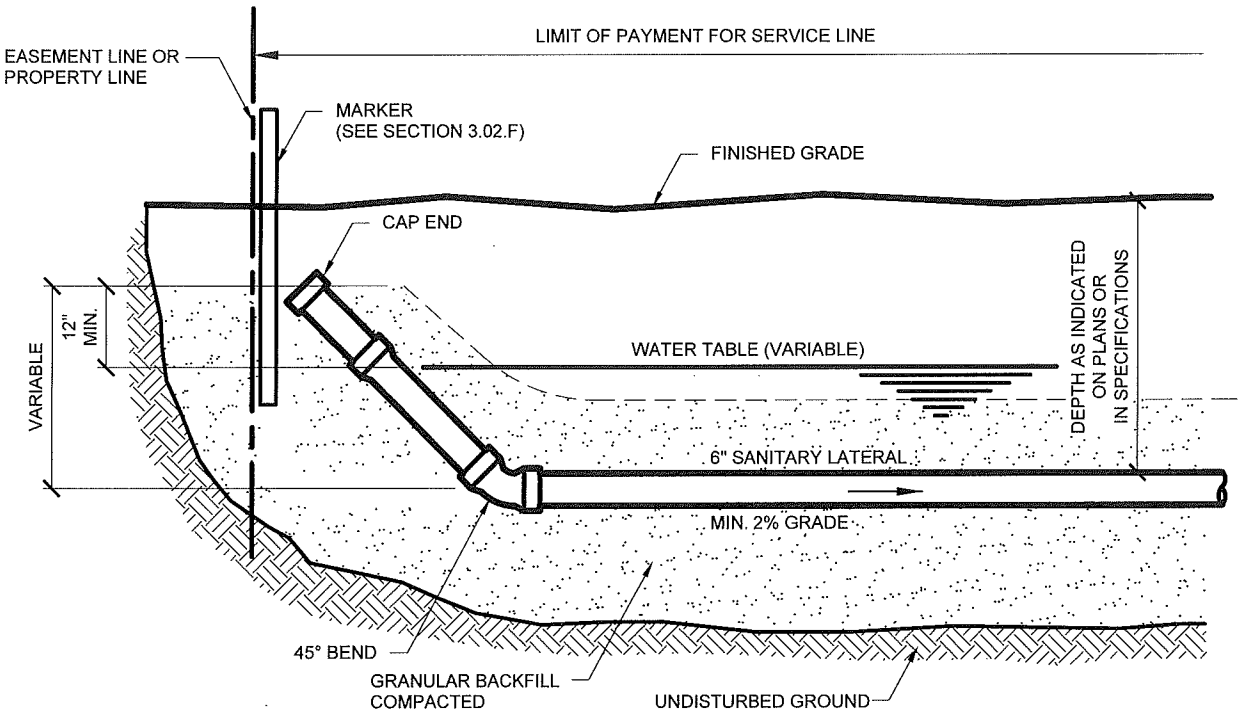
PLASTIC PIPE MANHOLE JUNCTION



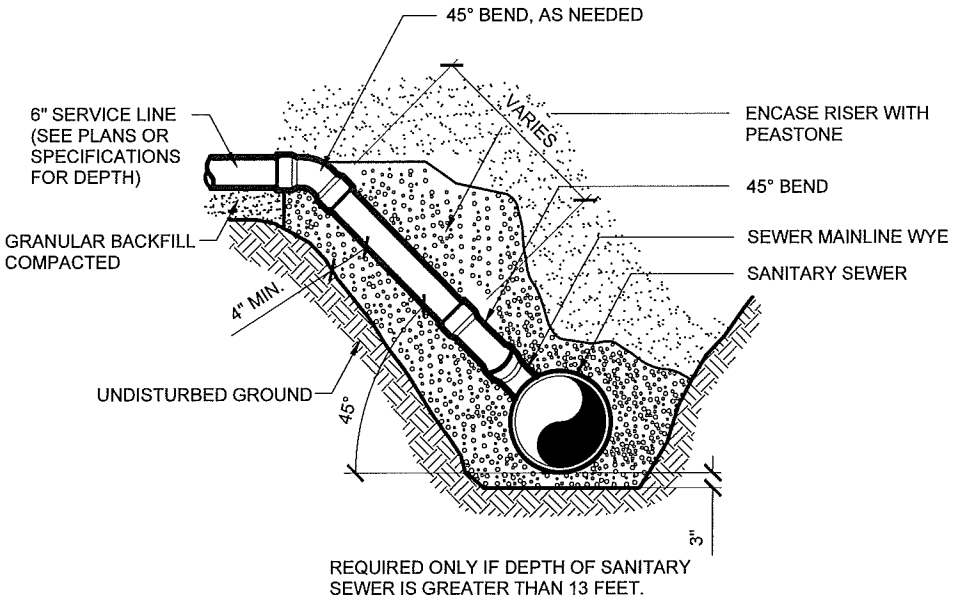
TABLE

MAINLINE	RISER
6"	6"
8"	8"
OVER 8"	8"

SANITARY SEWER CLEANOUT

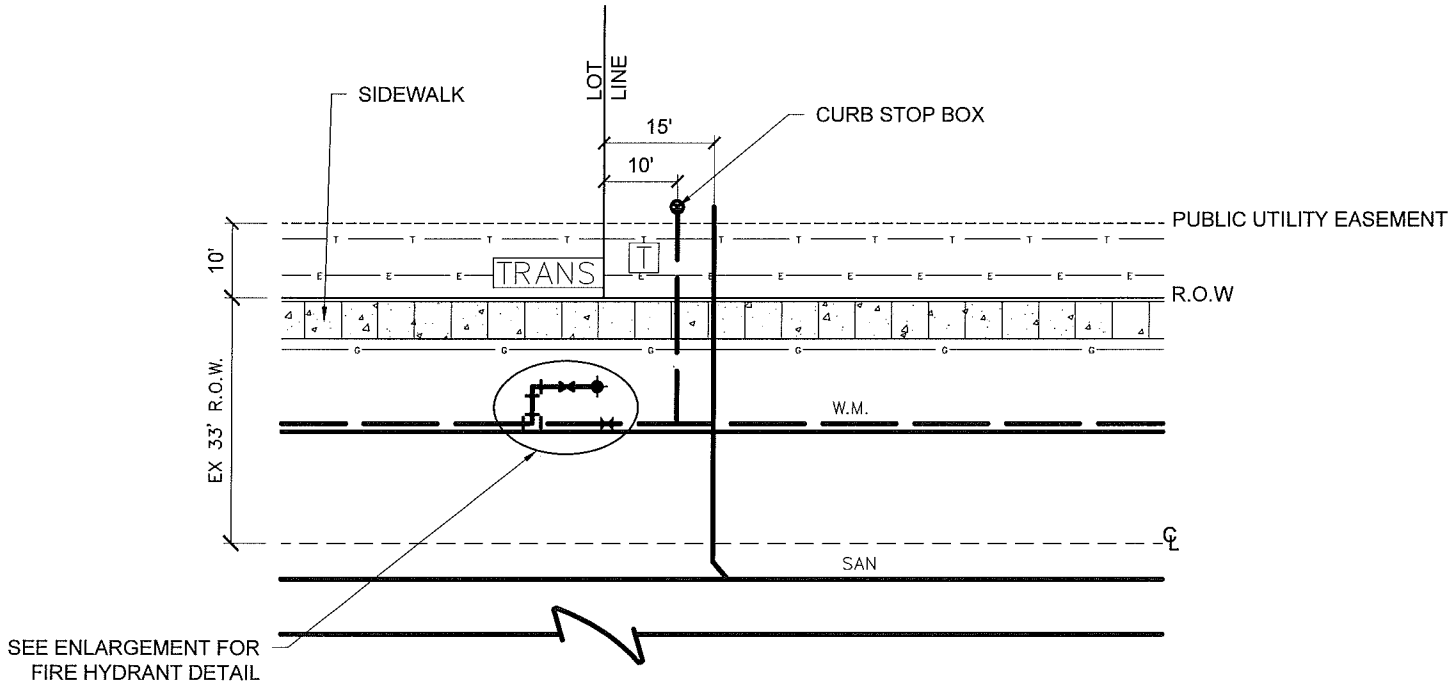


PROPERTY LINE RISER



MAINLINE RISER

STANDARD RISER DETAILS



UNDERGROUND UTILITIES

DRAWING TO SCALE

0 20 40

SCALE IN FEET

LEGEND

- Electrical
- Telephone
- Gas
- Telephone Pedestal
- TRANS Transformer

1071_Underground Utilities

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

MANHOLE FINAL INSPECTION PUNCH LIST

- ☐ Verify specification for correct casting.
- ☐ Record depth of all inverts to top of casting.
- ☐ Verify chimney adjustment rings are completely cemented in place and plaster coated.
- ☐ Verify casting is centered in the opening and completely cemented in place with no voids between casting and top of chimney (check maximum dimensions – see manhole detail).
- ☐ Cement lift holes and all penetrations.
- ☐ Verify pipe penetrations are properly sealed.
- ☐ Flow lines are completed and smooth with no high or low spots.
- ☐ Flow line is poured up to spring line or ½ the diameter of pipe.
- ☐ Benches sloped to flow line at 1" per foot minimum.
- ☐ All voids in walls and bottom are cemented.
- ☐ Manhole steps and bottom are clean of concrete, bituminous, dirt, debris, etc.
- ☐ Verify slope is correct from proposed upstream to down-stream inverts. Must have a minimum of 0.1 feet of elevation drop across inverts.
- ☐ Drainage structure constructed of blocks or bricks plaster coated inside of entire structure.
- ☐ Verify catch basin sumps are clean.
- ☐ Casting has been properly adjusted prior to final top course (check tilt to match pavement cross slope).
- ☐ Final inspection completed before final top course of asphalt is laid.

RECOMMENDED SAFETY CHECK LIST (may not be all-inclusive)

1. Use vehicle to protect yourself from traffic.
2. Use construction cones on street with traffic (4 minimum)
3. Always wear reflectorized safety vest.
4. Follow Confined Space Permitting & Entry Procedures if entering a manhole.